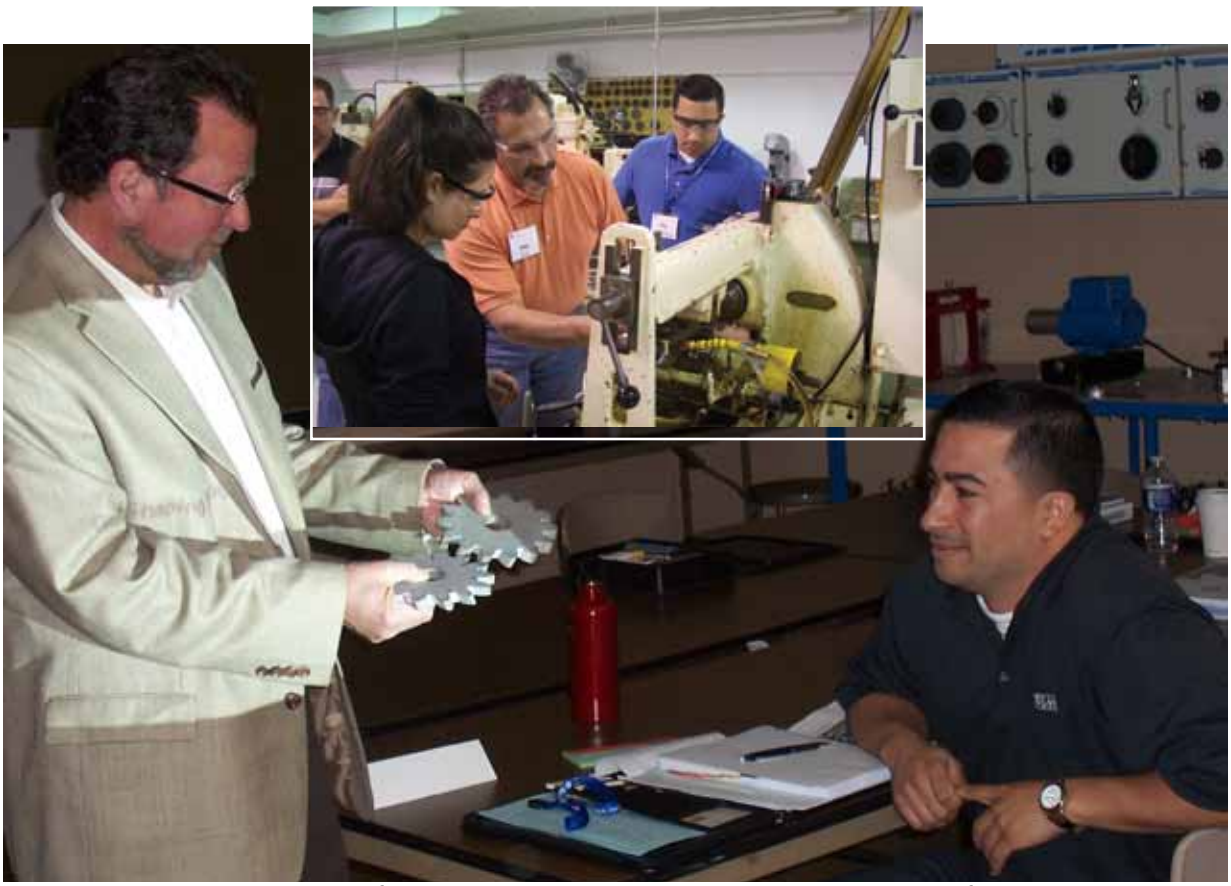
Now, More Than Ever

GEAR EDUCATION AND TRAINING VITAL TO SELLERS, BUYERS AND NATIONAL SECURITY

Jack McGuinn, Senior Editor



When it comes to expert training for an industry as complex as gear design and manufacturing, programs like the AGMA-supported Manufacturing Technology Institute at Chicago's Richard J. Daley Community College are carrying more than their share of the load (courtesy AGMA).

You wouldn't know it from the weekly or monthly unemployment figures, but manufacturing job openings have actually increased in recent years.

That's the good news.

But here's the rub—most of those opportunities exist only for highly skilled, often degreed, workers. Indeed, in the past decade, manufacturers represented a 44 percent increase in workers with an advanced degree.

And that's all well and good for United States competitiveness around the globe. But when looking at the gear industry's workforce needs, that's not the whole story. Certainly, gearmakers seek out and employ well-educated designers and engineers, etc. But there still remains the crying need for skilled people to understand and operate the highly sophisticated machinery and other equipment that is vital to a successful operation. Without that, what remains is a "too many generals and not enough foot soldiers" scenario in which dearly expensive machinery sits on the shop floor without fully realizing its potential capabilities and productivity.

