International competition as stopgap curriculum: Case study of Ryerson Invitational Thrill Design Competition

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Abstract—Students aspiring to careers in the themed entertainment and attractions industry have few formal options to learn and demonstrate skills and knowledge specific to the industry. Students have shown initiative in developing extracurricular activities, and industry has reached out to offer “next generation” programs and internships. It still remains problematic for industry employers to select the best qualified students from a large pool of aspirants and for motivated candidates to stand out as highly qualified for these opportunities. The Ryerson Invitational Thrill Design Competition (RITDC) was developed to address this problem. RITDC provides learning experiences and performance evaluation with not only completion as an indicator of accomplishment, but concurrent interactive evaluation by judges from industry. As such, although the competition is formally an extracurricular activity, it functions as stopgap curriculum. This paper describes the origin and evolution of the competition and the challenges it has encountered, and the response from participants and industry.

Keywords—themed entertainment, attractions, student design competition, internship

I. INTRODUCTION

Amusement attractions comprise an important component of the global tourism economy, enabling individuals, families, and groups of companions to experience immersive and interactive entertainment. The International Association of Themed Parks and Attractions (IAAPA) reported an estimated $44.8 billion in global spending at theme parks in 2017 [1]. The top 10 theme park groups worldwide had an estimated 8.6% growth in attendance in 2017 [2]. The 25 largest parks had an estimated 4.7% attendance increase in 2017 over 2016, with over 242 million visits. Several regions are notable hubs for theme parks, and TEA/AECOM (2018) reported over 75 million visits in 2017 at just the largest six attractions in Florida. Florida operations of Walt Disney Parks and Resorts, including its supply chain, have been described as contributing $18.2 billion, or 2.5% of the GDP of the state of Florida [3], and likely account for Orlando’s rank as the leading tourism destination in the USA [4]. However, theme parks are found all over the world.

The themed attractions economy comprises not just revenues, expenses, and employment of park operations, but also attraction design, manufacture, construction, and installation of attraction components. Major attractions integrate systems from multiple manufacturers sourced from around the world. For instance, the northern climate would seemingly limit the industry presence in Canada to seasonal operation of outdoor amusement parks and carnivals, but several major Canadian firms contribute prominently to the design and manufacture of waterslides and waterpark equipment (WhiteWater West, Proslide Technology), media-based attractions (Dynamic Attractions, CAVU Designwerks), and master planning and creative services (FORREC), among other components. The annual conferences of IAAPA showcase products and services from over 1,000 manufacturers and suppliers [5]. An industry rule of thumb is that park development budgets exceed $100 per first-year guest [6] [7]. A single attraction may cost tens of millions of dollars to develop [8] (p. 319-320) with major multi-attraction developments reaching into hundreds of millions of dollars [9][10]. Notable multi-year developments have reportedly exceeded $1 billion [11] [12] [13], and major theme parks may maintain annual investment in redevelopment of $500 million to maintain leadership positions in the industry [14].

Amusement attractions are engineered processes that are unique in that the product they manufacture is a compelling human experience, such as “fun”, “wonder”, or “thrill”. Attractions involve ride and show elements. Both involve engineering from various disciplines: mechanical, electrical, computing, industrial, civil and chemical engineering, as well as human factors, biomedical, and systems safety engineering. Engineers collaborate with other design disciplines such as architectural science, interior design, fashion, and theatrical specialties, to create attractions that meet strategic business needs.

The industry is a “dream job” for many young people, which generates a large candidate pool. Employers commonly use academic performance as a screening criterion [15]. Academic performance such as grade point average (GPA) is a readily available measure and has some relationship to cognitive skills and relevant knowledge, but the association to work performance is unclear [16] and it may not be the strongest predictor [15], and related experience is a higher priority for
employers [17]. In addition, some firms or hiring managers recognize that GPA may exclude candidates with knowledge and skills to produce work performance [18] [19]. “Job tryout” performance is a stronger predictor of work performance [15] [20]. Job tryouts also provide a preview of the nature of the work. A body of literature on “realistic job previews” has emerged to counter turnover resulting from disillusionment and unmet expectations about the nature of the work [21]. Unrealistic expectations can be a risk if candidates’ career interests are based on childhood dreams or enthusiastic guest or “fan” experience rather than realistic job knowledge.

Internships enable a candidate to learn practical skills and provide an opportunity for the employer to evaluate a candidate for later employment [22]. They provide hands-on experience that makes candidates more competitive on the entry-level job market [23] [17]. Internships can benefit the student’s academic training as well, since subsequent course selections can be informed by industry mentors. Internships of predetermined duration also eliminate a disadvantage of job tryouts, that supervisors may be reluctant to terminate marginal performers [20]. For these reasons, students are keenly interested in qualifying for internship or co-op positions. Whereas unpaid internships have been a subject of controversy [25] [26], attractions industry internships are typically paid. This may not be entirely altruistic, as paid interns clearly produce work for hire, thus the intellectual property belongs to the employer.

While the availability of attractions industry internships is fortunate, the importance of internships increases the pressure to secure them and shifts the intense competition earlier in the educational timeline. While employers are unlikely to entirely disregard general academic performance in screening internship candidates, a balanced assessment will include the candidate’s industry knowledge and skills related to the position and evidence of performance ability, in addition to the candidate’s motivation and passion for the industry.

II. STATUS QUO

Students have used several strategies to distinguish themselves as internship candidates for attractions industry employers: an industry-specific program of academic study, industry oriented extracurricular activities, and participation in industry educational experiences. These options will be briefly discussed in the next sections in relation to the evidence they provide for employers.

A. Formal educational options

Industry-specific education is a valuable approach to screening in many fields. Formal education can provide opportunities to develop knowledge and skills and also evaluate performance ability and encompass it within the GPA academic performance metric. Involvement in a formal academic program also indicates industry-specific motivation. However, despite the attractions industry’s size, diversity, and innovation, postsecondary degree-level education specific to the industry is scarce.

