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Industry-Academic Partnerships in Capstone Projects for Engineering Technology Students

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Abstract

This "Lessons Learned" paper highlights the collaborative efforts between Farmingdale State College students and Koehler Instrument Company, Inc., a manufacturer of quality laboratory testing equipment, to solve an industry-wide problem of grease contamination by developing and prototyping a portable instrument that utilizes the contact angle method. The contact angle method is a recently developed approach for the evaluation of the water-resistant property of a grease to quantify degradation via measurements of the contact angle of a water droplet on the surface of a grease sample. The students took a hands-on approach and were integrally involved at every stage of the development process of the contact angle instrument, highlighting the benefits of faculty and students engaging in solving real-world problems with real-world industries. Based on the success of this experience, the department plans to expand these collaborations by engaging additional local industries through a structured Capstone matchmaking program. This initiative will invite industry partners to propose annual challenges, allowing more students to engage in practical problem-solving with real-world impact.

Introduction

Grease is a commonly used lubricant in many industries, and different greases have different properties, making them appropriate for use in certain situations. However, when grease becomes contaminated—particularly with water—its effectiveness diminishes significantly, leading to increased wear and tear on components and a reduction in their operational lifespan**.** A solution to this problem could save companies money in repair and replacement costs, as well as reduce production downtime associated with equipment failure. Regular monitoring of grease contamination is therefore essential.

To address this issue, researchers at Louisiana State University (LSU) developed an effective method for assessing grease contamination by measuring the contact angle between a greased surface and a water droplet, as illustrated in Figure 1. This figure shows how the contact angle is measured between a greased surface and a droplet of water [1]. They have teamed up with Koehler Instrument Company, Inc. to develop a reliable, compact product to be used in the field, which will allow maintenance personnel to quickly monitor the contamination level of the grease, helping to reduce production costs.

As of April 2025, the development team is finalizing the prototype, with sample contact angle results shown in Figure 2 (left), internal components (middle), and the current state of the instrument shown in Figure 2 (right).

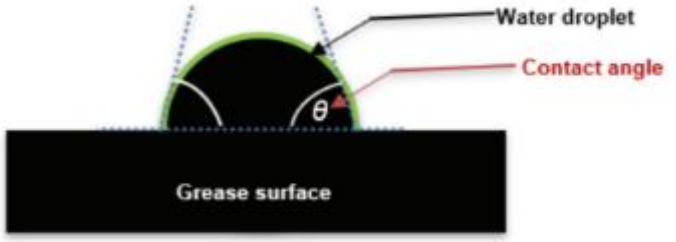

Figure 1. A Visual Representation of the Contact Angle Approach.

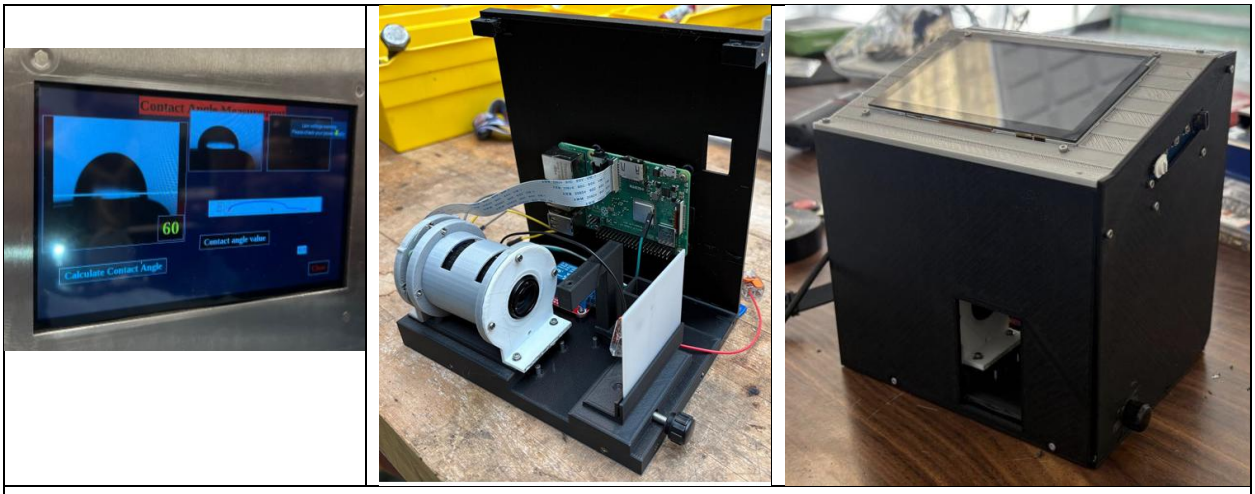

Figure 2. *(Left)* The contact angle as measured by the current prototype. *(Middle)* The internal components. *(Right)* The current assembled prototype of the Contact Angle Instrument by Koehler Instrument Company, Inc. and Farmingdale State College (FSC).

