

# Autonomous Snowplow Competition



**ION North Star Section  
Outreach Program**

**Autonomous Snowplow Committee**



**Competition Kickoff Meeting Presentation  
2014 Competition**

**16 October 2013**

# Meeting Agenda

- Introductions
  - Autonomous Snowplow Competition Committee Members
  - 2014 Competitors
- Venue
  - Saint Paul Winter Carnival
  - Student Final Presentations
    - Science Museum of Minnesota
  - Snowfield Surface
- Sponsors
- Preliminary Design Review Discussion
- Team Questions

# Contact List

## Committee Contacts

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# 2013-2014 Competitors



## School Name

## Team Name

Case Western Reserve University

“CWRUplower II”

Dunwoody College of Technology & University of Minnesota

“Snow Devils 0100<sub>2</sub>”

Iowa State University

“Robotics Club Snowplow”

Miami University

“Red Blade”

North Dakota State University

“T.H.U.N.D.A.R.”

University of Michigan - Dearborn

“Yeti”  
“Geili 3.0”  
“Zenith”

# Competition Venue

- The Saint Paul Winter Carnival
  - Rice Park, Downtown Saint Paul
    - Gain lots of media attention
    - 350,000 visitors per year
  - 23-26 January 2014
    - 2014 is 128<sup>th</sup> year anniversary of Carnival
  - Rosanne Bump
    - New CEO & President, St. Paul Festival and Heritage Foundation
    - Expect all Competition operations to remain the same and go smoothly



# Student Presentation Venue

- This year the Student Final Presentations will be held at:

- Science Museum of Minnesota

- 120 W. Kellogg Blvd.  
Saint Paul, MN 55102



**Science  
Museum**  
of Minnesota®



- Last year, the Student Final Presentations were held at the Landmark Center

- Nice venue, and can be used as a “warming” facility during the event

- Students are encouraged to visit the Science Museum as an attraction

- Museum is very close to the Competition site

# Competition Time Line

- Sep 2013 – Application Forms Due  
(ION National office requests outstanding items to be provided soon)
- Nov 2013 – Competition Preliminary Design Review  
(Saturday, 9 November 2013 – is this ok date for all?)
- Dec 2013 – Review status with teams (trip planning, etc.)
- Jan 2014 – Fourth Year of Competition  
Final Presentations, Vehicle Qualifications, &  
Snowplow Competitions

