Industrial Engineering at Warp Speed

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Abstract – Warp Speed is a high-impact, easy-to-implement experiential activity that can be used to enhance learning for a variety of industrial engineering topics, including facility layout, work methods, process improvement, and production control. Experiential activities provide a useful method for presenting engineering concepts in a way that more closely models real world problem complexity, thus addressing ABET program outcomes. Such activities support the use of active learning in the classroom and have been proven especially effective for addressing teamwork and leadership issues. Applications of Warp Speed can vary in duration and complexity, ranging from a simple 15-minute group initiative to a 50-minute problem-solving exercise. ABET program outcomes such as communications, teamwork, problem solving, and ethics can be integrated with the technical topics. This paper provides instructions for conducting the activity, discusses variations to address different industrial engineering topics and ABET program outcomes, and suggests facilitation strategies.

Keywords: activity, experiential, industrial, learning, teaching

Introduction

In today's educational environment of increasing knowledge content and declining credit hours, it is especially important to use exercises and assignments that are both efficient and effective. Warp Speed is a high-impact, easy-to-implement, experiential activity that can be used to enhance learning for a variety of industrial engineering topics. In addition, ABET program outcomes, such as teamwork and problem solving can be integrated with technical topics, efficiently using the time available. Experiential learning activities employ active learning and have been proven more effective than traditional classroom lecture for topics such as teamwork and leadership. These methods can also be used to simulate more closely real world problem complexity, thus addressing ABET program outcomes for design. [EAC, 1]

Warp Speed

In its basic form, Warp Speed is frequently used as a group initiative activity in teambuilding workshops. It may be used with groups of 8 to 20 participants and requires only a few simple props and enough open space for the group to form a circle. It is suitable for both indoor and outdoor use and can be adapted to accommodate participants with a range of disabilities. Depending on the topics and issues to be addressed, a Warp Speed activity can require from 15 to 50 minutes to complete. A variety of resources describing Warp Speed are available both online and in print. Rohnke [7] provides an excellent introduction to the use and facilitation of experiential learning activities and is highly recommended for instructors unacquainted with experiential learning activities. The following general instructions for Warp Speed were adapted from Rohnke [7] and First Steps Training and Development [2].

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Basic Warp Speed

Focus: teamwork, problem solving, decision making, communication

Equipment: one tennis ball or other soft object that can be thrown and caught

Set-up: Arrange the class in a circle, including the instructor/facilitator.

Safety briefing: "We will be throwing and catching a ball. Make sure the person you are throwing to has your attention before you throw the ball."

Conduct of the activity:

Explain: "I'm going to toss this ball to someone else in the circle. That person will toss it to someone else in the circle not next to him/her. That person will toss it to another person who has not yet received it and again not next to him/her. Throwing continues until the last person tosses the ball back to me. Remember who you received from and who you tossed to because we must repeat the pattern. Are there any questions?"

Toss the ball and create the pattern. Repeat it once or twice to ensure that everyone knows it.

Explain: "You are now going to see how quickly you can complete the pattern/process. I am going to step out of the circle, so the person that I tossed to will become both the beginning and the end person. Remember these rules: The ball must start and stop with the same person. The ball must move sequentially from person to person in the order we have established. Every person must have possession of the ball as it moves through the pattern/process. I will start time as soon as the ball leaves the first person, and I will stop time when it returns to him/her. You may begin when ready. Are there any questions?"

Time the first attempt. Applaud the first attempt, whatever it is (one second per participant or longer is quite normal). Then prompt them with "you can do better." Allow for planning, additional attempts and more planning. At some point the group will ask you how fast this can be done or how fast you've seen it done or what the ultimate goal is. The answer for most groups of approximately 20 people is less than one second. Continue until the group attains the elusive "warp speed" or ceases to be actively engaged in trying to reach it.

Debriefing: Focus discussion on teamwork, problem solving, decision making, and communication.

Variations

An almost endless variety of activities can be derived from basic Warp Speed by:

- Adding multiple objects of the same kind to the process.
- Adding multiple objects of various types and/or sizes to the process (tennis balls, foam balls, beach balls, Frisbees, rubber chickens).
- Requiring specific communications between the thrower and catcher as part of the process.
- Adding requirements or constraints on throwing/catching motions.
- Requiring certain objects be passed in the opposite direction of the original process.
- Requiring certain objects be passed in different patterns.

Rohnke [7] provides a variation called "Eggspeediency," which uses raw eggs rather than tennis balls. This variation can be used to provide a greater level of challenge and introduce the element of risk-taking. It is usually conducted outdoors.

Hull [3] provides a variation using different objects to represent tasks with different levels of importance/priority. Each type of object is controlled by different throwing/catching rules resulting in a very chaotic and somewhat stressful activity. This variation can be used to focus on issues of task prioritization, time management, and stress management.

Applications to Industrial Engineering Topics and ABET Outcomes

Using the variations listed above, Warp Speed can be used as a classroom exercise to enhance learning for numerous industrial engineering topics, including:

Process improvement – Most variations of Warp Speed can be used to address process improvement since reducing the process cycle time is an inherent part of the activity. In this application, the debriefing should specifically address the issue of process improvement. For example, did the students approach the task of process improvement in a formal manner or did they simply use a trial and error approach?