It may seem that the laws of science, technology, engineering, and mathematics are the same regardless of the application domain, but it is beneficial for students to understand about the industry, its state of the art and its practices, constraints, and standards, and in turn to have a credential affirming that understanding. However, there are no established programs of engineering design and technology that offer students industry-specific training. Some engineering and technology projects or single courses are offered, such as the occasional Roller Coaster Dynamics course at Purdue University [27].

Several post-secondary programs focus on operational management of theme parks and attractions. Rosen College of Hospitality Management at University of Central Florida (Orlando, FL) offers a Theme Parks and Attractions track for students of its Bachelor of Science in Hospitality Management. Breda University of Applied Sciences (Breda, Netherlands), offers Attractions and Theme Parks Management as an English-taught baccalaureate programme. San Diego State University's School of Hospitality & Tourism Management offers executive education programs associated with IAAPA. Other programs focus on the design of attractions, such as the Master of Fine Arts (MFA) in Themed Entertainment Design offered at Savannah College of Art and Design (Savannah, GA) and MFA in Themed Experience at University of Central Florida (Orlando, FL). IAAPA Foundation’s Academic Advisory Committee (http://www.iaapa.org/iaapa-foundation) and the newly established Themed Experience and Attractions Academic Society are working to identify post-secondary programs and courses.

B. Post-secondary institution student clubs

Students at an increasing number of universities have formed extracurricular clubs to bridge curriculum and industry interests. Clubs vary in the activities they undertake, choosing locally specific specific combinations of what may be described as “enthusiast” activities, “technology” activities, “production” activities, and “networking” activities. The next sections will elaborate on this activity typology and the potential the various activities offer for participants to acquire work-related knowledge and skills and produce evidence of performance. While all extracurricular clubs show interest and initiative, the activity level and productivity of a club may reflect transient club size and composition more than aptitudes of individual students.

1. Enthusiast activities

Enthusiast activities express members’ appreciation for themed entertainment as a product. Members may visit attractions, invite speakers for “insider” insight about notable attractions projects, and design or simulate whole attractions using various materials including games, toys, software, and artwork. These activities do not provide evidence of work quality for most fields because internship and early-career skill sets do not typically entail concept development and master planning of whole attractions projects except in junior roles and in specific academic fields, rarely engineering. Enthusiast activities can be beneficial to club spirit and membership development, as students with solely enthusiast interests may join along with students with professional aspirations. These projects can demonstrate passion for the industry, and soft skills...
such as teamwork and leadership, if an individual student’s contribution can be discerned.

2. Technology activities

Technology activities learn about and work on projects inspired by industry technologies. These activities can relate students’ academic learning to industry-relevant design and technical applications, through building models of technical systems, using programmable logic controllers to control a scale model of a ride, or constructing a bench-top model of linear induction motor propulsion. Ambitious clubs may design and build models that innovate new systems. The scale of projects is limited compared with full-scale industry projects, but successful projects may be useful evidence of work proficiency if individual contribution can be established. Technology activities may primarily appeal to disciplines related to the activity, so multiple technology activities, or other types of activity, would be needed to sustain an interdisciplinary club. The club may lose momentum on completion of the technology activity, or graduation of the project drivers. Therefore, centering a club on technology activities may hinder recruitment and compromise the club’s long-term viability unless the club establishes a continuity strategy.

3. Production activities

Production activities involve producing a themed attraction. University theme park clubs have produced haunted houses and even dark rides. Like campus theatre productions or fashion shows, producing an attraction for a local audience requires a variety of skill sets. Collaboration among students from multiple disciplines on a common mission provides an opportunity to learn about complementary disciplines and communicate across professions. If a production is produced by students from a single academic discipline, some will be producing work that does not provide evidence of their skills in their own field. As such, there may be limited career benefit to them. Participation in production activities is an opportunity to demonstrate persistence and leadership skills. It may be difficult for clubs to attain the capacity to undertake production activities because the activities require committed space, time, and materials and a sufficient production team size to be successful.

4. Networking activities

Networking activities are those that place the members in proximity of practising professionals to facilitate school-to-career transitions. This may include guest speakers about career topics, mentoring programs, and opportunities for job shadowing. In contrast to guest speakers as an enthusiast activity, networking guest speakers focus on professional development topics rather than behind-the-scenes stories of popular projects. Networking activities provide opportunities to learn and demonstrate soft skills but do not enable evaluation of work skills in technical fields.

C. Industry educational experiences

There are several educational experiences offered through the industry, and this section will briefly refer to three prominent opportunities: educational programs of the Themed Entertainment Association (TEA), programs of IAAPA, and student outreach of ASTM Committee F24.

1. TEA SATE and Summit educational programs

The Themed Entertainment Association (TEA, http://www.teaconnect.org) operates a “NextGen” program and educational conferences and numerous networking events on a global basis (www.teaconnect.org/nextgen). TEA NextGen encourages post-secondary student groups and can often provide speakers for the groups. TEA’s educational programming includes notably the SATE conferences and the TEA Summit (http://www.teaconnect.org/Events-Education). These events feature keynote presentations on emerging trends and case studies of significant projects, many posted on the TEA YouTube channel. While engineering students and young professionals are welcome and do participate, the programs of activities focus on design of storytelling experiences and environments. Technology seminars generally focus on technology as a medium or tool, and not entry-level technical knowledge for engineering and technology professions. SATE attendance is an indicator of interest, but involves no evaluation of learning outcomes or work abilities.

2. IAAPA educational programs

Many students interested in the attractions industry attend an IAAPA Expo: conferences held around the world, the largest of which is held in Orlando, Florida annually in November. Some students participate in the entire three- or four-day duration of the event, while others attend for a day or two. IAAPA offers a Young Professionals program and other educational programming providing knowledge about the industry (http://www.iaapa.org/about-iaapa/membership/join-iaapa/membership-dues/young-professionals). Attendance demonstrates interest and commitment, but involves no evaluation of the student’s abilities or potential.

