EIGHTH INTERNATIONAL ALUMINUM EXTRUSION
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Technical Solutions for the Aluminum Extrusion Industry

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ABSTRACT --- In the economically challenging environment of manufacturing in general and the aluminum extrusion industry specifically, companies need to continue to develop new products and improve processes while minimizing overhead and cost. One route to addressing these seemingly conflicting requirements is to utilize outside resources to augment internal staff capabilities. While a familiar concept in non-technical areas such as accounting and cleaning services, the extension to technical support is more challenging. One model for meeting the technical needs of the aluminum extrusion industry is based on a pooled resource approach involving companies, universities, and national laboratories with specialized capabilities. By coordinating these activities through a single, technically competent entity, comprehensive yet cost-effective technical results are possible. This paper will review this model and illustrate its effectiveness through the example of Secat, Inc., a company based on it.

INTRODUCTION

Development of innovative new products and improved processes has been the hallmark of the successful development of the aluminum extrusion industry. Groundbreaking applications in building and construction, aircraft and automotive application, and consumer goods have been the result of the R&D efforts of both large, vertically integrated aluminum producers who sought new markets for their expanding production capabilities as well as smaller, entrepreneurial organizations. These developments are documented in some excellent historical reviews of the aluminum industry including

1. Aluminum by Design by Sarah Nichols (Carnegie Museum of Art, 2000)
2. Monopoly to Competition by George David Smith (Cambridge University Press, 1988)
3. R&D for Industry, by Margaret B. W. Graham and Bettye H. Pruitt (Cambridge University Press, 1990)

The commercial environment that created these breakthroughs has changed significantly, however, as a result of corporate consolidations and strategic refocusing. The number of professionals engaged in aluminum R&D has dropped significantly with these consolidations, and those that do remain in R&D find that their focus is often on shorter term objectives related to supporting current products and processes. Likewise, the financial and competitive pressures on smaller, more entrepreneurial enterprises have also increased to the extent that development efforts often take a back seat to day-to-day operating concerns.

This raises some important questions. Where will the next breakthroughs in product and process technology that will sustain and grow the aluminum extrusion industry come from? How will companies implement these new developments into commercial practice? How can companies meet their technical needs while still controlling overhead expenses and having access to the depth of technical capability needed to efficiently and effectively maintain product quality and improve productivity?

Secat, Inc. in Lexington, KY, USA, is implementing one innovative approach that addresses these concerns and may serve as a model for the future. Established in 1999, Secat was the vision of Dr. Subodh K. Das. Upon retiring from Arco Aluminum Company, Dr. Das realized the need for a capability to support the aluminum industry in the region, and set about identifying support to establish a Center for Aluminum Technology in Kentucky. By identifying the importance of the aluminum industry to the state of Kentucky and the region, he obtained financial support from the state government, federal government, University of Kentucky, and strategic aluminum industry partners.

This model utilizes at its center a for-profit small business that maintains low overhead through low capital costs and minimum staff and then uses a virtual network of resources consisting of independent consultants as well as other companies, universities, and national laboratories to obtain the flexible capability necessary to meet a wide range of technical needs. The key innovative element that elevates this model above the level of simply a resource clearinghouse is the presence of technically competent staff along with baseline infrastructure in metallurgical analysis and testing that provides essential capabilities to complement and supplement

the specialized ones acquired from outside the organization.

Certainly there are alternative approaches for companies in the aluminum extrusion industry to obtain the technical support they need. These include universities and university-based consortia, independent consultants, and conventional technical service suppliers.

Universities and university-based consortia can be a cost-effective method to obtain technology, but often this comes with the issues related to not-for-profit educational institutions. These issues include a tendency to focus on academic rather than industrial problems, since the primary role of the university is education and the development of new knowledge. In addition, the time scale of the university work often is slower than that of industry, and can be affected by the academic calendar. Finally, handling intellectual property can sometimes be an issue due to the public or open nature of the university environment. Some of these issues can sometimes be ameliorated by industrial consortia formed around a specific technical topic at a university, but the compromise here is the inability to have work of a company proprietary nature addressed in the consortium environment.

