

AN INTERNATIONAL INDUSTRY/UNIVERSITY COLLABORATION: NORSK HYDRO/MICHIGAN TECH/NTNU

C. L. White¹, W. W. Predebon², E. Wathne³ and P. K. Larsen⁴

Abstract— For several years, Norsk Hydro's Light Metals Division has sponsored an international collaborative program involving the Norwegian University of Science and Technology (NTNU) and Michigan Technological University (Michigan Tech). This program includes contract research and graduate education focussed on application of aluminum extrusions in automotive structures. The program also promotes exchanges and technical interactions among the various participating institutions.

As a result of the collaboration, six students from NTNU and Michigan Tech have completed M.S. degrees based on the program's research. Norsk Hydro has sponsored several undergraduate student teams and design projects, and the visibility of the program has fostered an increased curricular emphasis on aluminum as a structural material. The program has also engendered an increased awareness on the part of faculty and students that both education and business are intensely international in character. Students from both universities have visited Norsk Hydro facilities in the U.S. and Norway. This paper will briefly summarize the genesis and initial outcomes of this collaboration.

Index Terms \approx international, collaboration, industry, aluminum.

INTRODUCTION

Partnerships and collaborations between educational institutions and industry, for the purpose of research and education are an important means of establishing and maintaining relevance to practice in the engineering curriculum. They facilitate sustained contact between faculty, students, and practicing engineers. They also provide a means for individual companies and industries to access expertise and facilities at university campuses, and gain visibility among potential employees. In this paper, we describe the establishment and initial activities in a three-way partnership between a large Norwegian company, a Norwegian university, and an American university. Documentation of the benefits and lessons learned in this process may be useful to other groups in establishing similar programs.

BACKGROUND

Norsk Hydro is a major worldwide producer of light metals (aluminum and magnesium), and a leading producer of aluminum alloy extrusions. The company has targeted the automotive industries in both Europe and North America as priority markets for its extruded aluminum products, and in Europe, the company has developed a strong infrastructure, with programs for development and manufacture of automotive sub-systems for customers such as BMW, Renault, and Lotus.

Norsk Hydro has a long established relationship with the Norwegian University of Science and Technology (NTNU), which conducts research on all aspects of aluminum production (smelting, casting, extrusion) as well as application of extrusions in marine, automotive, and civil construction. NTNU graduates constitute a large portion of the European engineering and research staff employed by Norsk Hydro.

As part of its plans to expand its business in North America, Norsk Hydro purchased several extrusion and fabrication facilities, and has completed construction of a scrap re-melting facility in Kentucky. In building its infrastructure in the US, the company recognized the need to develop a relationship with a university that could fill some of the same roles filled by NTNU in Europe.

In 1998, after visiting a number of US universities, Norsk Hydro entered into discussions with the Departments of Materials Science and Engineering, and Mechanical Engineering - Engineering Mechanics at Michigan Technological University (Michigan Tech). These discussions involved at least six meetings over a period approximately ten months, and included participants from NTNU as well as Norsk Hydro. During the course of these meetings, the capabilities and objectives of each party were discussed in detail. Issues included the following:

- general requirements and expectations for sponsored research
- intellectual property agreements
- possible modes of interaction (joint research, student & faculty exchanges, industrial internships and employment)

¹ C. L. White, Department of Materials Science and Engineering, Michigan Technological University, Houghton, MI 49931 cwhite@mtu.edu

² W. W. Predebon, Department of Mechanical Engineering - Engineering Mechanics, Michigan Technological University, Houghton, MI 49931 wwpredeb@mtu.edu

³ E. Wathne, Hydro Light Metals Technology Center N.A., Holland, MI 49423 Einar.Wathne@hydro.com

⁴ P. K. Larsen, Department of Structural Engineering, Norwegian University of Science and Technology, Trondheim, Norway, per.larsen@bygg.ntnu.no

In November of 1998, a memorandum of understanding was executed between Norsk Hydro, Michigan Tech, and NTNU. This agreement formalized the understandings that had been reached regarding modes of interaction, established a schedule of partnership meetings (one executive and one business meeting per year) and identified initial objectives for the first year's interactions. The description of program activities that follows will focus primarily on those between Michigan Tech and the two other partners as part of the partnership agreement. Bilateral interactions between Norsk Hydro and NTNU are too extensive to be described adequately here.