Students with limited time onsite at IAAPA’s conference will often focus on touring the exhibits with hopes of meeting and impressing exhibitors who might be potential employers. This is often a counterproductive strategy. Although manufacturers and suppliers are interested in future interns and professionals, their goal for IAAPA Expo is to exhibit and sell their products and services. Amidst the physically and mentally demanding schedule of exhibit hours and networking events, most exhibitors have a low capacity for talent acquisition at the conference.

IAAPA also offers a limited number of student opportunities to attend Expos in an unpaid “Ambassador” role. Ambassadors assist participants with directions, scan badges in to education sessions, and similar functions that may provide some exposure and opportunity to meet established professionals and hear expert presentations (http://www.iaapa.org/expos/show-ambassador-program). Ambassadors may receive performance evaluation and professional reference, but Ambassador skill sets align more closely to hospitality roles and less with engineering and technology careers.

3. Committee F24 student outreach

Owner/operators of theme parks and manufacturers and suppliers to the industry regularly meet up under the auspices of
industry organizations including ASTM International Committee F24 on Amusement Rides and Devices. Committee F24 involves professionals in design, manufacture, inspection, maintenance, and operation of amusement rides and devices to develop consensus standards that will ensure safety to personnel and the public [28]. Between formal meetings, professionals also discuss many common interests. Among the common interests in the past 10 years has been the need to develop the “next generation” of engineers. Committee F24 established student information sessions in connection with F24 meetings twice per year. Initially, fewer than 10 students attended, but in recent years, 80 or more students have participated from universities around the world. Committee 24 meetings also offer group sessions with general career advice for students, two group social networking receptions for participants including students, plus a networking luncheon for women including female students.

Students attending F24 meetings have incurred travel expenses and must make up missed work from at least three days of classes to attend the full conference, which indicates strong motivation. Employers also recognize that observing and interacting at these meetings provides exposure to knowledge not taught in academic programs about the thought process of designers and operational considerations, and the specific standards applicable to engineering design of rides and attractions. For these reasons, many interviews are held between hiring managers and internship seekers concurrent with these meetings. Beyond an impression of the student’s interaction, however, employers have no opportunity or mechanism to evaluate students’ learning from this experience or their work abilities.

III. RYERSON INVITATIONAL THRILL DESIGN COMPETITION

A. Origin and overview

Ryerson University, a public university in Toronto, Canada, was established in 1948 and now has a student body of some 40,000 students. The THRILL Lab, which focuses on human factors and amusement attractions, was established in 2001 (www.ryerson.ca/thrill). By 2013, dozens of students from Engineering and other academic programs had worked on lab projects and participated in guided field trips to the Canadian National Exhibition to learn about the structure and mechanisms of mobile amusement rides, attended IAAPA and ASTM F24 meetings, and several students had set personal goals to work in the attractions industry. Early in 2014, it was decided to produce the first Ryerson Invitational Thrill Design Competition (RITDC) to focus primarily on engineering design specific to the attractions industry.

One of the original, broader motives for the competition was to provide a learning experience that emphasized human-centred design, reflecting the author’s expertise as a Professional Engineer specializing in human factors engineering. The attractions industry provided an ideal application domain because effective human-centred design is critical to the attraction industry’s economic welfare, to attract and entertain guests and keep them safe and comfortable. While guest safety is essential, amusement also requires the guest to enjoy the experience. This highlights the important principle that design does not work unless it works for the user. Despite its importance to effective design of products and systems, outside of Industrial Engineering programs, most engineering programs contain little or no curriculum in human factors engineering [29]. A focus on technical function can result in designs that must rely on documentation, labels, and user training to ensure the correct use of the designed equipment. As such, knowledge acquired through the learning experiences of the competition should benefit all engineering students and improve the systems they design, even if ultimately practising in other sectors.

In relation to the attractions industry specifically, the competition intended to prepare students to secure internship opportunities: acquisition of attractions-industry knowledge and skills related to internship and entry-level positions, production of evidence of performance ability, and demonstration of motivation and passion for the industry. As tabulated in Table 1, the structure and scale of the competition has evolved and expanded over its four editions to date, incorporating observation and feedback.

The design challenges are deliberately not a “hackathon” to solve specific real problems. Although each design challenge is contained within a specific case or application as a hypothetical, the challenges simulate design decisions that designers often encounter in their unique projects, and solve in various ways. The challenges are focused, such as rider restraint and containment in a specific context or mechanical design to produce a certain ride action. The challenges, like real design environments, have no predetermined ideal solution, and may have no perfect solution at all. The judges observe how the teams understand the challenge, translate it to a design problem, and approach problem solving, including their consideration of multiple options. Solutions also show their knowledge of the technologies they use in their chosen solutions, and how they adapt to various pressures imposed during the competition. Short preparation time is one notable pressure, with some challenges received only upon arrival, leaving teams 18 to 48 hours to revise or completely solve the challenge. The second pressure is the “twists”, or additional and changed information about a challenge that has been partially prepared ahead. Design professionals confirm that twists are a business reality. While the timeframe of design revision is greatly compressed in the competition, the twists are considerably less extensive than the actual specification changes in real projects.