Independent consultants offer the ability to provide services to aluminum extrusion companies on an "on-demand" basis, and many are expert in the specific area of need, often bringing years of practical experience. For a small company seeking technical support, locating, evaluating, and utilizing independent consultants can often be a time-consuming, "hit-or-miss" task that requires some of the valuable time of technical staff to manage. In addition, because most consultants have a specific area of expertise, when a new need arises requiring another consultant, the company must begin the search again for someone to meet the new need. Intellectual property management is seldom an issue with independent consultants, who generally agree to assign the rights to any IP generated through their company-supported efforts to the company.

Finally, conventional technical service companies exist to meet the needs of a wide variety of customers, often in a specialized area. Again, while they may be very capable of supplying excellent quality services, they are often not the lowest cost due to the typically higher overhead in terms of full time staff and capital equipment that the company maintains in order to deliver its services. In addition, if a technical service is outside the portfolio of the company, it becomes incumbent on the aluminum extruder to locate, evaluate, and manage another technical services provider who can meet these new needs.

Thus, while each of the alternative approaches has specific advantages, a model utilizing virtual resources coordinated by technically astute staff in which intellectual property can be effectively handled can provide the most economical means to meet the extruder's technical needs.

Next, some specific examples of how this model has been deployed will be reviewed.

COLLABORATIVE R&D

One of the most difficult areas to invest for a small company is in long-range research and development. While projects that address significant barriers or promise breakthrough innovations are of interest, they are often too high risk to justify direct company funding. One route to addressing these opportunities is through support from the US government, which seeks to support innovations that will assist businesses in targeted areas.

The initial focus of the Secat model was to respond to opportunities presented by the Aluminum Industry Technology Roadmap and specifically the desire of the US Department of Energy's Office of Industrial Technologies to expand the range of industrial partners involved in its cost-shared R&D projects. By identifying areas of collective interest to a consortium of aluminum industry partners, proposals were made to carry out technology development efforts. The widespread participation of all sizes of aluminum companies ensured that the results were available to the bulk of the aluminum industry and did not result in monopolizing the research findings hence increasing chances in acceptance of the proposals. A second element of this strategy was to leverage the excellent but sometimes difficult to access technical capabilities of the National Laboratories to carry out the research. Coupling these resources with those from selected academic partners from universities as well as key players from the supplier industry with well-established Research & Development programs, a competent team was brought to bear on the challenging R&D problems. Secat served the role as project facilitator and repository of the resulting intellectual property. This helped to reduce conflicts between individual company goals as well focusing on the basic common targets. Regular focused meetings helped to direct the research towards well-defined goals. This model has resulted in some $15 million of

cost-shared R&D under management in the areas of ingot cracking; melt loss reduction, furnace efficiency, and continuous casting. These projects are now bearing fruit for the project sponsors in the form of implementable technology that will improve energy efficiency and reduce production cost. The same concept can be used in the extrusion industry to obtain the best leverage from industry dollars and optimize the chances of obtaining government funding.

Of particular relevance to the aluminum extrusion industry are the projects on melt loss reduction and furnace efficiency. The project entitled “Reduction of Oxidative Melt Loss of Aluminum and Its Alloys” is funded by the US Department of Energy and intends to establish aluminum melting practices that will significantly reduce the oxidation of aluminum during melting. A reasonably achievable target is a 50% reduction in oxidative melt loss leading to a reduction in dross losses from about 4% to 2%. Full-scale implementation of the results of the proposed research would lead to energy savings in excess of 58 trillion Btu by the year 2020.

The melt loss project consists of university, national laboratories and several participating aluminum companies providing the industrial support for the project. The project will come to a conclusion at the end of this year and has resulted in the filing of 2 patents for use of protective covers to reduce oxidation. Field trials on furnaces at participating companies site is planed if possible to try out the findings on molten Al on a large scale. Several testing procedures have been put into place that will permit in situ testing of Al alloy samples to permit oxidation behavior to be studied including determining types and % of oxides that are formed at participating laboratories.