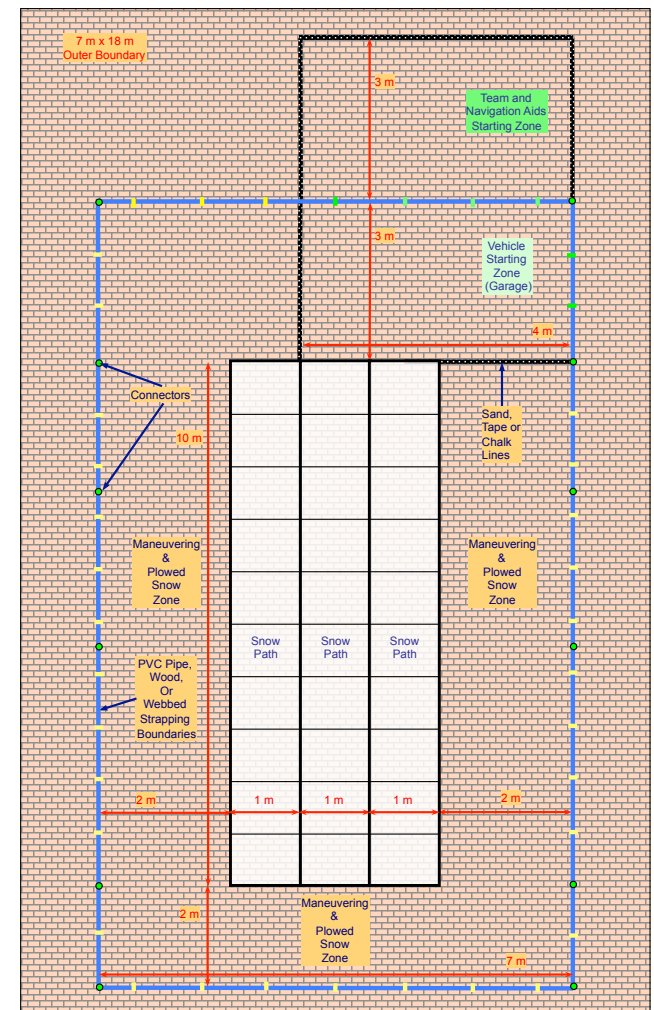
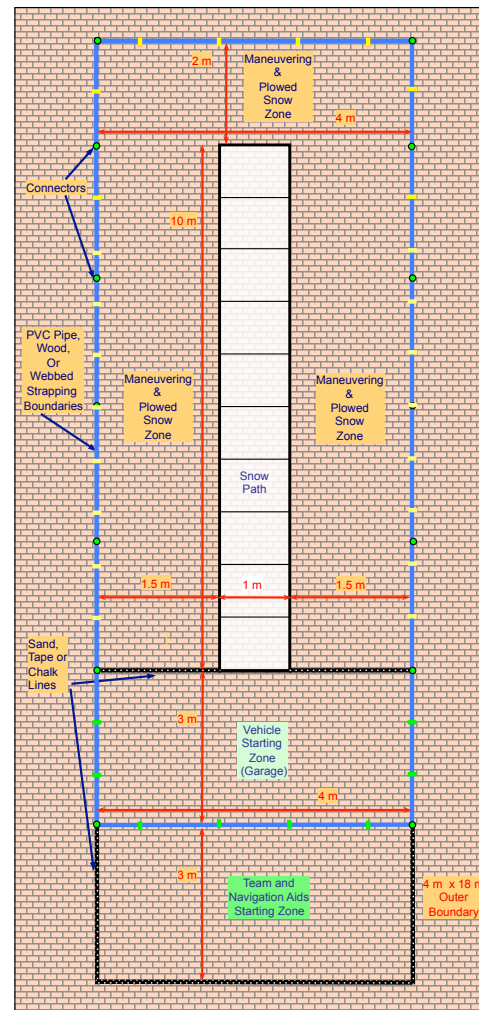
# Competition Rules

- Rulebook completed and available to teams
  - [www.autosnowplow.com](http://www.autosnowplow.com)

- Challenging competition
  - Vehicle Garage
  - Team Starting Zone
  - Post within Field

- Two competition snowfields
  - Single Straight "I"
  - Triple Straight "I"

- Single Straight "I"
  - 1-m width path
- Triple Straight "I"
  - Three 1-m width paths