Design and Implementation

The contact angle prototype was designed using a compact optical platform with a mounted camera system capable of capturing droplet geometry. The students were involved in selecting hardware components, designing 3D-printed holders for grease samples, and creating user instructions for field operation. Several iterations were completed to address light consistency, grease surface uniformity, and image clarity. Student-led testing involved repeated trials across grease types and contamination levels. Final validation runs showed promising correlation with expected contact angle trends.

The project taught students key engineering processes, including CAD modeling, rapid prototyping, and design for manufacturability. Close collaboration with Koehler's manufacturing team allowed students to understand production constraints and revise the external casing to reduce complexity and cost. This real-world design evolution greatly contributed to their readiness for professional engineering environments.

Student Learning Experience and Industry Feedback

Students described the experience as one of the most impactful elements of their academic careers, highlighting how it gave them confidence in applying theoretical knowledge to a practical challenge. They also appreciated learning how to effectively communicate with stakeholders across organizations. According to a post-project reflection, one student shared, "It felt like we were really part of something that matters—and it gave me a sense of purpose beyond just completing a class."

Koehler Instrument Company responded positively to the final prototype and expressed interest in continuing refinement work. Their product development team noted the innovation potential of the tool for their customers in lubricant quality monitoring and praised the student team's professionalism and ingenuity.

Benefits to the Industry

Entry-level employees spend a significant amount of time during their onboarding process learning about how a company operates, as well as understanding the engineering process outside of an academic setting. As a result, they may take longer to complete a task compared to employees who have been working in the field for 1+ years. When students are exposed to industry-based practices while obtaining their degree, particularly in a Capstone project, they become more familiar with the necessary processes that a company has in place. This results in entry-level employees who possess excellent communication skills, verbal skills, interpersonal skills, and even critical thinking and analytical skills that are comparable to those who are more advanced in their profession. This results in fewer misunderstandings or mistakes and better communication overall, resulting in more efficient and effective employees.

Benefits to Academia

When engineering technology students participate in industry-academic partnerships for Capstone projects, they gain practical experience in working with other professionals and in the basics of their future profession. This experience allows them to put related work experience on their resumes, which can be valuable in securing an entry-level position. Furthermore, these partnerships create networking opportunities with professionals and may even lead to employment opportunities for the student.

Drawbacks

One potential drawback of these Capstone project partnerships is that the student may be asked to complete a project setup by a company, and the deadlines and expectations for the student's coursework and for the company may differ, leading to incomplete projects. Another potential drawback is the issue of resources, as the student may have to rely on school resources that are

not as plentiful as those in the industry. It's important to address these potential issues at the beginning of the Capstone project to ensure the project can be completed by the company or school deadline.

Outcomes and Conclusions

Partnerships between academia and industry for Capstone projects are crucial for the success of both students and companies. As the baby boomer generation retires, the U.S. needs more engineers. These partnerships help bridge the generational knowledge gap and ensure that the next generation of engineers are ready to face the challenges ahead. Projects such as this demonstrate how structured collaboration with industry provides meaningful outcomes for all parties and inspires academic programs to further develop these initiatives.

Moving Forward

Although progress has been made on the Capstone project, there is still more work to be done. For example, students can consider designing a different grease holder for greases with different chemical makeups. They can also continue to run experiments to create a catalog of results for different grease structures and work closely with researchers to determine a cutoff for the standard deviation, which will alert the user to change the grease sample.

Additionally, Farmingdale State College plans to establish a formal Capstone Industry Partner Program, through which companies can propose challenges aligned with their innovation goals. Faculty will curate a project pipeline that aligns with academic learning outcomes while providing scalable, impactful problems for students to solve. Through this, the college intends to increase the number of students participating in industry-sponsored projects and further integrate practical, hands-on experience into its curriculum.

References

1. K. Lijesh, RA. Miller, R. Shah, K. Shirvani and MM. Khonsari, "The standard for assessing water resistance properties of lubricating grease using contact angle measurements." *Lubricants* 11.10 (2023): 440.