A second collaborative R&D project is entitled “Improving Energy Efficiency in Aluminum Melting”. The US Department of Energy is the responsible agent for funding this project. The goal of this jointly funded, multi-partner research program is to improve the energy efficiency of aluminum melting practices by 25%. Full-scale implementation of the results of the research by the year 2015 could lead to yearly energy savings of 13 trillion Btu and related energy cost savings of 57 million dollars per year for the US aluminum industry.

The Project Manager manages all aspects of the project along with a steering committee. The national laboratories, university participants, and industry participants carry out the technical execution of the project. Figure 1 provides an organization plan for the project.

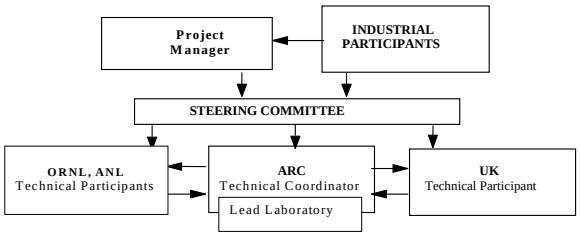

Figure 1. Collaborative R&D Project Organization

The project has completed 2 years. The benefits of the project to date include design, development and construction of modular furnace capable of carrying out trials to reproduce industrial furnace behavior and how to improve furnace efficiency by varying dimensions, refractory lining, etc. Several software are also being developed to help the practical melter vary performance criteria and come up with the best set of operating conditions for each melter/holder based on best practices. In this regard a course on Energy Evaluation in plants has been conducted and is also available on request for presentation at individual plant sites to train concerned personnel in use of software.

PROPRIETARY R&D

In some cases, companies have more specific, nearer-term needs than can be met through large collaborative R&D efforts. In this case, a proprietary R&D project may be needed.
In house research capabilities in response to industry needs, especially with an increased focus on assisting end use customers of aluminum as well as those involved in its production has been developed to perform research and development, including a $2 million investment in mechanical testing, metal quality, and microstructural evaluation equipment along with professional staff resources. An extension of these capabilities has been achieved through a series of agreements with industry experts “ on call consultants” as well as organizations with complementary technical capabilities including universities like University of Kentucky and national laboratories e.g. Oak Ridge, Argonne and Albany. Through this support network, it is possible to bring consolidated expertise to bear on industry problems, either on a proprietary or multi-company basis. In a sense, this model serves as the “R&D Department” for companies that do not have extensive internal technical staffs, providing the leverage of a larger organization without the ongoing overhead expenses

typically required. Managing the intellectual property and performing proprietary work is possible due to the for-profit status. Universities are not able to protect intellectual property and have an obligation to publish the experimental evidence that they generate in the course of their work with industry.

For the extrusion industry this approach can be integrated in to a technical solutions package as has been developed by Secat.

For the specific case of interest here, the Aluminum Extrusion Technology includes:

• Extruded product selection and development for specific applications
• Extrusion process development
• Extrusion billet cast house improvement and quality assessment
• Microstructural evaluation and material testing of extruded products, including texture, fatigue, etc.
• Pilot scale extrusion capabilities

SUPPORTING THE INDUSTRY

Due to industrial and university partnerships, the model extends beyond the direct performance of R&D to assist in the development and support of technical resources for the industry generally. These efforts include sponsorship of a scholarship at the University of Kentucky for outstanding students in the Materials Science and Engineering program as well as education and training programs from academic as well as industry professionals specific to aluminum technology. Further, support to the aluminum Industry is also provided through a service named *Aluminum Answers*^{SM}, a web-based resource providing answers to frequently asked technical questions about aluminum, technical articles and book reviews, and access to experts.

SUMMARY

In the unfolding era of tighter resources both financially and technically, the capabilities of R&D organizations this model will be increasingly important to carry forward the pace of cost-effective and innovative developments needed to maintain the aluminum industry in 3 major directions

1. Leveraging industry dollars to obtain the up to date technical capabilities in terms of equipment, resources and manpower within a targeted time frame
2. Direct proprietary research –short and long term leveraging capabilities at all available sites by linking national laboratories, universities best suited for identified tasks
3. Introducing young students to the aluminum industry to ensure bright young minds are attracted to the aluminum industry for its long term overall growth.