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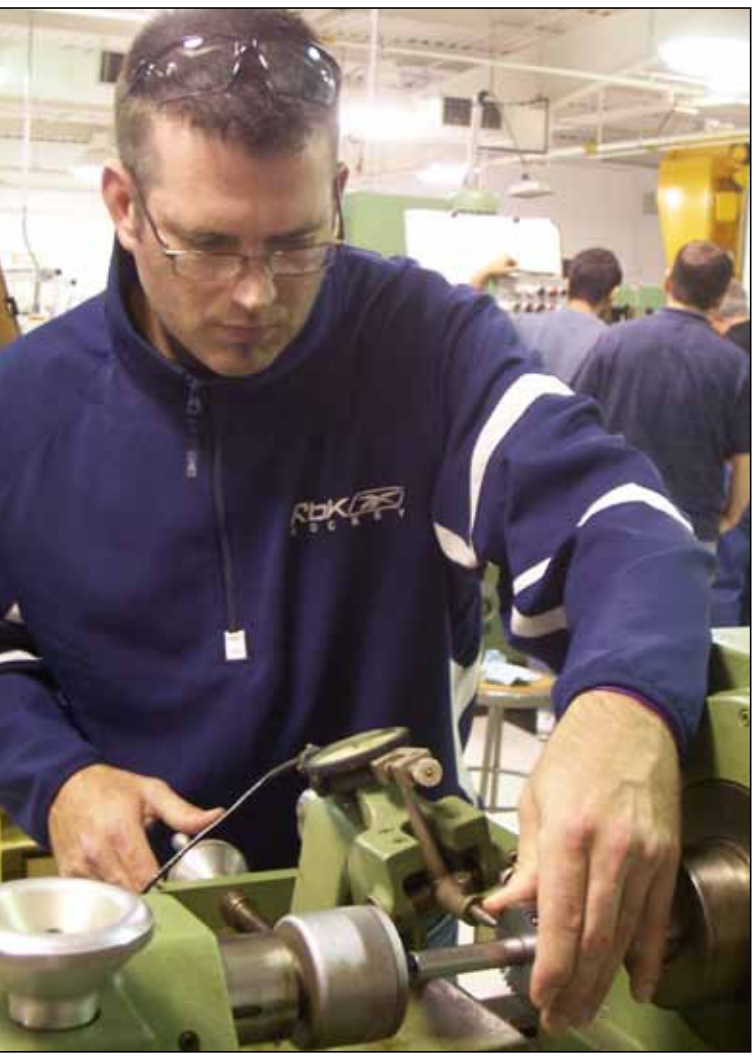
But one thing is certain: the unheralded and—some might say—under-appreciated U.S. gear industry knows how to take care of its own, and has been doing so for many years. As those reading this already know, the vagaries and complexities inherent in making gears go well beyond what might be expected in a typical manufacturing setting; this is not assembly line work.

With that said, it's good to know that gear training and education continue unabated around the country, whether at universities, community colleges, AGMA, or commercial training provided by leading machinery manufacturers and others. What follows is a look at some of those institutions fighting the good fight despite, in most cases, little or no help from government. This is by no means an exhaustive survey of existing gear-learning opportunities. For those we've left out this time around, we'd love to hear from you for future discussion.



The Daley College Manufacturing Technology Institute benefits from the strong support of AGMA and participating gear industry companies, as evidenced by the gear-specific equipment and machinery available to all students (courtesy AGMA).

American Gear Manufacturers Association (AGMA)

AGMA, of course, is the industry's association headmaster, if you will. We talked with AGMA education manager Jan Alfieri to get some background perspective and a glimpse of future plans. Following are her remarks.

"In the mid 1990s, several AGMA members worked together to create our training school for gear manufacturing taught at the Daley College in Chicago. This week-long school includes both a classroom and a factory floor component where students learn the basics of gear manufacturing.

"A bit later we added the option for individual companies to have an instructor come to their plant for two or three days to provide individualized instruction. And, as time went on, our instructors—Geoff Ashcroft and Ron Green from their company, Gear Consulting Group—added courses at regional sites for companies that could not justify a dedicated course but wanted additional training for some employees.

"With funding from the AGMA Foundation, we extended these courses by developing three online modules in a Workforce Training Series. This series includes Fundamentals of Gearing, Parallel Gear Inspection and Hobbing. We have had over two thousand individuals register to use these courses over the last three years. Interestingly, over 40 percent of the registrants have over two years of engineering experience.

"A number of our member companies have established this as a requirement for their employees. Because of the exam, companies are using these courses as an element in their formal training program and to help meet requirements of management systems programs such as ISO 9000.

"To meet the need for advanced engineering programs, AGMA has sought independent consultant members to develop and present courses and continues to seek experienced instructors. Our current instructors include Robert Errichello, who presents Gear Failure Analysis, an extremely popular course that is taught twice a year and sells out each time. In addition, Ray Drago has developed five advanced courses which he and his associates present each year—Detailed Gear Design, Gearbox CSI, Gear Manufacturing & Inspection, Materials & Metallurgy and Gearbox System Design.

Jan Alfieri, AGMA education manager (courtesy AGMA).

"In 2009 the AGMA Foundation granted assistance to AGMA to create an online version of Detailed Gear Design: Beyond Simple Service Factors. The online video course contains 15 one-hour modules and will debut in January.

"Our Technical Division provides other, subject-specific seminars and workshops as needed, and they bring the industry together each fall for the Fall Technical Meeting, a series of 15–20 technical papers and special presentations. The 2010 FTM had exceptional response from industry, with 150 attendees, of which over half were younger engineers and first-time attendees."

(*Alfieri welcomes any suggestions, course proposals and interest in becoming an instructor for AGMA. You can contact her at* alfieri@agma.org *or 703-838-0055. You can also visit the AGMA website for information on all AGMA education opportunities* www.agma.org.)

Geoffrey Ashcroft of Gear Consulting Group.