PROGRAM ACTIVITIES

Program activities identified and proposed at the commencement of the partnership included the following:

- guest lectures by participant from each partnering institution
- student exchanges between Michigan Tech and NTNU
- support of M.S. projects involving both Michigan Tech and NTNU students
- Norsk Hydro involvement in undergraduate capstone design projects at Michigan Tech
- student internships at Norsk Hydro facilities (both domestic and international)
- faculty exchanges between Michigan Tech and NTNU
- faculty and student participation in workshops, summer schools, and seminars
- course development at the graduate and undergraduate level
- employee recruitment activities by Norsk Hydro on the Michigan Tech campus

The list of activities is reviewed at each semiannual partnership management meeting, and specific objectives are established for the following meeting.

Guest Lectures and Faculty Interactions

The formation of the Norsk Hydro/Michigan Tech/NTNU partnership has directly resulted in the exchange of approximately nine technical and scientific presentations by representatives of the three institutions. These presentations and the associated interactions serve the purpose of acquainting the participants with the expertise, research interests, and facilities associated with each participating institution. Many of these presentations were presented at a level that permitted undergraduate students, as well as graduate students and faculty members to benefit from the interactions.

In the summer of 1999, Norsk Hydro sponsored the participation of three Michigan Tech faculty members, one Michigan Tech graduate student, and numerous NTNU faculty members and students in the International Summer School on Aluminum Metallurgy in Trondheim in 1999. The first Michigan Tech faculty sabbatical leave under the

program is scheduled to take place during the 2001-02 academic year. In addition to these formalized interactions, the partnership has facilitated several dozen plant and laboratory visits by representatives of the three participating institutions.

Student Exchanges, Internships, and Employment

Two Michigan Tech graduate students have completed M.S. degrees working on Norsk Hydro sponsored research projects, and one additional student is currently engaged in M.S. research on a Norsk Hydro sponsored project. The two M.S. students who have completed their degrees also participated in summer internships at Norsk Hydro facilities in Norway during the summer of 1999, and have accepted permanent employment at the company's Automotive Structures Plant and its Technology Center in Holland, MI. In addition, Norsk Hydro has hired several other Michigan Tech graduates at various locations throughout the U.S.

In addition to Michigan Tech students, four NTNU M.Sc. degree students have completed their thesis research at Michigan Tech under the direction of Michigan Tech faculty. These students normally complete all coursework prior to arriving at Michigan Tech, and the NTNU thesis advisor, and the Michigan Tech research advisor have agreed upon the direction and scope of the proposed thesis research. In general, the NTNU students work closely with the Michigan Tech students on Norsk Hydro sponsored thesis projects.

Undergraduate Capstone Design

In addition to graduate research activities, the partnership has supported undergraduate capstone design projects at Michigan Tech. Projects in the Materials Science and Engineering Department have emphasized processing and properties of novel aluminum product forms (e.g. foamed aluminum). Projects in the Mechanical Engineering - Engineering Mechanics Department have focussed on FEA analysis of aluminum component designs (pillars and bumpers), and verification of crush performance through laboratory testing. Student teams in both departments have benefited greatly from the technical expertise, donation of materials, and direct financial support of Norsk Hydro and its engineers.

Workshop on Application of Aluminum Extrusions in Automotive Structures

In November of 1999, Norsk Hydro and Michigan Tech sponsored a university-industry workshop on automotive applications of aluminum extrusions. The workshop was attended by more than 30 participants from 11 institutions, mostly automobile manufacturers and their suppliers. The focus of the workshop was to identify advantages and opportunities associated with use of extruded aluminum in automotive structural subsystems. It also addressed the principal barriers, both technological and educational, to the introduction of aluminum extrusions in these applications.

The discussions and conclusions from the workshop, as well as the personal contacts developed during discussions, have influenced both the focuses of the partnership, and Norsk Hydro's research and development priorities in North America.