# Competition Site

Downtown Saint Paul, MN

Landmark Center

Ice Rink

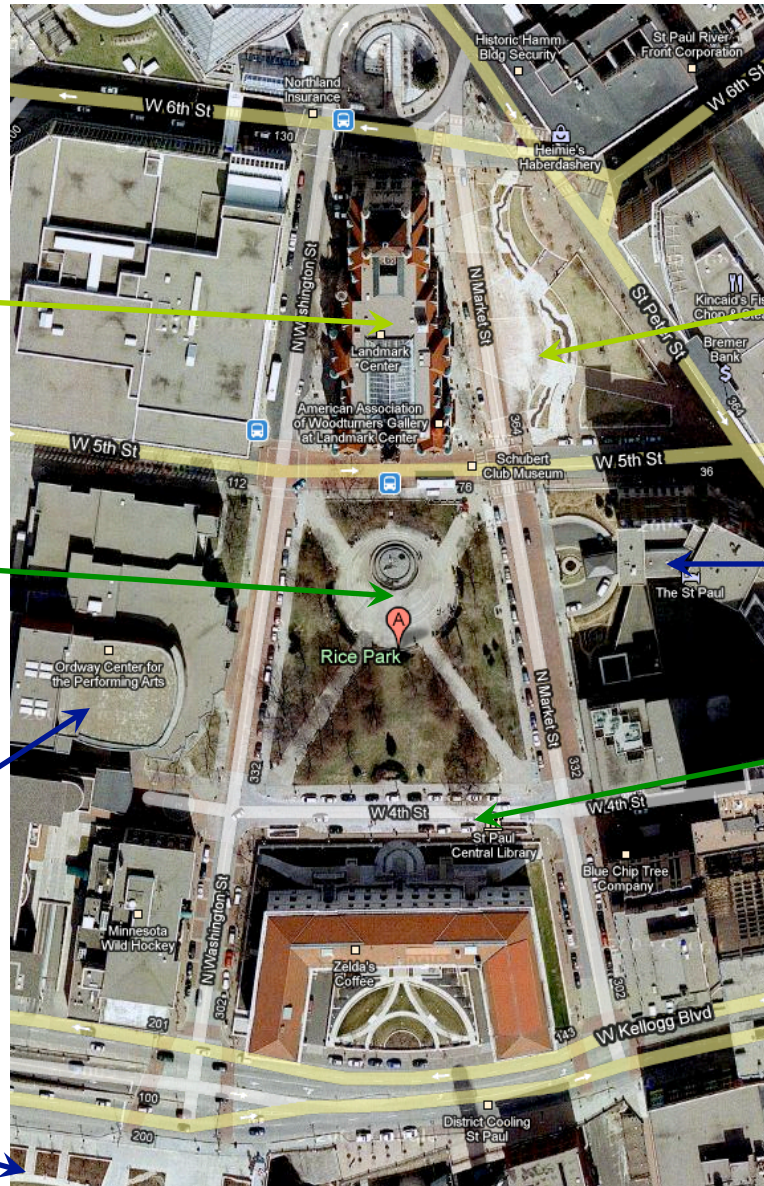
Rice Park

The St Paul Hotel

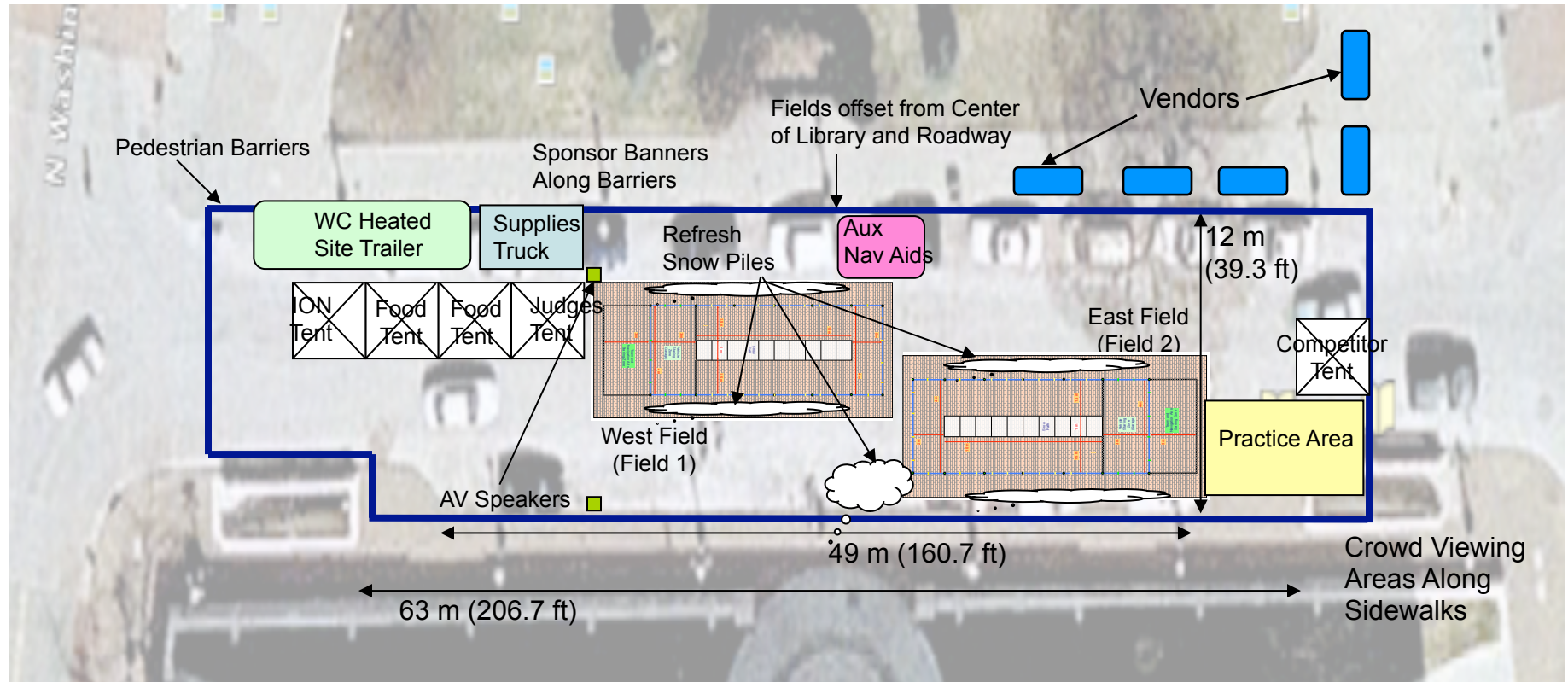
Ordway Center

W 4th Street

Science Museum



# Competition Site: Layout



- Competition site: two snowfields set up directly on road, W 4th St, Saint Paul, MN
- Barriers installed to stop crowds from entering competition areas
- Vendors close to draw in viewers
- Viewers can stand and watch all along barriers and steps of Central Library
- Practice area: available for all teams
- Snow filled trucks: for fresh snowfield set up



# Fake Snow

- Issue of how to test the vehicles in labs
  - How to test year round and in warm climates?
- Solution: Fake Movie Snow!!
  - Fairly inexpensive and does not melt!
  - Need to compare consistency to real snow
- Real snow used for competition



<http://www.stevespanglerscience.com/product/1262>



<http://www.discoverthis.com/super-snow.html>



<http://www.amazon.com/Be-Amazing-Toys-4100-Blizzard/>

# Competition Procedures

- Competition Run and Set up Time
  - Single 20-minute run for each team
  - Teams may set up navigation systems as needed, but set up time is included as part of the 20-minute run
- Variable Snow Depth
  - Snow depth can vary between 5 and 10 cm along the snow path for either snowfield
- No After-Hours Operations within Competition Area
  - Due to insurance and safety, as well as snowfield protection

# Competition Procedures

- Garage
  - Starting position for vehicle
  - Any portion of vehicle must return to garage at end of run, otherwise lose points
- Starting Zone
  - All team members must start within this Zone at beginning of run before any navigation aids are placed
- Fast Completion
  - Extra points for clearing snow from the snow paths in under 20 minutes
- No items can be dropped/expelled from vehicle in any direction
  - No sand, water, fire, etc.
  - Keeps snowfield playing field surface the same for all teams

# Changes for 2014

- Simulated Posts
  - Simulates a tree or parking meter near or on the snow path
  - One post randomly placed outside of field snow path but within the field boundaries
    - No points lost for hitting this post outside of snow
    - But should be avoided in case it topples over and cause issues
  - One post randomly placed in 1-m<sup>2</sup> square of snow path
    - Points lost (10%) if vehicle hits, moves, or topples over this post
      - However, snow can “hit” post without losing points
    - Snow “void” surrounding post, so vehicle does not need to plow right against post
    - First competition “obstacle”
- Presentations and Reports
  - Judges would like to see new content each year
    - Please don't recycle last year's report or presentation, or judges will deduct points up to 10%
  - Teams will be asked to describe year-over-year changes and their biggest design challenges