Gear Consulting Group

Gear Consulting Group (GCG) was formed as a company to service the gear industry in various capacities including, but not limited to, education. Presentation of the educational programs is the main responsibility of Geoffrey Ashcroft, former vice president of American Pfauter and a mechanical and manufacturing engineer with a broad experience of gear manufacturing on three continents over a career spanning 50-plus years. He is currently a director of Overton-Chicago Gear. Following are his remarks.

"For the last ten years GCG has partnered with AGMA to produce and present these programs on a regional basis around the country, and they are open to all comers. Usually these seminars are hosted by an AGMA member company—at their place of operations—allowing for demonstration of the processes. In addition, AGMA offers the same school on an in-plant basis for a single company.

"The theme of the gear schools produced by GCG is that of a logical approach to troubleshooting the manufacturing process and includes a gear technology section that is considered a 'must' for a proper understanding of the process. Included in the usual curriculum are modules on inspection, gear hobbing, shaping and shaving as well as cutting tool materials, tool maintenance and tool failure analysis. Both traditional as well as state-of-the-art methods are covered. Attendees are encouraged to bring examples of their own problems for analysis.

"In addition to the standard curriculum, GCG produces custom programs for training and developing manufacturing personnel based on the type of industry and product of a specific client. A library of some 40 different modules has been produced over the last 10 years.

"The structure of the program is aimed to be of benefit to a variety of people—from operators through manufacturing engineers—and carries certification by AGMA."

In Ashcroft's view, and that of many others, "There is a lack of structured education available to people in the gear industry," and the scant number of formal schools discussed in this article is clear evidence of that. "This," he adds, "coupled with elimination of apprenticeships, leaves a large part of this country's valuable and intelligent workforce without the tools to constantly improve the process and take care of day-to-day problems."

Gear Failure Analysis (GFA) Seminar (Robert Errichello)

As mentioned above, Robert Errichello's twice-yearly Gear Failure Analysis seminar is among the most popular

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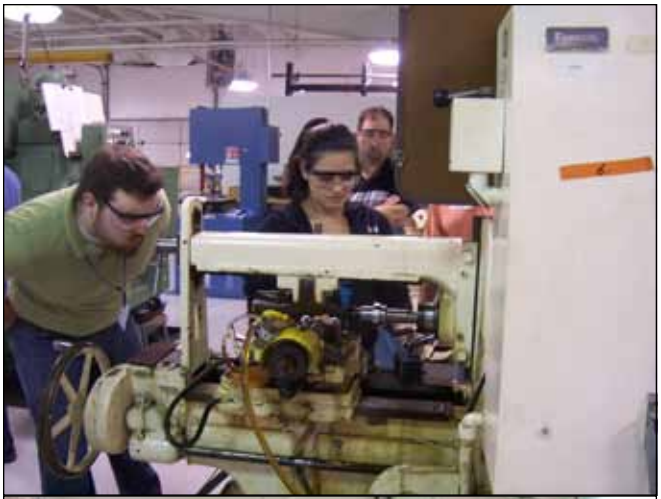
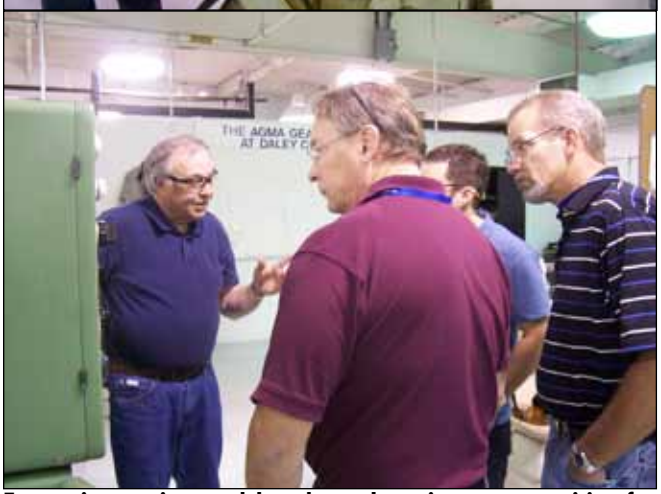
and respected learning opportunities AGMA offers.

Gear Technology (GT): How long have you been presenting this course?

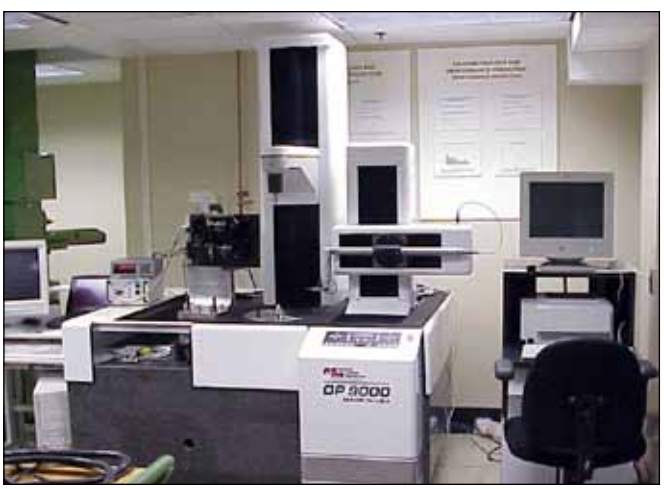
Robert Errichello (RE): We started the GFA Seminar for AGMA in 1992 and have conducted it twice each year since then.

GT: Given your broad range of experience, is there a particular reason for focusing on gear failure as opposed to other topics?





