The Purdue Polytechnic Leadership Academy aims to develop professional competencies essential for the leaders of the 21st century. This document provides expanded descriptions of all 9 competencies that Purdue Polytechnic Institute included as part of the T-shaped professional. These descriptions and examples should be used to identify artifacts for each competency and guide the development of your reflections. We use the example of a robotics class to assist you with artifact ideation for all competencies.

Deeper Learning: The process of becoming an expert on a specific topic. Deeper learning involves the application of expert knowledge to new situations and innovative applications, showing that even though you learned about a certain context, you are able to apply the knowledge to other contexts. Demonstrating your ability to apply the knowledge you have acquired to new situations is critical for professional success and lifelong learning. Deeper learning also requires mapping facts and concepts to help build on prior knowledge, enabling you to connect ideas, apply knowledge across content areas, and solve real-world problems.

Example: In a robotics class, students engage deeply with math and physics as they measure and assess the impact of the changes they are making to control their robots' speed, agility, and water displacement.

Analytical Reasoning: The capability to break a problem down into smaller pieces, whether parts of an object or parts of a process. It involves analyzing a problem by making evaluations, developing solutions, considering alternatives, and carrying out plans to address the problem. Activities such as researching, brainstorming, and design thinking help you engage in analytical reasoning.

Example: The robotics students are testing their hypotheses and designing solutions to the unexpected challenges they confront in their robot design.

Effective Communication: Listening to and understanding others are the foundation of effective communication. We must listen attentively and be aware of people's emotions, gestures, and cultural identity. Active listening requires reflecting back what the speaker has stated in your own words. This encourages elaboration from the speaker, provides positive feedback, and ensures that your understanding is correct. Active listening requires empathy, which is being open to and sensitive of the values and feelings of other people, understanding the other person's perspective, and being willing to discuss your own thoughts in an open manner. We must:

- consider our communications from the point of view of the listener or reader;
- be clear and concise;
- provide visual cues to support our speech (when appropriate);
- motivate and support others by giving praise, encouragement, and feedback;

- and demonstrate tact to those we disagree with.

Example: At the beginning of the project, students must listen to and understand the tasks required of the robot. During the project, students communicate with each other as part of their teamwork. At the end of the project, they present their robot to the class and explain the adjustments they made to the controllers.

Managing Complexity: First, we must understand what complexity means. Complexity is defined as the information required to describe an entity. Explaining complex entities involves multiple layers of analysis, including breaking entities down into their constituent parts and demonstrating the interactions between the parts. Complexity management can include delayering, decentralizing (or centralizing), streamlining processes, and creating stronger processes that ensure alignment. Big data and advanced analytics are emerging techniques for managing complexity, allowing us to monitor large numbers of variables to see how they develop and interact over time. As you seek to tackle problems, you must be able to analyze those problems, develop solutions, and carry out plans to address them.

Example: Breaking down the concept of a robot into its parts and design considerations (e.g., materials and functionality).

Critical Thinking: Philosophers believe that critical thinking should form the basis of our beliefs and help inform our behavior and actions. Critical thinking is objective and is the ideal of science, where evidence, not personal biases and opinions, inform our judgments and actions. It is a way of judging information by analyzing, applying standards (about what constitutes *quality* information), discriminating, seeking new information, logical reasoning, predicting, and transforming knowledge. Critical thinking requires an understanding that there is no single correct way to generate and evaluate arguments, so we must always be aware of our own biases and the biases of others. It is based on logic and objectivity, strategic problem solving and planning. It entails using judgment, assumptions and reasoning to come up with innovative solutions to problems or situations.

Example: Evaluating feedback from the instructor and classmates objectively to determine and inform improvements for their robot.

Collaborative Work: The act of two or more people (or organizations, teams, etc.) working together for a particular purpose. No (wo)man is an island, and this has become increasingly true in recent years. Interdepartmental collaboration in organizations is the norm, and frequently, this is combined with interorganizational collaboration. Information technology has given us the ability to collaborate with hundreds, even thousands, of people around the world on a given day. Success on projects requires considering various viewpoints, working together to find the best plan, and implementing that plan in a coordinated way. The ever-increasing rate of technological advancement makes collaboration even more necessary for success since, increasingly, no individual can possess all the knowledge required to succeed. Collaborative work helps students become better team members in the future as they learn to identify strengths, assign responsibilities, and reflect on successes. By planning thoughtful group activities, creating expectations around group work, and encouraging conversations about open-mindedness, students develop the skills necessary for collaborative work.

Example: In each robotics group, students have created team agreements, identified group leaders, and divided responsibilities equally.

Self-Directed Learning: Self-directed learning requires, first, identification of what your learning needs are. Then you must formulate learning goals, identify the resources you will use for your learning, select and implement learning strategies, and finally, evaluate the learning outcomes. Self-directed learning demonstrates initiative and drive, which becomes much more important once you begin your career. At work, you are tasked with succeeding in your daily job but also enhancing existing skills and developing new ones. With the explosion of knowledge work and the ever-increasing rate of technological change, the ability to increase your depth of knowledge as well as acquiring new knowledge and skills is increasingly important. Self-directed learning may be achieved through goal setting, progress tracking, reflecting on strengths and weaknesses, and the ability to turn setbacks into opportunities for growth.

Example: In robotics class, students identify daily goals for their robot design in their groups, create challenges for their teams, and surpass the requirements and standards outlined in the project.

Cultural awareness: Developing cultural awareness also develops self-awareness, a foundational skill for effective leadership. Without awareness of our own culture, we cannot be aware and accepting of other cultures, but we frequently cannot understand our own culture without exposure to and experience with other cultures. Cultural awareness is necessary for effective communication since norms of behavior change from culture to culture. Culture is simply the knowledge people acquire in their daily lives that allows them to interpret experiences and guide their social behavior. Culture is passed down to new generations because they are immersed in the symbols, patterns, and behaviors of the existing culture.

Example: Students learn about the cultural background of their team members and develop an understanding of how cultures relate to values, behaviors, and design decisions in this applied context.

Innovation: Innovation is the process of adapting an existing idea to new uses, improving an existing product or process, or inventing a new product. Innovation should create value, whether that means commercial value or value for society. Successful innovation may require a combination of cognitive, behavioral, and technical skills. New ideas are developed every day, but it takes an innovator to recognize the potential of a new idea to create value for your organization or society. The person who creates an innovation is not always the primary beneficiary—sometimes it takes a person with vision to understand the potential value of an innovation. Innovators must be constantly questioning the status quo, closely observing the details of your products and processes to identify new ways of doing things, networking to gain diverse perspectives from people of different backgrounds, experimenting with new ideas and experiences, and drawing connections between seemingly disparate ideas.

Example: The robots developed through the class project involve innovative approaches to design and technology.