The competition is also not intended to be a “fantasy camp”, where mechanical engineers would pretend to be business executives planning entire theme parks or art directors choosing set design and themed dining experiences. Instead, challenges were intended to enable demonstration of proficiency with entry-level engineering skills, accentuated with creative ingenuity and insight into the nature of the business. Visual communication, including artistic skills and understanding of the use of storytelling in themed entertainment, enhances an engineering presentation. However, out-of-discipline skills do
<table>
<thead>
<tr>
<th>Feature</th>
<th>RITDC14</th>
<th>RITDC16</th>
<th>RITDC17</th>
<th>RITDC18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Toronto / Canada’s Wonderland</td>
<td>Orlando / Universal Orlando</td>
<td>Orlando / Universal Orlando</td>
<td>Orlando / Universal Orlando</td>
</tr>
<tr>
<td>Days excluding welcome evening</td>
<td>2</td>
<td>2.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Tours and park access</td>
<td>Most of day, 4 spots</td>
<td>Morning tour, 3 spots; 3-day park access pass</td>
<td>Morning tour, 3 spots; 3-day park access pass</td>
<td>Morning tour, 3 spots; 3-day park access pass</td>
</tr>
<tr>
<td>IAAPA Expo</td>
<td>Begins two weeks later, requires separate trip</td>
<td>Begins day after competition; same city</td>
<td>Begins day after competition; same city</td>
<td>Begins day after competition; same city</td>
</tr>
<tr>
<td>Learning opportunity: Access to expert feedback</td>
<td>Students received only own feedback</td>
<td>All teams watched all presentations and received all feedback</td>
<td>All competing teams watched all presentations in same sessions and received all feedback</td>
<td>All competing teams watched all presentations in same sessions and received all feedback</td>
</tr>
<tr>
<td>Learning opportunity: Educational material</td>
<td>Faculty subject matter interpreters on tour</td>
<td>Reading material sent to teams prior to competition</td>
<td>Reading material sent to teams prior to competition</td>
<td>Reading material sent to teams prior to competition</td>
</tr>
<tr>
<td>Evaluation: Internship screening</td>
<td>Internships for winning team and others</td>
<td>Internships allocated on individual basis</td>
<td>HR presentation and internships</td>
<td></td>
</tr>
<tr>
<td>Evaluation: Judges</td>
<td>Assorted industry and affiliated</td>
<td>Sponsor’s internal professionals</td>
<td>Sponsor’s internal professionals + External manufacturers/ suppliers</td>
<td>Sponsor’s Internal professionals + External manufacturers/ suppliers</td>
</tr>
<tr>
<td>Challenges</td>
<td>3</td>
<td>3</td>
<td>8 (one challenge had legacy/ new team variants)</td>
<td>9</td>
</tr>
<tr>
<td>Teams</td>
<td>4 plus one remote</td>
<td>4</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Students</td>
<td>20</td>
<td>24</td>
<td>48</td>
<td>86</td>
</tr>
<tr>
<td>Challenges per team</td>
<td>All 3</td>
<td>All 3</td>
<td>Up to all 8 challenges</td>
<td>Up to 5 of 9 challenges</td>
</tr>
<tr>
<td>Teams per challenge</td>
<td>All</td>
<td>All</td>
<td>Up to all 8 teams</td>
<td>Maximum 8 teams</td>
</tr>
<tr>
<td>Students per team</td>
<td>5</td>
<td>6</td>
<td>Discretionary</td>
<td>Up to 12</td>
</tr>
<tr>
<td>Awards</td>
<td>Per challenge and overall</td>
<td>Per challenge and overall</td>
<td>Per challenge, plus engineering, artistic, overall</td>
<td>Per challenge, plus engineering, artistic, overall</td>
</tr>
<tr>
<td>Tournament points system</td>
<td>Not used</td>
<td>Not used</td>
<td>Introduced, points for all ranks plus opportunity cost supplement</td>
<td>Points for top three ranks, opportunity cost supplement capped at 5</td>
</tr>
<tr>
<td>Challenge topics</td>
<td>Re-imagine classic ride for wider demographic / human centred design of experience</td>
<td>Restraint and containment challenge (prepared in advance)</td>
<td>Restraint and containment challenge (prepared in advance)</td>
<td>Restraint and containment challenge (prepared in advance)</td>
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<td></td>
<td>NoLimits roller coaster model with assigned specifications provided on arrival</td>
<td>NoLimits roller coaster model: assigned specifications and twist on arrival</td>
<td>NoLimits roller coaster model: assigned specifications and twist on arrival</td>
<td>Freehand rendering concept art of assigned emotion, free choice of scene</td>
</tr>
<tr>
<td></td>
<td>Communicate educational benefit for engineering students to learn about attractions design</td>
<td>Re-imagine classic ride for wider demographic</td>
<td>One of Re-imagine classic ride (first time teams only) or Mechanical design challenge</td>
<td>NoLimits roller coaster model: assigned specifications and twist on arrival</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Queue design (environmental storytelling) – prepared + twist</td>
<td>Attraction design challenge (dark ride) – prepared + twist</td>
</tr>
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<td></td>
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<td></td>
<td>Patron behaviour-shaping (human-centred design of experience)</td>
<td>Accessibility and accommodation challenge</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Freehand landscape rendering (concept art of assigned scene)</td>
<td>Mechanical design challenge</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rider accommodation design (accessibility)</td>
<td>Experience design challenge (human-centred design)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Themed land design (layout/capacity and artistic) – prepared with additional specifications on arrival</td>
<td>Retheme existing ride (theme and show)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Reimagine existing land (layout/capacity and artistic design, and business case for area) – prepared with additional specifications on arrival</td>
</tr>
</tbody>
</table>
not replace in-discipline skills as evidence of knowledge and capacity for discipline-specific internships. As the competition evolved and incorporated challenges broader than engineering, it created incentives to build interdisciplinary teams. The following sections describe the evolving form, scope, and scale of the competition, year by year.

B. Year to year evolution

1. RITDC14

RITDC was first held in 2014 onsite at Ryerson University. Initially created as an engineering competition, sponsored by the Faculty of Engineering and Architectural Science and directed by the author, the competition consisted of both partially prepared and impromptu challenges. Participants were required to be full time students from the same university including any affiliated colleges, and it was recommended that teams include engineering students, though no restrictions were imposed on program of study.

Participants arrived for an evening welcome followed by a two-day program. On the first day of the competition, they attended tours at Canada’s Wonderland theme park north of Toronto on a day when the park was closed to the public, but was staffed for the tour, and to prepare for guests later in the day for Hallowe’en haunts. The tours were enhanced by having industry and academic experts present to interpret the technology and experience as groups visited each stop on the tour. Teams then returned to their accommodation to design and prepare their presentations. Two challenges involved designing, one a roller coaster, and the other a human-centred re-imagining of a classic ride. The third challenge was a communication challenge. Competition rules prohibited seeking or receiving any advice or coaching from professionals (including professors, teaching assistants, supervisors from past or current work, or even family).