Expert instruction and hands-on learning opportunities for students of all ages—and genders—are available at the Richard J. Daley Community College (DCC)/AGMA-sponsored Manufacturing Technology Institute (courtesy AGMA).



All Gear Research Institute equipment will be made available for Penn State University's first-ever undergraduate gear training program (courtesy Gear Research Institute).

Robert Errichello, GEARTECH president and *Gear Technology* technical editor (courtesy Robert Errichello).

RE: We started with seminars on gear design and gear lubrication and gravitated to GFA because it became a large part of our consulting work and we got many requests from clients and attendees at seminars for GFA. Early in my career as a gear designer I realized that knowledge of how gears failed was necessary to be able to design reliable gears.

GT: Who typically attends your class?

RE: We get a wide range of new and experienced mechanical engineers, failure analysts, metallurgists, lubrication engineers, equipment operators and maintenance technicians from many different industries including the oil and gas, mining, wind turbines, aerospace, automotive, marine and lubricant and additive companies.

GT: Who *should* attend your class?

RE: Anyone interested in how gears work and how they fail. Many students re-take the course to refresh their knowledge and gain updated material.

GT: Are you the sole instructor?

RE: No, Jane Muller handles all logistics and instructs students during the practical workshop.

GT: Is the fee typically paid by attendees' employers or is it on their own dime?

RE: Usually paid by employers, but sometimes consultants pay their own way.

GT: Is there any room for college-level students?

RE: The course is ideal for college-level students. Generally junior- and senior-level engineering students have the necessary background in stress analysis and strength of materials courses.

GT: Can you comment a bit on the course manual? I saw somewhere it alone is worth the cost of the seminar.

RE: The course manual includes copies of all text slides and most photo slides so students can concentrate on the presentation rather than note taking. It includes a textbook for the gear failure analyst that explains how to manage a gear failure analysis and describes gear tooth failure modes, root causes and remedies. Furthermore, there is a wealth of reference information.

GT: Are there any frustrations in teaching the class? Do you find today's attendees as engaged as in previous times?

RE: The only frustration is time. It takes careful management of time to balance scope with attention to detail. Today's attendees are more engaged than ever. Part of the reason for the enhanced interest is the recent interest in wind turbines and the challenging demands that wind turbines require from gearboxes.

GT: How did the class come about? Was it your initiative or AGMA's?

RE: I don't recall who first thought of the class. I've been an AGMA member since the mid 1960s and have been active on many committees, so the GFA seminar was a natu-

ral consequence of my experience.

GT: Considering the other AGMA-sponsored seminars, how would you rate gear failure analysis in terms of complexity?

RE: It's complex because of the scope. However, concepts are easy to understand and we find students that win the prizes are often those with the least formal education. The most challenging part of GFA is correctly identifying the failure mode. Once the failure mode is known, the textbook and other sources of information can be used to understand the mechanisms, root causes and remedies.

GT: To what extent is your proprietary *GEARTECH* software used in the class?

RE: We don't use the software because of time constraints. However, we discuss software capability for predicting failure modes and how one should use calculations to support conclusions regarding root causes. Lastly, an important feature of the class is the informal atmosphere and the personal attention each student receives. Students love the location, which is in scenic Montana and close to Yellowstone Park. The course is intensive but very rewarding (especially for those students who win prizes).

Richard J. Daley Community College (DCC) (Chicago, IL)

In tandem with its strong relationship with AGMA, Daley Community College is doing more than its part in helping to shake off some of the rust in Rust Belt cities like Chicago. Ray Prendergast, the recently appointed director of the school's Manufacturing Technology Institute, provides us with some insights on the school and its role in helping to provide skilled workers for the gear industry.

GT: Does DCC offer credited coursework in gearing/manufacturing?

Ray Prendergast (RP): At the moment Daley is only offering non-credit skills training in gear manufacturing. I would like to develop credit courses in the near future.

Ray Prendergast, director of Richard J. Daley Community College (DCC) Manufacturing Technology Institute (courtesy DCC).

GT: Is the Manufacturing Productivity Program the core offering for gearing, etc?

RP: Our Manufacturing Productivity degree focuses on CNC machining, which of course is an essential part of gear manufacturing. I would like to add manual gear hobbing and gear shaping as an elective credit class for students who work in the field.

The AGMA-Daley Gear School was started around 1993 and Daley College did draft a program for training that included four credit hours, but I think it was never approved. Today gears are produced on CNC machines but the manual training in hobbing, shaping and gear inspection connects the computerized machine tool operator, the manufacturing engineer, the

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sales reps, etc., to the gear manufacturing processes in a way that can't be done through push buttons and G-code.

GT: Is there a higher level of instruction beyond that?

RP: Currently not at Daley College.

GT: What is the background of the instructors?

RP: They all have extensive experience in gear manufacturing. In addition to set-up and operation of production equipment, they also have experience in sales and service of gear cutting machinery and quality assurance.

GT: How does the Certificate Program in manufacturing differ from the Manufacturing Productivity courses?

RP: The certificate program is shorter, only about half of the AAS (Associate's) degree program. Ideally, the certificate is a milepost on the way to the AAS degree. Of course, for working adults even a 'two-year' AAS degree can take four years or longer. Work and family life come first, so students may complete the program in straight-line fashion. This is why most of our classes are in the evenings and on Saturdays. Soon the college will be offering Sunday classes as well. We are dedicated to serving working adults, especially in manufacturing where the majority of our AAS degree students are already in the industry.