# Sponsorship

- Current Sponsors

- ION Satellite Division
- Lockheed Martin, Inc.
- ASTER Labs, Inc.
- Honeywell Inc.
- Space Exploration Technologies Corp.
- The Toro Company
- Alliant Techsystems, Inc.
- U.S. Bancorp
- Proto Labs, Inc.
- Nuts & Volts, Servo Magazine



- Always looking for additional sponsors & funding!!



# Competition Scoring

Category	Scoring (%)
PDR Presentation	5
Final Presentation	10
Final Report	10
Single "I"-Shaped Snow Path	25
Triple "I"-Shaped Snow Path	<u>50</u>
<b>Total Competition Points</b>	<b>100</b>



# PDR Presentation

- PDR presentation day: 9 November 2013 (Saturday)
  - Presentation medium: conference call & screen sharing
- PDR presentation slides held in confidence until the end of competition
  - All Team materials may be eventually made public
- PDR presentation slides submission deadline: Final Version
  - 9:00 PM (Central); 7 November 2013 (Thursday)
  - Email submission to Vibhor and Suneel:  
[vibhor.bageshwar@honeywell.com](mailto:vibhor.bageshwar@honeywell.com) & [sheikh@asterlabs.com](mailto:sheikh@asterlabs.com)
    - Please submit a PDF version of the presentation to minimize file size
  - CD submission (not necessary if you email the presentation slides)

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55422



# Team Questions

- Any Questions?
- General Discussion



# Backup Slides



# Introduction

- Goal: Design an Engineering-based Outreach student competition
  - Specific to Guidance, Navigation, and Control (GNC) technology
- Modeled after ION Robotic Lawn Mower Competition
  - Complementary competitions
    - Similar vehicles, sensors, and goals
    - Different seasons
- Take a *winter-approach* to the competition
  - Choose snow-blowing/snow-plowing, instead of lawn-mowing,
  - Winter is a potentially a tougher scenario
    - Less fixed visual cues
      - Covered with snow (pure white)
      - Blowing snow (visibility poor)
    - Changing visual cues
      - Snow drifts change from day to day
    - Harsher environment
      - Cold effects sensors performance
      - Reduced lighting
    - Control challenges
      - Must redirect new snow away from old high snow drifts



# Motivation

- Public Outreach
  - Significant publicity and visibility of ION and its members to a new area
  - Promote ION's talents and capabilities to large public audience
- Technology Potential
  - Minnesota Department Of Transportation: Snowplow safety systems
  - Minneapolis Airport Commission and FAA: Automated runway clearing
  - University of Minnesota: Driver-assisted bus and Alaskan highway snowplows
- Encourage growth within ION North Star Section
  - Competition provides a large, local project to which members can immediately contribute towards
- Large public venue
  - St. Paul Winter Carnival (January in MN ... refreshing!)
- Encourage participation in all three ION competitions
  - Mini-Urban Challenge : High School-Level students
  - Robotic Lawn Mower : Spring Event, College-Level students
  - Autonomous Snowplow : Winter Event, College-Level students + public
- Encourage industry sponsorship
  - Mentorship and Judging competition opportunities
  - Meet competent, highly-motivated potential employees



# Plowing versus Blowing

- **Snow Plow**

- Move snow from one area to another along the ground



Hand Plow



Wheeled Plows



Yuki-Taro Autonomous Snow Plow Robot



RC Plow

- **Snow Blow**

- Eject snow from one area to another through air



Hand-Wheeled Blowers



Heavy Wheeled Blowers