DISCUSSION

Collaborations, even between universities in different countries, or between a university and a private sector institution, are not all that uncommon. Three way collaborations involving partners outside the European community are probably somewhat less common, but by no means unique. In spite of this, there seems to be little in the literature on higher education that documents the issues and benefits associated with such partnerships.

As with all successful relationships, collaborations such as this must be based firmly on mutual trust, respect, and a willingness to understand and respect the institutional imperatives of the other partners. The success to date of the Norsk Hydro/Michigan Tech/NTNU partnership is due in large part to the willingness of each partner to understand and accept as legitimate the different values and requirements associated with their partner institutions.

An example of this acceptance involves tuition and modes of graduate student and faculty support for research. At NTNU, faculty members are nominally paid for the full calendar year, and graduate students do not pay tuition. Furthermore, while Ph.D. students are supported on stipends, M.Sc. students are not. Research budgets do include operating costs for projects, and may include some faculty support, they need not include levels of funding for student support (stipend and tuition) that are common for university funded research in the U.S.

Tuition costs associated with NTNU students completing M.Sc. research at Michigan Tech was another issue that needed to be addressed. These students, even though not enrolled in a degree program at Michigan Tech, needed to be enrolled as full time students in order to obtain the appropriate visas for entry into the U.S. Furthermore, Michigan Tech policy requires that tuition be collected as a direct cost to programs and departments. Because tuition is not normally a direct cost associated with thesis or dissertation research in the Norwegian system of higher education, it was essential that all parties (including Norsk Hydro, who paid for the tuition) to understand the differences between the two systems.

ACCREDITATION

The Accreditation Board for Engineering and Technology (ABET) is the accrediting agency for engineering programs in the U.S. Under its EC2000 accreditation criteria, ABET requires that each program seeking accreditation demonstrate that its graduates have the broad education necessary to "understand the impact of engineering solutions in a global context" [1].

In Norway, undergraduate students are encouraged to spend at least one semester abroad, and many do so. While it certainly would be desirable for each Michigan Tech undergraduate in engineering to experience an educational or industrial internship experience outside the U.S. prior to graduation, the fact is that this goal is not likely to be achieved in the near future. It is possible, however, to provide undergraduates with exposure to multinational companies, who routinely expect their employees to function effectively outside their native countries. This experience brings with it awareness that aesthetics, use patterns, and regulations can change significantly when one crosses international borders. Furthermore, professional contacts with practicing engineers whom have worked (or are working) outside their native countries convey this message far more effectively than can a lecture or two on globalization of the engineering marketplace [2]. At Michigan Tech, the interactions with Norsk Hydro have served this purpose admirably, allowing undergraduate and graduate students to view their careers in a global context.

CONCLUSIONS

International collaborations involving industry and universities can be extraordinarily beneficial for all participants. In order for these activities to achieve their potential, however, a solid foundation must be established. That foundation consists of a clear common understanding of each partner's long term vision for the collaboration (and compatibility of those visions), and a plan that involves sufficient resources to move the effort through its initial stages. In the case of the Norsk Hydro/Michigan Tech/NTNU partnership, this foundation was built through sustained personal contact between individuals committed to the project. It was also important that these participants were empowered to make and follow through on commitments to the joint program.

Benefits of the partnership at Michigan Tech and NTNU are significant and multifaceted. Norsk Hydro supports and provides guidance to student projects (both graduate and undergraduate) at both institutions. The company also provides internship and permanent employment opportunities to students from both universities. The partnership helps the two universities work together, as well, facilitating interactions between their faculty and students. Perhaps most importantly, the partnership provides an important element of industrial relevance and cultural diversity to the education of students in the participating programs.

Norsk Hydro benefits from the expertise of the university faculty members, and their participation in company sponsored research. This research, and its impact on educational programs at both the undergraduate and graduate level, impacts the strategic goals of company. The company also benefits from its visibility within the student bodies of both universities.

REFERENCES

- [1] Engineering Accreditation Commission, "Criteria for Accrediting Engineering Programs", *Accreditation Board for Engineering and Technology*, November 1999, pp. 32-33.
- [2] Herbeaux, J.-L., "A New Senior Level Design Course in International Design", *Journal of Engineering Education*, Vol, 88, No. 1, Jan. 1999, pp. 23-25