GT: Does the gear manufacturing program receive any funding from industry?

RP: We receive considerable support from industry. For example, Northstar Aerospace Chicago is donating gear measuring equipment. Employees of several gear manufacturers serve on our advisory board and hire our graduates. I have not solicited monetary donations from the industry yet, but I feel that we have a lot of support already.

GT: Is the bulk of funding from Chicago and/or Illinois taxpayers?

RP: The Daley-AGMA gear school is funded by fees. Companies and individuals pay the tuition. There is no government funding for it.

GT: Any help from Washington?

RP: Not specifically for gear training, but there is funding through WIA (Workforce Investment Act) and TAA (Trade Act Program), and financial aid through Pell grants.

GT: Is there by any chance a "study abroad" –e.g., Germany—program available for manufacturing students?

RP: No—interesting idea though!

GT: Is there an outreach program in place for attracting young people—not just the disadvantaged—to a career in gear technology/manufacturing?

RP: Yes. I'm on the advisory board of Austin Polytechincal Academy (in Chicago) and I was on the design team for this manufacturing-themed high school. I am marketing machining careers to students there and so are other advisory council members including Arrow Gear, Brad Foote Gear and Bison Gear. I also work with Chicago-area Curie and Gage Park High Schools and Prosser Career Academy, and we will be reaching out to Simeon Career Academy as well. These are all schools with manufacturing career programs.

GT: What would you like to see done on a national level to attract young people to manufacturing?

RP: We have to convince people, especially parents, that

there are great careers in manufacturing. It is remarkable that even with the high unemployment rate of today there are still many job openings, particularly in manufacturing. In fact, there was a remarkable two-week period at the end of October/beginning of November when a large number of job postings ran across my desk, including:

Company A is planning to hire 10 to 15 maintenance mechanics, along with a large number of semi-skilled machine operators.

Company B opened up their Maintenance Technician Apprenticeships. They have tested applicants and will create a long-term list for hiring.

Gear Manufacturer C has several openings for CNC machinist trainees, starting at $14.73/hr.

Gear Manufacturer D is getting ready to hire about eight CNC machinists.

Company E has several openings for CNC machinists.

Company F and Headhunter G need automation technicians.

All of these jobs are good-paying 'middle skills' jobs, and remarkably, this is what entry-level employment looks like in today's manufacturing! There are jobs, but you can't get them without skills.

GT: What percentage of students completes the gearing/manufacturing program?

RP: Almost 100 percent complete the gear school, which is a one-week program. For our CNC machininst training I don't have the numbers yet.

GT: Should graduates expect to be fully qualified for at least an 'entry level' job in gearing?

RP: Students that complete our AAS degree in Manufacturing Productivity are qualified in CNC mills and lathes, but not in hobbing or shaping. The gear school students are already in the field.

GT: Are scholarships available?

RP: Yes for the AAS degree program.

GT: Is gear design and software taught?

RP: Not at this time. But that is something I would like to add.

Beyond the industry-specific education outlets described above, there do exist four-year colleges and universities in the country offering highly relevant core programs and graduate studies in mechanical engineering, if not hands-on, gearing-specific studies. Two such schools are Ohio State University and Penn State University, both of which are very well-known for their post-graduate Gear Lab and Gear Research Institute (GRI), respectively. We talked to important players from each—Dr. Ahmet Kahraman (OSU/Gear Lab) and Suren Rao (Penn State/GRI).

In an exciting development announced at the AGMA Fall Technical Meeting, it was learned that Penn State will in 2011 offer an upper-class (Junior/Senior) undergraduate program under the auspices of the university. Although the initial effort is small in scale, one can only hope that other learning institutions will soon step up and follow suit.

Penn State University/GRI

GT: What circumstances came together to compel a

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decision to begin an undergraduate program for gear training?

Suren Rao (SR): A number of gear-related companies indicated that a significant portion of their expert workforce would be retiring in the next 5–10 years. Also, some of their recent technical hires had been laid off in the 2008 downturn and had since left the business. These organizations indicated that they needed assistance to recruit and maintain their technical human resources.

Suren Rao, Gear Research Institute managing director (courtesy GRI).

GT: Will the program/curriculum be administered by GRI or the university?

SR: All aspects of this program will be administered by the University. Students selected will be already enrolled in Penn State with junior/senior standing and will work at GRI's laboratories at ARL/Penn State for wages and/or independent study credits, if appropriate.

GT: How many students will be accepted?

SR: Our current sponsored efforts can absorb about five students. More can be trained if additional sponsored projects happen.

GT: Are you hiring additional instructors for the program?

SR: No, they will work with existing faculty and staff.

GT: Any thoughts on why more U.S. schools aren't doing this?

SR: There are very few schools in the country with a dedicated gear research program.

GT: Are you receiving any support (not necessarily financial) from NASA or the aerospace industry?

SR: Not specifically for this effort, but selected students can work on projects sponsored by the aerospace industry.

GT: To what extent—if any—will GRI receive financial assistance from either industry or state/federal government for the school?

SR: GRI is currently seeking industry funds to pay the wages for students in this program while they are at Penn State.

GT: Are there recruitment/outreach programs in place or contemplated to help boost enrollment?

SR: We are just getting the word out through AGMA and now through *Gear Technology* magazine.