Four universities attended in person, including two with established theme park design clubs. A fifth club from a U.S. based university presented their solutions remotely over an Internet connection. Diverse judges attended to evaluate the solutions presented on the second day. The first two challenges were judged concurrently by judging panels in separate locations, and teams presented in series and did not see each other’s presentations.

In relation to the competition goals, the competition clearly presented learning opportunities, through tours, learning experiences of the design challenges, and feedback from judges. However, because clubs moved from one judge panel to the next and were working on future presentations in between, students did not have the opportunity to learn from observing presentations from other teams, hearing feedback on other designs, or why specific teams won specific challenges. This format limited knowledge and skills acquisition. Also, the club that presented remotely did not benefit from the learning exposures during the tour and networking.

Attendance could be indicative of motivation to design for themed attractions, particularly for teams that already had an industry-focused club. However, it was not clear that local teams were interested in the attractions industry specifically, more than as a general engineering competition. Several U.S. based clubs actively interested in themed attractions were invited but did not accept the invitation; attending a competition in Canada may have been problematic.

Most significantly, the competition enabled industry judges to directly evaluate presenters’ skills. This advantage was the primary impetus in the next steps with RITDC.

2. RITDC16

In 2015, no competition was organized, as the author as producer/director took sabbatical leave and engaged with the industry in other ways. During this period, Universal Creative™ suggested relocating RITDC to Universal Orlando Resort™. This overture was in the context of established relationships between the author and Universal Creative professionals through IAAPA, ASTM Committee F24, and other mutual interests, and the previous experience of Universal Creative’s executive champion having judged RITDC14. Canada’s Wonderland had provided hospitality, proximity to campus, and Ryerson alumni and seasonal employment connections, but competition scheduling was complicated by seasonal closings and cool temperature for later parts of the Fall semester. Universal Orlando operates year-round with generally more amenable weather in the Fall. Relocating to Orlando made it possible for Orlando-based designer/engineers to participate as judges and also eliminated international travel obstacles for U.S. university clubs. Ryerson Faculty of Engineering and Architectural Science continued to support the administrative aspects of producing the competition.

The most significant benefit to Universal Creative was the opportunity for judges to directly evaluate student ideas and execution. To maximize this benefit, we agreed to schedule the competition consecutively to IAAPA Expo, so more prospective judges would be likely to be in Orlando to attend IAAPA Expo and available to assist with judging. The consecutive schedule also permitted RITDC participants to attend IAAPA Expo without additional airfare, simply incurring additional nights of lodging. IAAPA provided a student-discount code for participants.

RITDC16 maintained the three-challenge format from the original competition. To allow all teams to see all presentations, the schedule was extended a half-day from Thursday arrival/Friday/Saturday (2014) to Friday arrival/ Saturday/Sunday/ Monday morning (2016) with IAAPA Kickoff on Tuesday. Four universities participated, with a total of 24 participants.

One challenge was revealed and prepared entirely in advance so that it would be judged more heavily on presentation and communication skills. One challenge was prepared partially in advance with a “twist” revealed on arrival. A third challenge was revealed after a guided park walk on the morning of Day 1, which provided some foreshadowing of the challenge. All teams participated in all challenges, and were expected to observe all other team presentations and learn from all the feedback.

Judges were not provided with a rubric, and as colleagues of
one another, readily devised rubrics for each challenge based on the prompts provided. For instance, criteria included innovative, effective (solved what was asked), and communication in one challenge, and pitch, story/experience, technical (G-force, restraint, reach envelope, capacity and standards compliance), business, and demographics for another. In at least one case, having set the criteria, judges preferred one solution but determined that another won “on a technicality” based on parsing the specific language of the challenge. Note was taken of the need to anticipate judging in planning the next edition of the competition.

Teams stayed onsite at Universal Orlando Resort™ and did groupwork and presentations at the office meeting space of Universal Creative™ on the two weekend days, with the final challenge presentations at a dining venue at Universal CityWalk™, where the awards banquet was held. Universal Parks & Resorts provided park admissions for participants to return to the park for inspiration and make observations to inform their design work, and following the awards, to appreciate the experience. Universal Creative™ also offered internships to members of the winning team, and some other participants based on performance. Intern placement was significantly aided by senior engineering decision-makers participating as judges, giving feedback, and assessing possible interns during presentations.

The new model met all three major objectives for helping students to become competitive for industry internships: it demonstrated participants’ motivation (by travelling to the competition and undertaking the intense onsite experiences), supported acquisition and development of knowledge and skills (through the guided tour, the challenges themselves, and judges’ feedback), and enabled employers to evaluate performance to the degree that some internships were placed.

It was clear that storytelling and artistic aspects were fun for participants. However, these aspects have a limited benefit for evaluating qualification for engineering internships, as these functions typically fall under the scope of work of other professions. Rather than discourage consideration of these essential parts of themed entertainment design, we decided to encourage interdisciplinary teams for the next edition of the competition.

3. RITDC17

The third edition of the competition returned to Universal Orlando Resort™, with presentations at dining venues in Universal CityWalk™ that were closed to the public during the day. Groups worked on challenges in their suites at the onsite hotel. Participants also had the opportunity to attend a one-hour mixer with several hundred TEA professionals between morning presentations and an afternoon set aside for groupwork. The competition also built in the discounted IAAPA membership and registration to the competition fee, streamlining access to this educational opportunity. Universal Parks & Resorts again provided park admissions for participants for competition research and experience.

