The National Center for Manufacturing Sciences Cross-Sector Leveraging for Maximum Technology Output

By James H. Lindsay, Technical Editor, *Plating & Surface Finishing*

Synergy—the working together of two or more things, people or organizations, especially when the result is greater than the sum of their individual effects or capabilities. This is the core capability of the National Center for Manufacturing Sciences (NCMS) in Ann Arbor, Michigan. Beyond that, NCMS has the knowledge and capability to put the most appropriate combination of things, people and organizations together to produce the maximum outcome.

According to the NCIS mission statement, "The NCMS mission is to lead the rapid development of cross-industry R&D programs to build the global competitiveness of its manufacturing industry partners." Their stated goal is "leveraging excellence."

NCMS is basically a research consortium. Its members (currently 155 and growing) are manufacturers, universities, trade organizations and professional societies. Both governmental and commercial sectors are participants. NCMS is the agent for putting collaborations together. Their knowledge base and experience allows them to select participants that possess the ingredients for the most effective results. They have the ability to bring together rather diverse entities that at first might not be obvious to the participants themselves. This cross-sector capability is NCMS's niche.

It all began in 1986, following implementation of the National Cooperative Research Act of 1984 which allowed company collaborations to be legal. This act, later amended and renamed the National Cooperative Research and Production Act of 1993 (NCRPA), clarified how antitrust laws applied to joint ventures, such as consortia, and encouraged joint research and development by providing some protection to participants in such activities. Formerly, General Motors, Ford and Daimler-Chrysler could not collaborate on mutually beneficial research that would eliminate obvious triplication of effort. With this legislation, efforts such as those of the United States Council for Automotive Research (USCAR) and the Semiconductor Manufacturing Technology Consortium (SEMATECH) quickly got underway. Participants are able to do collaborative R&D without violating antitrust or jeopardizing intellectual property.

National Center for Manufacturing Sciences, Ann Arbor, MI.

Commercial Technologies for Maintenance Activities

The largest consortium organized by NCMS is the Commercial Technologies for Maintenance Activities (CTMA). Formed in 1998, it is a collaboration between NCMS, the U.S. Department of Defense (DoD) and NCMS member companies. This entity undertakes a multitude of projects in technological R&D and application to DoD maintenance activities. The focus of CTMA is to use manufacturing technology to reduce maintenance costs. Through forums, group meetings, workshops and private meetings, industry members and DoD maintenance people identify the major problems with solutions that can be mutually beneficial. Then a project is conceived and the wheels start rolling. The DoD benefits from reduced costs, while the industrial partners benefit from a real world assessment of their technologies. Under the CTMA program, NCMS has managed nearly 46 projects totaling almost $87 million.

Where does this fit into the surface finishing arena? There have been numerous projects coming out of CMTA directly benefiting our industry. Among them are:

Chromium Mist Reduction Device To Meet New Employee Exposure Limits (Proposed)

This work, at the proposal stage, deals with the evaluation of an inexpensive capture device to meet the new chromium PEL limits. The device is said to capture the mist generated by the bubble stream from the process and divert it to the existing ventilation system.

Replacement for Hexavalent Chromium in Surface Finishing Processes

Substitutes for toxic hexavalent chromium chemistries have been a critical technological goal for our industry. One of the more difficult needs is a viable substitute for hard chromium. In some applications, existing alternatives still fall short when

compared to conventional Cr(VI)-based deposits. In those areas, the consensus has been that Cr(VI)-based deposits will have to remain, and with high-level, engineering control systems the environmental and health issues can be addressed. Still, these efforts fall short. Help seems to be on the way in the form of a new trivalent chromium process that can provide hard functional coatings. The intent of this work is to optimize the new process to meet military and industrial specifications and evaluate its performance.

Recent Alternatives to Chromate Conversion Coatings

This project will provide a comparison of recent developments in alternative chromate-free coatings as replacements for existing chromate conversion coatings that are based on hexavalent chromium chemistries. Information will result in realistic appraisals for particular applications.

Biological Air Pollution Controls

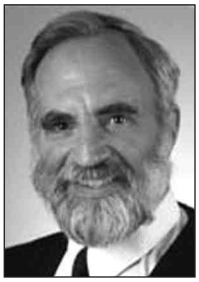
There are a number of projects ongoing on air pollution control. In paint lines, the standard method is thermal oxidation, that is, literally burning away volatile organic compounds to yield carbon dioxide and water. It is energy intensive and is a contributor of carbon dioxide to the atmosphere. Project is ongoing at a military maintenance facility to evaluate a means of biological control of the paint fumes on a pilot scale. The process literally creates a "bug haven" to destroy the pollutants and "digest" the organic solvent fumes.