GT: What will be the enrollment requirements (grades)?

SR: We will focus on junior/senior ME (mechanical engineering), ESM (engineering, science and mathematics, and Materials Science students who would be eligible to go on to a graduate degree.

GT: Are scholarships in place at this time?

SR: The GRI has been utilizing its discretionary funds, supplemented by corporate membership fees, to sponsor one undergraduate for the last 3–4 years. No other scholarships are in place at this time.

GT: Please describe the intern program for onsite experience.

SR: Students will participate in ongoing sponsored projects. This will include setting up test machines, inspecting test specimens including test gears, preparing metallurgical samples and conducting metallurgical evaluations of microstructure, hardness, residual stresses and retained austenite. Students can also be involved in the design of special test fixtures and test specimens and minor machining and fabrication to complete and experimental set-up. The student will be expected to work for the sponsor as a summer job at the sponsor's facility and as required by the sponsor.

GT: Please describe how the "sponsor" process works. Why is that necessary?

SR: A commitment to support the student during the academic semester at Penn State is all that is needed. We estimate that to be about $4,000 per semester (about 10–15 hrs/week for 16 weeks), as a grant to GRI.

GT: Please explain how sponsors can recruit a graduate for employment.

SR: The student commits to spending the summer at the sponsor's facility. This is an opportunity for the company to get to know the individual and for the individual to get to know the company. If a mutual relationship develops we anticipate this will lead to recruitment.

GT: Will the undergrads have full access to GRI equipment, etc.?

SR: Yes, they will be trained by the existing faculty, staff and engineering technicians and provided full access as they demonstrate competence. We, the Board of Trustees of the Gear Research Institute, believe this is a mutually beneficial golden opportunity. The GRI fulfills its mission while the gear industry finds its future employees.

Ohio State University/Gear Lab

It's almost pointless to talk about OSU's undergraduate mechanical and aerospace engineering program without acknowledging its industry-vital Gear Lab, so we've done both. Following are remarks from Gear Lab director Dr. Ahmet Kahraman.

GT: After some 30 years, what's new at the Gear Lab?

Dr. Ahmet Kahraman, director of Ohio State University's Gear Lab (courtesy Gear Lab).

Ahmet Kahraman (AK): Gear Lab was established 30 years ago by Professor Donald Houser as a consortium of a few companies. Over the years it grew exponentially, reaching the current membership of nearly 60 companies from automotive, aerospace, off-highway vehicle and industrial gearbox sectors. The original focus of Gear Lab under the name of Gear Dynamics and Gear Noise Research Laboratory was on gear design, dynamics and noise. With the expanding membership, other areas of gearing such as fatigue, lubrication, efficiency became to form a substantial portion of the Lab's portfolio. In order to reflect this better, name of the lab was changed in 2006 to Gear and

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Power Transmission Research Laboratory. At the same time, the University received a generous gift from the Gleason Family Foundation, in return naming the facilities of Gear Lab as 'Gleason Gear and Power Transmission Research Laboratories.' Most recently, Pratt & Whitney initiated an extensive collaboration with Gear Lab to form The Center of Excellence in Gearbox Technology at Ohio State.

GT: Are Gear Lab participants primarily OSU grads?

AK: The researchers in Gear Lab consist of full-time research engineers, graduate research associates (Ph.D. and M.S. students) and undergraduate research assistants. Our graduate research associates come from Ohio State as well as other prominent U.S. and foreign universities.

GT: What funding—if any—do you receive from gear-related industries?

AK: Gear Lab uses two funding mechanisms. One mechanism consists of Gear Research Consortium fund where each member company pays a certain yearly membership fee. With this, member companies gain access to Gear Lab research supported by the Consortium as well as Gear Lab gear design and analysis software. The second mechanism is through individual grants from companies and government agencies. The findings from these research projects are shared only with the sponsor. In addition, Pratt & Whitney Center of Excellence in Gearbox Technology is funded by a block grant by Pratt & Whitney. These various forms of fund support about 20 graduate researchers, 10 undergraduate researchers, five full-time research staff members as well as experimental activities of Gear Lab.

GT: What are the enrollment requirements for the Gear Lab? Are there scholarships/grants and if so who funds them?

AK: The graduate research assistants must meet the requirements of the Graduate School of the Ohio State University.

GT: Has OSU ever considered beginning an undergraduate program in gear training? What would be the challenge in doing so?

AK: Undergraduate curriculum in the Department of the Mechanical and Aerospace Engineering is set up in such a way that such an undergrad specialization on gears is not possible. Students learn about the basics of gear design and geometry in the machine elements courses and specialize further in certain areas of gearing during their graduate studies if they choose to work at Gear Lab.

GT: To what extent are undergrads involved in the Gear Lab? What sort of course work credit do they receive?

AK: Gear Lab supports a number of undergraduate research assistants with the intent to expose them to gear research early in their education. Many of these undergraduate assistants are later recruited to become graduate researchers in the Lab. Students do not receive course credit for their work at Gear Lab.

GT: Regarding the extremely popular and necessary Gear Dynamics/Gear Noise course, who typically attends? Is there sponsorship involved from businesses?

AK: Attendees form by a wide spectrum that includes drivetrain/powertrain engineers to gear designers to NVH specialists and supervisors. Since the conception of the basic course in 1978, more than 1,650 engineers attended these courses globally. Each attendee pays a registration fee. The Gear Research Consortium members receive discounts.