The competition expanded in several ways. The program started a day earlier to accommodate a program of eight challenges in which teams could enter three or more. Challenges were expanded to include artistic/creative subjects, and challenges that would benefit from collaboration of technical and artistic disciplines. All of the previous clubs returned. With the participation of new clubs, attendance doubled to eight teams, 48 participants. Teams were required to have at least two members but maximum size was left to teams to determine based on affordability and available participants. The cohort of judges also expanded to include more Universal Creative™ professionals and senior professionals from major manufacturers and suppliers.

As before, one challenge was revealed in advance (one month), some were previewed a week ahead but a “twist” was revealed on arrival, and others were revealed only onsite. In addition, during the challenge reveal period, some reference and reading material related to attractions design was posted for the teams to review. Some readings would make it easier to adjust to the twists or onsite reveals, such as designing to shape rider behaviour, but the relevance of specific readings was not indicated.

The competition co-directors met in advance to develop rubrics for the challenges. Criteria were customized to the challenge. For instance, a challenge prepared entirely in advance had half the points for presentation, and the other half for technical merit (i.e., effectiveness to solve the stated problem and not create new operational problems, safety problems, guest dissatisfaction, or unreasonable costs). A mechanical design challenge was evaluated on technical feasibility of mechanical and structural design, clear documentation, use of appropriate ASTM standards, safety, comfort, and inclusion/accessibility, use of an appropriate theme, well rendered (freehand or digital), and clear presentation including leading alternatives not selected and rationale for choice of final option. A challenge to design a themed attraction queue was evaluated on the design meeting or exceeding the required number of different show elements, feasibility of guest flow through the space, renderings including plan and perspective views representing the design and the theme, and communication of rationales for design choices in a clear and engaging presentation. Criteria were grouped in relation to three tiers of weight, determined by the co-directors. Judges rated each criterion equally, with weights applied after judging, to determine team standing.

With nine challenges to schedule, some challenges were presented concurrently, with a technical challenge in one venue and an artistic challenge in the other. Attendance at all challenges was not mandatory, except that participants entered in a challenge were required to remain in the venue for all presentations, to incentivize learning from feedback on all solutions to the same challenge, and not just their own. Recognizing there was an opportunity cost of having those members unavailable to work elsewhere on other challenges, the number of tournament points reflected both the team’s placement in the challenge and the number of team members present for the full session.

Judges again were complimentary of the experience and exposure to the challenge presentations, and a number of interns were placed with participating companies. Judges did note that...
sessions with all eight teams presenting were the most difficult to evaluate, and recommended that eight presentations per challenge should be the maximum regardless of growth in the overall competition. The criteria were noted to be too structured for the judges. Quantitative rating of each criterion for each presentation prolonged deliberations and more importantly, discouraged judges from raising additional considerations based on their professional experience.

The perceived value to participants was best reflected in the return of all eight 2017 teams for RITDC18. That said, some clubs were less favourable about larger teams being able to enter more challenges and thereby accumulate more points toward Overall Winner. It was intentional to incentivize teams to have interdisciplinary composition when entering interdisciplinary challenges, but it was not intended to reward sheer size of a team. The trophies themselves do not serve any of the program objectives (provide learning, enable evaluation, show motivation) but teams often use trophies to justify their sponsors’ investment in their participation. As such, the “tournament points” system determining trophy allocation needed some adjustment to ensure it was fair.

4. RITDC18

The fourth edition of the competition maintained most features of the third edition, except there was no TEA mixer on the program. The program continued to open with a Thursday evening welcome and conclude with Monday awards luncheon. Universal Parks & Resorts again provided park admissions luncheon. Universal Parks & Resorts again provided park admissions luncheon. Universal Parks & Resorts (operations) professionals were added, and more manufacturer and supplier judges joined. Universal Creative Human Resources professionals presented an educational session to assist prospective interns in their internship search. Reflecting the formal expansion to an interdisciplinary focus, Ryerson International assumed support of the University’s production functions. The competition was mentioned at the ASTM Committee F24 meeting in February and several teams requested invitations, with the result that student participation nearly doubled again, with 86 students (exceeding the target of 80), representing 12 universities, including all legacy teams and four new universities. Team size was capped at 12. (A team expressed interest in sending an entire graduate class cohort but was limited to 12.) The competition filled in June, with additional inquiries added to a waitlist for future editions. At this point, RITDC accounts for 20% of IAAPA student membership growth (Hallenbeck, personal communication).

Nine challenges were offered. As a new policy, the competition allowed a maximum of five challenges per team for several reasons: to implement a maximum of eight teams in any challenge, avoid overloading smaller teams with too many challenges to enjoy their experience, and equalize eligibility for the Overall Winner trophy. Teams preregistered for specific challenges as early as April, based on the professional mix of team members anticipated the following Fall, and challenges were allocated in order of preregistration. When some challenges filled, subsequent teams selected their most preferred among the challenges with space remaining.

In lieu of a rubric, judges received an overview of the intent of each challenge and a description of how long participants have had with the challenge to provide context for the solutions they would see. The judge panel received a set of cards representing the teams entered in the challenge, and an assignment to rank the top three teams. Following all presentations, panels of five or six judges used the cards to deliberate on each design in a holistic way, arranging and rearranging the ordering of the cards as they pointed out commendable aspects and weaknesses of the various solutions until consensus was reached. Judges had lively discussions reflecting the diverse priorities of different stakeholders for each challenge, ranging from technical function, reliable safety, maintainability, and cost justification, to operational implications and effects on guest interactions. The relative importance of “blue sky” innovation versus cost and theoretical hourly ride capacity varied from panel to panel, even for the same judge. The next edition will incorporate those observations into the judges’ briefing to increase consistency.

Tournament points toward the overall champion trophy and the technical and artistic sub-championships were awarded only for the top three placements, and to be fair to smaller teams, opportunity-cost points for members present for the session were capped at five members. Part-way through the competition, some teams asked that these points consider team members in both venues of concurrent presentations. We maintained the announced scheme for the subsequent challenges, but agreed to consider this for the future.