Other NCMS projects, both part of and separate from the CTMA programs that have been undertaken in the last several years, include:

- Assessment of the electrochemical machining process
- Pulse electrochemical machining
- Spray coating process technologies: state-of-the-art assessment
- Dimensionally-stable, thin film PWB materials
- Lead-free high-temperature fatigue-resistant solder
- Printed wiring board surface finishes

AESF Collaborations

For the surface finishing community, perhaps the most familiar face in the pantheon of NCMS people is that of Dr. Paul Chalmer. As Program Manager, Dr. Chalmer deals with environmental projects in manufacturing, including alternatives to hexavalent chromium and air pollution control technology. In addition, he



Paul Chalmer

George Cushnie

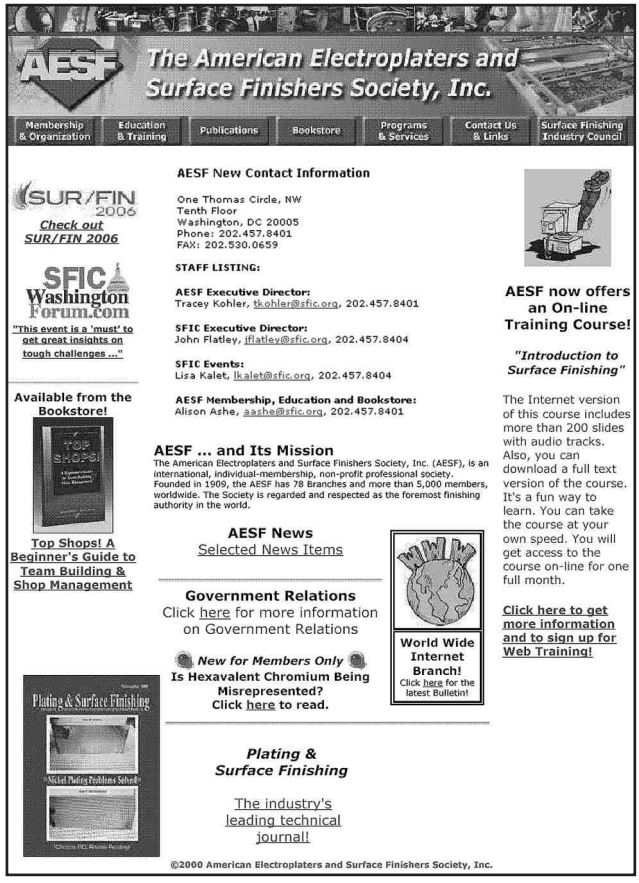
directs seven Internet-based EPA-sponsored Compliance Assistance Centers in areas including metal finishing, paints and coatings, healthcare, construction, printed wiring boards, automotive recycling and transborder waste shipment issues.

Early on, the AESF had an interest in working with NCMS. Dr. Chalmer helped to bring AESF to the table. The priority issues in plating operations in the early 1990s were concerned with emissions. A consortium, consisting of the AESF, along with the NAMF, Marsh Plating, Scientific Control Laboratories, United Technologies, General Motors (GM R&D Center and the former Allison Gas Turbine Division) and Texas Instruments was formed to develop a database of then-current practices. Another person familiar to AESF circles was George Cushnie, who owns and operates CAI Resources, Inc., in Vienna, VA, which specializes in engineering services for the metal finishing industry. He was the contractor on this project. The result was a book, entitled *Pollution Prevention and Control Technology from Plating Operations*, informally dubbed the "Blue Book," because of its significance to the industry. This result is illustrative of the sort of results achievable by the resource base that can be drawn from, with the assistance of NCMS.

The Blue Book consists of an extensive survey of the plating industry and the technologies available as well as a survey of existing literature. As noted in the project overview, the results show "which treatment, recovery and bath maintenance technologies have been most successful for different plating processes and the costs for purchasing and operating these technologies. The project results also cover trends in chemical substitution, the identification of compliance-problem pollutants, sludge generation rates, off-site sludge recovery and disposal options, and many other pertinent topics."

AESF Web site

One of the most visible NCMS collaborations linked Cushnie's CAI Resources, Inc. with the AESF once again. This work led to the creation of the AESF Web site (www.aesf.org), including sophisticated e-mail capabilities. Not only are staff e-mail communications available, each AESF Branch, Board, Section and Committee has its own page through which minutes and other relevant materials can be broadcast to the entire group. Of course, Web pages on upcoming programs are also available. It should be noted here that the entire AESF Web site is currently undergoing significant changes, as those who access it will notice. The entire look and feel of the Web site is being revamped and improved. The AESF Web site, as well as those of the MFSA and NAMF, were an outgrowth of the work establishing the environmental resource centers.



Environmental Resource Centers

Another highly important resource developed to benefit the plating and surface finishing community involves the NCMS-spawned resource centers, specifically the National Metal Finishing Resource Center.

The advent of the Internet revolutionized worldwide information resources and activities in ways heretofore unimagined. The impact on the metal finishing industry was no less revolutionary. In 1995, the National Institute of Standards and Technology (NIST) of the U.S. Department of Commerce (formerly the National Bureau of Standards) issued a request for proposal for a resource center for pollution prevention and compliance. At this point, a Web site was not even envisioned.