GT: What kind of internships exists through Gear Lab?

AK: There are two types. Many Gear Lab undergraduate or graduate research assistants take on summer internships at various gear and powertrain companies. Gear Lab not only encourages such internships but helps students to find such opportunities for them to gain real-life gearing experience. The other type is when students or scholars from other institutions or countries come to work with us. At any given time, we might host up to five such visiting scholars.

GT: Are Gear Lab instructors fulltime staff? Are there "guest" instructors from related industries?

AK: The research of Gear Lab is supervised by full time faculty members. Time to time, Gear Lab sponsors seminars by experts from the industry.

GT: Not to be flip, but why is a course on gear dynamics/noise needed? What challenges are still present after 30 years of teaching the course?

AK: Gear dynamics and gear noise remains to be a critical issue in gearbox and powertrain applications. Even though significant gains have been accomplished over the years through modeling tools and experimental studies, the requirements have also become more stringent. In other words, we have a moving target. In addition, efforts to optimize gears for other functional attributes, say efficiency, often result in increased noise. Therefore, design solutions that balance the durability, efficiency and noise aspect of the gear performance are becoming a must.

GT: What is the enrollment cost for the Gear Lab?

AK: Gear Lab is not a gear school. It is a research group dedicated to gear and power transmission applications. Assuming that the graduate researchers are meant by "enrollment" they are supported through a stipend and tuition waiver through the Gear Lab funds.

GT: Is there a time-definite duration—i.e., a determined curriculum for instruction? Or do enrollees "cherry pick" courses of greatest interest to them?

AK: The Gear Lab researchers choose courses based on their specialization and research interest including math and statistics courses.

GT: Where do successful Gear Lab graduates typically go from there? How many would you say go into teaching?

AK: A great majority of our graduates are hired by companies to work on gear and transmission- related assignments. Over the years, more than 150 alumni of Gear Lab with M.S. or Ph.D. degrees went on to work for the gear industry.

GT: Do you have any particular outreach or recruitment programs in place for the Gear Lab?

AK: Gear Lab continuously recruits researchers from U.S. universities as well as prominent schools from the Far East, India and Middle East.

GT: How do you think attracting young people to the gear industry can best be done?

AK: Best way is to provide them with interesting and challenging gear problems to show them (i) gears are indeed highly engineered, precision components, (ii) they are criti-

cal to almost every sector, and (iii) a specialization in gears is a smart thing to do.

Brigham Young University (BYU)

While BYU does not offer core programs in gear instruction, it boasts a history of machine design, manufacturing technology and research. It has established itself particularly in student-led automotive-related competitions around the world addressing heat treating, metallurgy, NC machining, assembly tolerances, etc. Professor and AGMA member Kenneth Chase—and a presenter at last year's FTM—provided the following information on what his school and department are doing to advance drivetrain and other gear-related areas of learning.

Undergraduate/Gear-Related Topics

Machine Design—"General machine design, which includes the analysis and design of gears, shafts and bearings, subjected to static, dynamic and fatigue loading, and sized, based on the AGMA standards. Gearboxes and transmissions, both manual and automatic, are also treated.

"The school also houses an extensive collection of failure specimens, including gears, bearings, shafts, etc. Included, is the J. O. Almen Collection, which is the lifetime collection of the vice president of engineering at General Motors. It includes documentation and photos, plus copies of his many publications."

Design Competitions

"BYU also has several ongoing design competitions each year, in which teams of students, from more than one department, participate in major design projects involving gear and transmission design. They not only design, but also build and assemble the components, gaining experience with heat treating, metallurgy, NC (numerical control) machining, assembly tolerances, etc. Then, they compete with their vehicle at a national or international event. BYU has a long track record (pardon the pun) of successes in these competitions."

Mini-Baja off-road vehicle. (eight years)—More first-through-fifth-place awards than any other university during the eight years of participation.

Formula SAE race car. (three years)

Formula Hybrid race car. (three years)–Innovation award (2008); 4th place overall (2009)

PACE Collaborative Design (4 years)–Automotive design project.

Two electric passenger vehicles. One project, an automobile donated by Ford, converted to all electric, and driven for three years as a commuter car. Another similar project as well.

Manufacturing Technology Competitions

Electric streamliner (six years)–going for the world record for its class on the Utah Salt Flats.

Research

"The College of Engineering & Technology has pursued several research projects involving gearing and other automotive applications. A current ongoing effort involves the development of Positively Engaged Infinitely Variable (PEIVT) and Continuously Variable Transmissions (CVT)."

Commercial Training

And last, but in no way least, we talked to two leading U.S. and international manufacturers of gear machinery—Gleason Corporation and Koepfer America LLC. While they don't confer degrees, they definitely do their part in straightening out the learning curve when it comes to operating the highly sophisticated machinery they build and sell. Sure, it's in their own best interests, but the fact remains that such teaching/learning modules are extremely important to the gear industry workforce and the customers that buy those machines. We talked with Gleason director of marketing Al Finegan and Koepfer America president Dennis Gimpert.

Gleason

GT: Can you tell me when Gleason began offering gear training?

Al Finegan, Gleason Corp. director of marketing.