As the challenges diversified, we noticed in this edition several instances where a team’s solution relied on strategies outside the field of training of the members involved. While this can show “out of the box” thinking, it has two limitations. First, without a team member from the other field, the design idea may lack advanced or even basic knowledge needed to fully evaluate the merit of the proposed solution and develop it properly. Second, presenting such a solution does not enable judges to evaluate the capacity of the students in their actual field of training, which is the basis for prospective internships. Note was taken to require teams to ground their designs within the disciplinary context of team members, providing that broader solution sets would be welcome provided the team contained members with the disciplinary expertise applied.

C. Administrative and logistical challenges

The competition continues to adapt and learn from year to year as it encounters various administrative and logistical challenges.

In early editions, some participants gave media interviews following the competition, not only spoiling the substance of specific challenges for future use, but were represented by the media as solving the sponsors’ problems. Students understandably want to celebrate their participation and especially their achievement, particularly to thank their institutional sponsors. Media coverage suggesting that large, sophisticated, and globally recognized operators would turn to undergraduates to solve intractable design or operational problems could create harmful public impressions and
discourage future sponsorship. This has been an opportunity to educate participants about Non-Disclosure Agreements (NDA), ubiquitous in this innovative industry. Media guidelines and information releases are still evolving.

The schedule requiring participants’ absence from regular classes has sometimes been challenging. While we have offered to supervise tests scheduled during the competition, most students have negotiated make-up tests with their professors. However, some participants did not request academic consideration early enough to satisfy their professor, or the professor disapproved of the timing or the duration of the proposed absence. Some have been compelled to return immediately after the awards luncheon, missing the “reward” park time and the IAAPA program. As the availability of judges and indeed the timing of the IAAPA Expo is not flexible, it is not possible to accommodate professors’ suggestions that the competition be held during the mid-year break or reading week. This resistance is not a judgement about the educational value of the competition: a class focusing on themed entertainment sought to enroll the entire cohort in the competition. Professors in unrelated, even adjacent, courses may not share the students’ appreciation for exposure and potential internships in this industry. We are exploring other forms of academic liaison, better documenting the alignment to conventional learning goals.

Following individual institution policies, some teams have sought a breakdown of registration fees to ensure they were not reimbursed for ineligible items, which varied from team to team. In each case, per-person cost excluding ineligible items have exceeded the registration cost net of sponsorships. Although the registration cost is greatly mitigated by sponsorships, teams also incur different amounts of travel expenses per person depending on how far they travel to Orlando, and whether they fly or are close enough to drive, and how much of IAAPA Expo they stay to attend. Students obtain their funding in a variety of ways, including university/ faculty/ program support, student organization support, personal funding, fundraising activities, and even crowdfunding. Some clubs have free latitude to fundraise any way they wish, while others are limited by institutional policies.

Some associates of teams, including family and university faculty/staff, have requested to observe the competition. This has not been permitted, nor is it being considered, for several reasons. The competition outcomes—from trophies to professional opportunities to confidence and clarity of career goals—speak for themselves, so concurrent observation is redundant. Industry partners’ confidence in the integrity of the competition would be compromised by any suggestion that a team’s solution could have been coached by non-participants, particularly professionals. In addition, involvement of associates would complicate fulfillment of the participant agreement covering intellectual property and non-disclosure, and could lead to plagiarism of the competition itself. No teams have indicated that observation is needed for chaperoning.

A complication unique to non-U.S. citizen participants were barriers to internship employment in the U.S. The inclusion of judges from manufacturers and suppliers outside the U.S. has proved to be strategically important, as these exposures expanded internship options.

University staff workload has been allocated to registration and hosting administration such as processing payments and executing contracts for catering and hotel. However, as an extracurricular non-credit initiative, the production and direction of the competition has had no faculty workload allocated to date. Directing the competition has grown considerably from a three-challenge weekend event evaluated concurrently. It is now comparable to a 120-student undergraduate course with over 12 groups undertaking various combinations of nine different group projects and 20 guest lecturers. Much of the production/direction workload comes from designing new challenges each year to allow repeatability, and creation of hypothetical attractions using public-domain themes in which to situate each year’s challenges. Recruiting judges, preparing educational communication for participants, providing evaluation guidance to judges, and liaising with industry partners including the presenting sponsor also demand time and care.

D. “Stopgap curriculum”

The competition is addressed to design teams aiming to work in a multi-disciplinary industry domain. Therefore, it does not aim to fulfill an exclusively “engineering” curriculum. Rather, it has taken its cue from the industry subject-matter experts who have judged or described their design workflow. Favourable evaluations in the competition challenges will require knowledge and understanding of the application domain of themed attractions, both ride and show, considerations of story and entertainment brand, and diverse user characteristics and expectations. Teams are guided to use applicable standards, notably those produced by ASTM Committee F24. However, considerable latitude exists for each student to have an individual learning experience. That said, the competition as described above in section III.A complements engineering accreditation expectations well.

For instance, the ABET student outcomes (for 2019-20 and beyond [30]) are briefly paraphrased to (1) solve engineering problems, (2) apply engineering design to specified needs, (3) communicate effectively to a wide range of audiences, (4) make informed professional judgements with societal implications, (5) function effectively on a team, (6) acquire, interpret, and use data, and (7) learn and apply new knowledge.

In the competition, engineering students must use what they are learning in their home program and demonstrate their previous knowledge and industry-specific learning not to a course professor but to industry experts, including highly qualified engineers alongside other professions with whom engineers must engage effectively as collaborators and clients.

Effective communication is a central requirement. Each challenge is presented to judges. Communication includes oral presentation and interaction with judge questions, production of calculations and design drawings, FMEA analysis, animations, and other renderings.

The competition also requires teamwork, among engineers and between engineers and other disciplines. Teamwork is
unavoidable under the competition’s intentional time pressures, and it is readily evident to judges and to other teams how effective teamwork has been. Some teams do their groupwork in “food court” space at the competition hotel, and teams can often observe other group dynamics from a distance. Both the insight into the process and the observation of the results provide a learning experience for those teams that have struggled.

