



Patrick Horvath Endowed Professorship of Materials Science and Engineering
Paul Sanders, Patrick Horvath Professor

Overall, funding has been stable or growing throughout the pandemic. In 2020 my team graduated 2 PhD and 2 MS student, while adding 3 PhD and 2 MS students. We currently have 11 graduate students: 4 on-campus PhDs, 5 off-campus PhDs, and 2 MS. The ARC team is the largest research group in MSE and among the largest on the Michigan Tech campus. The growth of our off-campus PhD cohort is enabled by company tuition assistance programs, the student's current salary from their company employment, and \$10-20k of company or foundation support for on campus research activities and advising expenses. Interestingly, Michigan Tech has not recognized off-campus PhDs as a growth strategy and has not helped facilitate this potentially significant research activity.

The Michigan Tech senior design sequence (year 3 spring material design class, year 4 fall and spring senior design project class) is applying measurement system analysis and material design with CALPHAD utilizing design of experiments methods to real world projects. One indication of our success is that Michigan Tech MSE has won 1st place in the ASM Undergraduate Design Competition for the last 3 years.

Chaired Professor Activity

All phases of this Horvath chaired professor plan were advanced over the course of 2020.

- **Co-ops:** For 2020, we hired 2 spring-summer and 2 summer-fall co-op students to assist in research and development activities in Michigan Tech's pilot scale foundry and thermo-mechanical processing laboratories. These students get extensive hands-on experience on real-world projects funded by our industrial sponsors.
 - a. The ARC co-op program is the leading on-campus co-op program, and others across campus are looking to replicate our strategy.
 - b. In addition, within MSE we are suggesting co-op student be employed to help other staff members.
 - c. Finally, we presented our strategy to Tech's new VP for Diversity and Inclusion Wayne Gersie and he really liked this program. We will try to leverage this program to recruit students from other undergraduate institutions.
- **Collaborations:** Last year collaborations with 2 professors at the University of Michigan were supported by Horvath funds. The strategy for these collaborations is to increase the breadth and depth of research at Michigan Tech with the eventual outcome of more

scientific publications. Instead of the typical model of fee for service, we started doing innovative processing such as roll forming and custom alloy casting to support advanced material characterization efforts. We don't charge for these services, but rather use Horvath funds to leverage funding already secured by our external collaborators. In this way, we devote more time and effort to process optimization which yields better materials. Since we are key members of the project team, my students and I have the opportunity to author more papers and participate in future proposals than in the traditional model.

- **Future collaborations:** Horvath funds have been used to enhance future collaborations and grow new ones, primarily through travel to current and potential research partners. Face-to-face visits are key to maintaining and establishing new relationships. Dale Dewald (ARC staff member) and I made a trip to Amsted Rail in St. Louis in early 2020 before the pandemic set in.
- **Publications:** *The Paper Forge*. ARC staff member Dr. Joe Licavoli has led an effort to structure and accelerate the ARC team's paper publishing. We utilized a tool we use for project work, *Scrum*, which is an agile project management system that traditionally uses sticky notes on a white board to track completion of a project backlog (to do list) through the doing and done phase. This tactile process has been adapted by software platforms such as Trello to a virtual "sticky note" board with easy tracking and replication with the tasks and deadline notifications available on a mobile device. A template "card" was created which includes step-by-step checklists for the writer and tracker to use to complete paper writing tasks. A screen shot of a portion of the board and card template shows the stages of the process with checklists for each step in. This process has **tripled** our paper submission rate, but our actual publication rate is closer to double as researchers across the globe are focusing on publishing during the pandemic.

Regarding utilization of funds (Table 2), approximately 1/3 of the funds were used to support Dr. Licavoli and his Paper Forge initiative. Staff, co-op, and graduate student support were used as needed to help the ARC organization function properly, while limited amounts were spent on facilitates, services, and travel.

In summary, it is an honor to be the Patrick Horvath Endowed Professorship of Materials Science and Engineering. I hope that as the pandemic eases, I may travel to visit Patrick and Debbie to update them in person on our progress.