As envisioned, a resource center would be *"created by NCMS in partnership with major industry trade organizations and the Environmental Protection Agency, provide environmental compliance and pollution prevention information, state-specific resource locators, access to industry experts, and a wide variety of additional features relevant to specific industry sectors or topics."*

In its simplest form a resource center's purpose is to make sense of the environmental regulations pertinent to a given industrial segment. It is intended to answer the question, "What are the rules?"

The resource center most germane to the surface finishing industry is the National Metal Finishing Resource Center (NMFRC). The NCMS developed a proposal to provide a resource center for the plating industry, working with all three organizations (AESF, NAMF and MFSA) and the U.S. Environmental Protection Agency. The growth of the Internet and the Worldwide Web made the creation of a web-based resource center as the primary means of communicating a natural choice (www.nmfrc.org).

The NMFRC site that is online today provides guidance on environmental regulations germane to the plating industry, including the full text of regulations, directives and their latest revisions, as well as interpretations from EPA and the individual states. However, it goes far beyond the original charter. For example, the papers and articles from *Plating & Surface Finishing* are available six months after publication. Indeed, AESF journal access goes back to the days of the *Monthly Review*. The site contains a searchable technical database containing over 7,000 articles, papers and reports covering metal finishing process and pollution control topics. There is a collection of metal finishing specifications, a resource that is difficult to find all in one place. In addition there is a comprehensive directory of shops, suppliers and individuals, containing over 8,000 entries. An interactive feature allows users to ask the experts on specific plating problems and issues. Many of these features are available without cost, but the entire technical package is subscription-based at nominal cost. Currently, over 7,000 individuals from 50 states and 30 nations subscribe to NMFRC.

As implied earlier in this discussion, the NMFRC is not the only resource center developed by NCMS. Indeed, there are 14 "Compliance Assistance Centers" detailing the enforcement effects of Environmental Protection Agency regulations, either in action or proposed. All provide the same type of information containing in the NMFRC website, including environmental compliance and pollution prevention information, state-specific resource locators, access to industry experts and a wide variety of additional features relevant to specific industry sectors or topics. The sites developed by NCMS include:

- Border Compliance Assistance Center, www.bordercenter.org
- Compliance Assistance Platform, www.envcap.org
- Construction Industry Compliance Assistance Center (CICA), www.CICAcenter.org
- Environmental Center for Automotive Recycling (ECAR), www.ECARcenter.org
- National Metal Finishing Resource Center (NMFRC), www.nmfrc.org
- Healthcare Environmental Resource Center (HERC), www.HERCenter.org
- Paints and Coatings Resource Center (PCRC), www.paintcenter.org
- Printed Wiring Board Resource Center (PWBRC), www.pwbrc.org

National Metal Finishing Strategic Goals Program

Finally, there is one other program in play that should be mentioned. The National Metal Finishing Strategic Goals Program, begun in 1998, encourages companies to go beyond the mandated environmental compliance levels. Again, the data is being collected through the offices of the NMFRC with NCMS serving as the catalyst between the U.S. EPA, AESF, MFSA, NAMF and SFIC.

One particularly outstanding NCMS project effort is entitled, *Benchmarking Metal Finishing*. Published in June 2000, the report gives a comprehensive view of the environmental state of the metal finishing industry based on an extensive survey of metal finishing operations throughout the United States. It is a detailed, process-by-process collection of best practices and serves as a guidebook for saving money and reducing waste in all common metal finishing operations.

The Strategic Goals Program continues the benchmarking process. Each member company provides process and performance data on a continuing basis. Such information includes:

- Facility location
- Annual sales
- Annual wastewater discharge
- Annual wastewater treatment sludge generated
- Annual wastewater treatment sludge disposed of in landfills
- Wastewater treatment sludge % solids
- Annual electricity usage
- Annual TRI organics emissions

Also included in the mix is information on sales percentages. Data on market percentages in the fastener and automotive sectors as well as sales percentages for each process (*e.g.*, zinc rack, zinc barrel, nickel, decorative chromium, etc.)

As anonymity is preserved, each member company can see the progress being made, as well as how they stack up against other finishers. This benchmarking process can be used to predict water usage, based on a company's product mix and position in the industry (*i.e.*, size), and thus determine what needs to be done to achieve further cost savings. This data can be applied to predict future trends, including the analysis of costs to industry as a result of proposed or pending regulations.

Here the fact that environmental activities can lead to significant cost savings becomes the driver to exceed current regulations. This program helps member companies with a variety of tools from a variety of state and local resources. These can include workshops, training and assistance. Additional information is available at www.strategicgoals.org.

In the end, "leveraging excellence" is an appropriate description of NCMS. With no in-house agenda, they organize projects and bring people together. They are a catalyst, and a rather effective one at that. ***P&SF***