Obviously, based on its name, the competition particularly emphasizes design. Engineering design has become a critical part of accredited engineering curricula, with Canadian universities requiring no less than 225 academic units (each unit is one lecture hour or 2 lab hours) in engineering design. “Engineering design integrates mathematics, natural sciences, engineering sciences, and complementary studies in order to develop elements, systems, and processes to meet specific needs. It is a creative, iterative, and open-ended process, subject to constraints which may be governed by standards or legislation to varying degrees depending upon the discipline. These constraints may also relate to economic, health, safety, environmental, societal or other interdisciplinary factors. (3.4.4.3)” The Canadian Engineering Accreditation Board (CEAB) goes on to require a significant design experience, preferably involving teamwork (3.4.4.4). [31] ABET likewise requires graduate competence in design, defined as “identifying opportunities, developing requirements, performing analysis and synthesis, generating multiple solutions, evaluating solutions against requirements, considering risks, and making trade-offs, for the purpose of obtaining a high-quality solution under the given circumstances.” [30]

The competition challenges are realistic and complex, as are many real design environments. Teams must define requirements, consider multiple solutions, and make trade-offs.

Unlike formal university courses assigning individual marks, competition participants are not evaluated individually. Judges and prospective internship hosts may evaluate individual abilities through each student’s role in team presentations.

E. Future plans

At the time of writing, preregistration for the 2019 competition is open by invitation. Capacity has been set at 120 participants and by the beginning of April 2019, preregistration reached 98 participants from 13 teams. The competition will include eight challenges from which teams may enter four, with a maximum of eight teams per challenge. Challenges will again be allocated by team preference, in the order of preregistration. Team size will be limited to nine students, with participants from any one discipline capped at six, to encourage clubs to develop interdisciplinary collaborations on campus.

We continue to explore the best way to support and streamline the task of judges, as they contribute their expertise largely on the weekends. The objective is to facilitate their deliberations and use of their professional expertise, without overly structuring them and having a presentation winning “on a technicality”. Ranking the top three presentations proved easier than ranking all presentations, but there are still “colourful” deliberations. It is unclear that a rubric could not anticipate it. Judges need to understand the intention and goal of each challenge and the implied design requirements, without a rubric that could unintentionally constrain the use of judges’ professional insights. Judges appear to enjoy the experience and interactions within the panels. Many judges have asked to return, and other professionals have expressed interest in joining.

While some educational preparation material has been sent to teams ahead of the competition, teams’ use of and benefit from the material has not been evaluated. A more systematic plan and evaluation of this element will be considered. We also are undertaking surveys of student experience, initially with team surveys, and plan a survey of individual “alumni”.

IV. DISCUSSION

RITDC has grown exponentially with the support of industry sponsors. Through participation growth and scope expansion, the competition maintained a focus on specific entry-level professional skills in a unique industry by adopting an interdisciplinary structure. Realistic, focused challenges showcase real skill expectations for entry level professionals and interns, not just technical skills and knowledge but also interdisciplinary collaboration, time management, creative agility, and presentation. Judges from Universal Creative and its partner companies take an avid interest in how teams adjust to time pressures, approach problem definition, make trade-offs, and present their proposals. The invitation from Universal Creative™ to hold the competition at their location and their ongoing presentation of the competition enabled exponential growth, access to world-class facilities and expert judges, and a network of internship opportunities not only at Universal Creative™ but at associated manufacturers and suppliers. Competition alumni have taken internships and graduate employment in the attractions industry.

The competition has been successful at its chief objectives, specifically providing knowledge to participants about the attractions industry that is difficult to acquire through formal post-secondary curricula, enabling students to show evidence of their skills in relation to their fitness for entry-level positions or internships, and verifying students’ motivation and commitment to industry opportunities. As the competition evolved, it offered a roster of diverse challenges that enabled teams to enter challenges matching the skill set and disciplinary specialization of their team members, from single-discipline focused to multidisciplinary. Judges were able to assess communication skills, poise, and group dynamics through the presentations and other interactions during the competition. The characteristics of challenges, including time pressures and changing requirements, was perceived by sponsors and judges to be a realistic simulation of pressures expected in professional work.

The competition continues to adapt and learn from year to year as it encounters various challenges, ranging from participant disclosures and media, logistics of academic absence and institutional oversight, challenges for teams to cover their costs, barriers to internship opportunities, and growing workload for production and direction of the competition. Through this evolution, the partners remain committed to sustaining and
exploring the potential of the competition, whether it remains “stopgap curriculum” or transitions to formal curriculum.

The durability of the industry partnerships indicates that the success of the competition is authentic. The competition is now discussed among industry professionals as valid evidence of motivation, industry awareness, and some ability. The authenticity is further validated by the appreciation of the competition by students in attractions programs or courses.

The competition has been seen as a form of stopgap curriculum, providing a learning experience to compensate for formal attractions industry education that is otherwise scarce, particularly in technical disciplines, but it is largely complementary to engineering accreditation expectations. Further evaluation is needed to understand whether participants experience it as a quasi-curricular activity or merely as an audition for internships.

ACKNOWLEDGMENTS

The competition was initiated thanks to support of Ryerson University Faculty of Engineering and Architectural Science (FEAS) under Interim Dean Dr. Sri Krishnan. FEAS Director Zohair Khan provided multi-year administrative support, ably succeeded by Ryerson International Student Mobility Officer Amie Shipman-Gervais. Universal Creative Senior Vice President Engineering and Safety Steve Blum has been the executive champion and sponsor. The late Dr. Paula Stenzler, Senior Director, Engineering and Safety, Universal Creative, co-directed the challenges and judged the second and third competitions and her leadership is honoured with a challenge trophy in her name. The competition’s execution and growth would not have been possible without superlative co-production by Universal Parks and Resorts Senior Director of Global Operations, Standards & Harmonization John Riggleman and his staff.

REFERENCES