Facility Layout: This topic is usually demonstrated in the basic version of Warp Speed. Most groups will begin by making the circle tighter to reduce the distance of the throws and then rearrange themselves to form a circular process with throwers and catchers adjacent to each other. Some groups will then rearrange themselves again to form a linear process. The debriefing questions should focus on facility layout principles.

Project management: Project management issues can be addressed by using multiple objects passed in a single pattern or with different throwing/catching rules for each type of object, as previously discussed [Hull, 3]. The debriefing can address issues of managing multiple projects and task/project prioritization.

Work methods: The instructor may impose required throwing/catching/passing motions (such as throw and catch with the left hand only) during the initial definition of the process. It is then left to the student group to improve the process by using the principles of motion economy. A time study of the process might also be conducted.

Production control: This variation uses multiple objects of different types and sizes. Students must investigate the merits of batch processing versus single piece flow.

Problem Solving: Using any variation of Warp Speed, the students must demonstrate formal problem solving strategies as they work to reduce the cycle time.

Communications: A formal sequence of communications between the thrower and catcher is initially defined as part of the process. For example, prior to the throw, Sam asks, “Rachel, are you ready?” Rachel responds, “I’m ready Sam.” Sam then says, “Here it comes, Rachel,” and throws the ball. After the throw, Rachel says, “Thank you, Sam.” Sam replies “You’re welcome, Rachel.” Rachel then turns to the person to whom she is throwing and says, “Dave, are you ready?” This sequence of communication continues with each thrower and catcher. The long sequence of communications slows the process dramatically. With multiple objects in the process, the noise of several persons speaking at once is quite distracting and further hampers the process. In this variation, polite communication is frequently the first casualty in the attempt to reduce cycle time.

Teamwork: This issue can always be addressed.

Ethics: During variations that require specified communications between the thrower and catcher, the students will sometimes proceed with the process even though a mistake was made in the communications sequence. Debriefing questions can bring up issues of ethical behavior, whistle blowing, etc.

Facilitation Strategies

Good planning and preparation are essential to the success of any experiential activity, including Warp Speed. Hunter [4] presents a useful framework for the planning of experiential learning programs. Instructors planning to use Warp Speed should carefully consider the following:

1. Focus of the activity, topics to be addressed, and the desired goals/outcomes.
2. Presentation and framing of the activity.
3. Conduct of the activity.
4. Debriefing students with emphasis on application.

Although Warp Speed can be applied to a wide variety of topics, it is best to address only a limited set in order to maintain the focus of the students during the debriefing. A typical variation might focus on one technical topic and one or two teamwork/leadership issues. Of course, it is impossible to guarantee the outcome of any experiential activity and instructors must be prepared to adapt to the situation. There are excellent lessons to be learned from failures as well as successes.

Framing of the activity is the context in which it is presented to the students. The most typical forms of framing include fantasy, reality, and isomorphic. Isomorphic framing presents the exercise in a context familiar to the students, such as the engineering workplace or classroom. The use of isomorphic framing has been found to supplement the debriefing process and enhance the transfer of knowledge from the activity to the workplace [Priest, 6]. Including fictional or fantasy elements in an otherwise isomorphic framing scenario can make the exercise more fun for the students and still provide the desired results. For example, reality framing would present Warp Speed as the passing of some tennis balls and nothing more, while isomorphic framing might present the activity as a material handling process.

The most critical part of implementing an experiential activity is the debriefing of the students. One of the most effective techniques is metaphoric debriefing, which attempts to draw clear parallels between the exercise and the workplace or classroom [Priest, 6]. Kaagan [5] recommends a series of questions that address, in order:

1. What happened during the exercise?
2. What can be implied from the experience?
3. How can the knowledge gained be applied in the workplace?

Careful preparation of questions in each of these areas and good facilitation are essential to achieving optimum results for the activity. Students should do most of the talking during the debriefing and all students should be encouraged to contribute. The facilitator must ensure that the specific issues and goals related to the activity have been fully addressed, especially the application of the results to the workplace. However, as stated earlier, it is impossible to guarantee the outcome of any experiential activity and instructors must also be prepared to adapt to the situation.

Assessment

A survey of students was conducted one semester after they had experienced Warp Speed as part of a class activity focused on team building. Preliminary evidence indicates the students recalled lessons related to teamwork, communications, problem solving, decision making, leadership, and process improvement. Scores for effectiveness were highest for communications, problem solving, and decision making. Additional assessment is needed to provide statistically significant conclusions.

Summary

Warp Speed is a versatile activity that can be implemented in a variety of industrial engineering courses, ranging from a 15-minute exercise focused on process improvement to a 50-minute exercise focused on production control and team problem solving. Students remember the activity and the associated concepts because it involves active experiential learning. The activity is low cost and easy to use in a variety of settings. Finally, Warp Speed offers efficiency and effectiveness, two of the most important criteria in industrial engineering.

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