Al Finegan (AF): Gleason has always viewed training as an integral part of our (total) solutions.We view training as more than just gear theory and calculations, but also training in machine set-up, operation and maintenance, as well as in the use of cutting tools, workholding and other products. I do not know when Gleason started offering training courses to customers, but it was deeply entrenched in the company when I started my career some 40 years ago, and I suspect it has been an integral part of the business at some level since the beginning of the company. When we made acquisitions in the 1995–2005 period, those companies also had well-established customer training programs.

GT: Would you say it was customer-driven or sales/marketing-driven? Or perhaps both?

AF: Gear manufacturing is a special form of metalworking technology and one that requires special knowledge and skills. Our offerings are not complete without the training to make our customers successful.

GT: Can you guestimate the cost to Gleason for providing this training?

AF: Since training is part of our total solution, I would not venture any kind of estimate of its cost. Similarly, I would not estimate its benefit to the market and to Gleason's business, but we know it is significant.

GT: Would you consider it as just another "cost of doing business"?

AF: As a total gear solutions provider, we take a different view. Training is not a cost of doing business but an investment in our customers; the more they know, the more successful they will be and the better for equipment suppliers like Gleason.

GT: Which area/areas of the training you provide would you say is most requested?

AF: Gear basics, gear theory and operator training are most popular. We offer training through webinars, publications and as direct training at our facilities or our customers' facilities.

GT: Are there any particular differences/challenges in providing training for your foreign customers, like in India

continued

and China?

AF: Gleason offers training in all regions of the world. Location itself is not a factor, but there are language, cultural and other issues that must be considered. Since Gleason has a presence in more than 30 countries around the world, we have the ability to address those issues and provide effective training.

GT: How does the training program respond in adapting new technologies?

AF: While the fundamentals of design and manufacture of gears remain pretty much the same, the software and the hardware evolve at an ever-accelerating rate. Course content must change continuously to keep pace with technological change and with changes in market demographics. Some customers have experienced declines in their overall gear knowledge.

GT: Are there any impending/future changes in store for the training program that you can share at this time?

AF: Nothing specific except again to continue to respond to changes in technology and in the market. For example, we anticipate continued growth in internet-based training.

(I might add) that many of the prior questions seemed to imply that training is something we can choose to offer or not. Again, Gleason believes that training is an integral component of our role as a "full service" gear solutions provider, and not offering training is not a consideration.

GT: Finally, and admittedly a bit off-topic, how does a major player like Gleason strike that delicate balance in providing gear and machinery training in countries like China—especially China—in that the training (and technology) provided affords Chinese companies the eventual wherewithal to begin gobbling up market share there at a company like Gleason's expense?

AF: Interesting question. The alternative is to offer an incomplete solution that guarantees our customers' failure as a gear producer and eventually our own as a supplier. We believe that countries like China and others will naturally evolve to a level of manufacturing capability and technology, with or without Gleason. Our mission is to stay a level ahead of competition, regardless of it source.

Koepfer America LLC

GT: Can you tell me when Koepfer began offering gear training?

Dennis Gimpert (DG): Koepfer America, LLC offered our first formal gear school in 1990, 'Fundamentals of Parallel Axis Gear Manufacturing'. This class has been offered annually with nearly 1,000 students having attended. We also offer regional training as focused events on specific current topics or needs.

Koepfer America LLC president Dennis Gimpert (courtesy Koepfer America).

GT: Would you say it was customer-driven or sales/marketing driven? Or both?

DG: Our training is clearly both customer and sales driven. Training is offered to fulfill part of our mission statement. 'Koepfer America provides industry-leading service and support in an expedient, ethical manner. Our goal is to provide the customer with the ultimate value.

GT: Can you guestimate the cost to Koepfer for providing this training?

DG: Priceless (small joke).

GT: Would you consider it as just another "cost" of doing business?

DG: Today we do not look at our training as a 'cost' but also as an opportunity.

GT: Which area/areas of training you provide would you say is most requested?

DG: Four areas are in demand. First, the fundamentals for new manufacturing engineers and other personnel that are entering the industry. Second, information regarding current technology and gear processing techniques. Third, operational training on machine setup and operation, fixtures, gear blanks, inspection, etc. to maximize the efficiency of the gear manufacturing systems. Fourth, troubleshooting of gear manufacturing problems.

GT: Are there any particular differences/challenges in providing training for your foreign customers in India and China?

AF: This question does not apply to Koepfer America, LLC as we are responsible for only North American operations. It is a question for our parent company, Koepfer, Germany that uses their EMAG group to provide local customer training and support. As our gear industry has become more global a more important role has been taken by the AGMA. I was personally involved with the original formation of the Education Council of the AGMA and helped promote the concepts of web-based training to provide education opportunities globally.

GT: How does the training program respond in adapting new technologies?

DG: Each year we formally review our training program. We utilize feedback from the program attendees as part of this review. We also review current machines, tools and processes and modify our program based upon these trends.

GT: How would you assess or quantify the importance of the value-added component the training provides to the bottom line?

DG: It is difficult to quantify the total value of training as there are many benefits. It can provide basic necessary knowledge for the employee to do his job. It may be a requirement of an ISO-based organization to provide annual training to each employee. It is a big motivational factor that the company is willing to invest in the person. What is the value of 'one' good idea in a company?

Ed.'s Note: *Looking for specifics on the programs and learning opportunities discussed here? Go to the Jan/Feb online issue of* Gear Technology *(*www. geartechnology. com/issues/0111*/) where you'll find comprehensive contact information regarding degree programs, associate degrees, schedules, tuition and fees (where applicable) and locations.*