

# Autonomous Snowplow Competition



**ION North Star Section  
Outreach Program**

**Autonomous Snowplow Committee**



**Competition Kickoff Meeting Presentation  
2013 Competition**

**3 October 2012**

# Meeting Agenda

- Introductions
  - Autonomous Snowplow Competition Committee Members
  - 2013 Competitors
- Venue
  - Saint Paul Winter Carnival
  - Student Final Presentations
  - Snowfield Surface
- Sponsors
- Preliminary Design Review Discussion
- Team Questions



# Contact List

## Committee Contacts

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Marketing Director  
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# 2012-2013 Competitors

	<u>School Name</u>	<u>Team Name</u>
	University of Minnesota	"Blizzard Buster 2"
	Dunwoody College of Technology	"Snow Devil 0011 <sub>2</sub> "
	Ohio University	"M.A.C.S."
	Miami University	"Red Blade"
	North Dakota State University	"Albino Bison"
	Iowa State University	"SnowClone"
	University of Michigan - Dearborn	3 Teams!

# Competition Venue

- The Saint Paul Winter Carnival
  - Rice Park, Downtown Saint Paul
    - Gain lots of media attention
    - 350,000 visitors per year
  - 24-27 January 2013
    - 2013 is 127<sup>th</sup> year anniversary of Carnival
  - Beth Pinkney
    - CEO & President, St. Paul Festival and Heritage Foundation
    - This is Beth's last year as CEO
      - She and her team have been incredibly helpful and generous over the years



# Student Presentation Venue

- This year the Student Final Presentations will be held at:
  - Landmark Center of Minnesota
    - 75 West 5<sup>th</sup> Street
    - Saint Paul, MN 55102

LANDMARK  
C E N T E R



- In past years, this event was held at the Science Museum of Minnesota
  - However, a kitchen remodel is planned for the same time as our event
  - Will likely return to Science Museum in following years
- Students will still be encouraged to visit the Science Museum as an attraction
  - Museum is very close to our field

# Competition Time Line

- Sep 2012 – Application Forms Due  
(thanks for getting them in on time!)
- Oct 2012 – Competition Preliminary Design Review  
(Saturday, 20 October 2012)
- Nov 2012 – Review status with teams (trip planning, etc.)
- Jan 2013 – Third Year of Competition  
Final Presentations, Vehicle Qualifications, &  
Snowplow Competitions

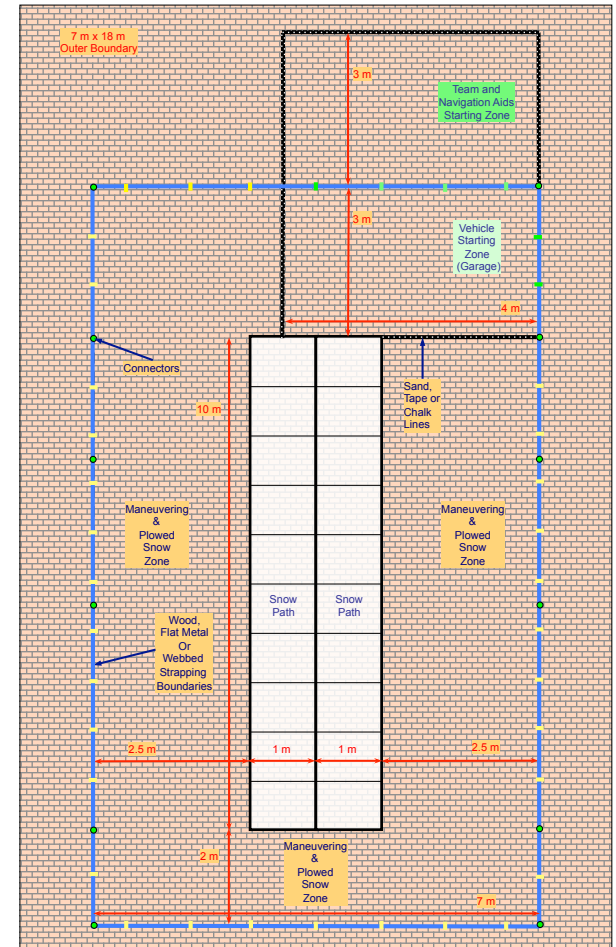
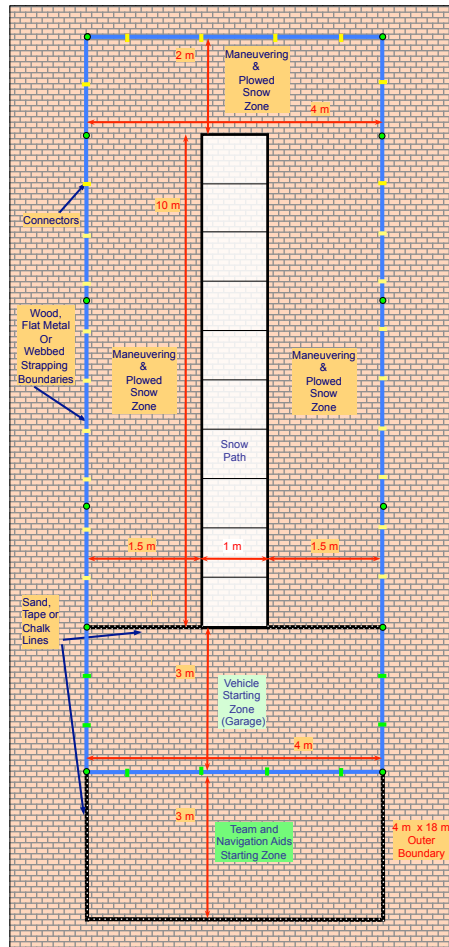


# Contest Rules

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

- A challenging contest
  - Garage
  - Starting Zone

- Two snowfields to plow
  - Single Straight "I"
  - Double Straight "I"
  - 1-m width paths





# Competition Site

Downtown Saint Paul, MN

Landmark Center

Ice Rink

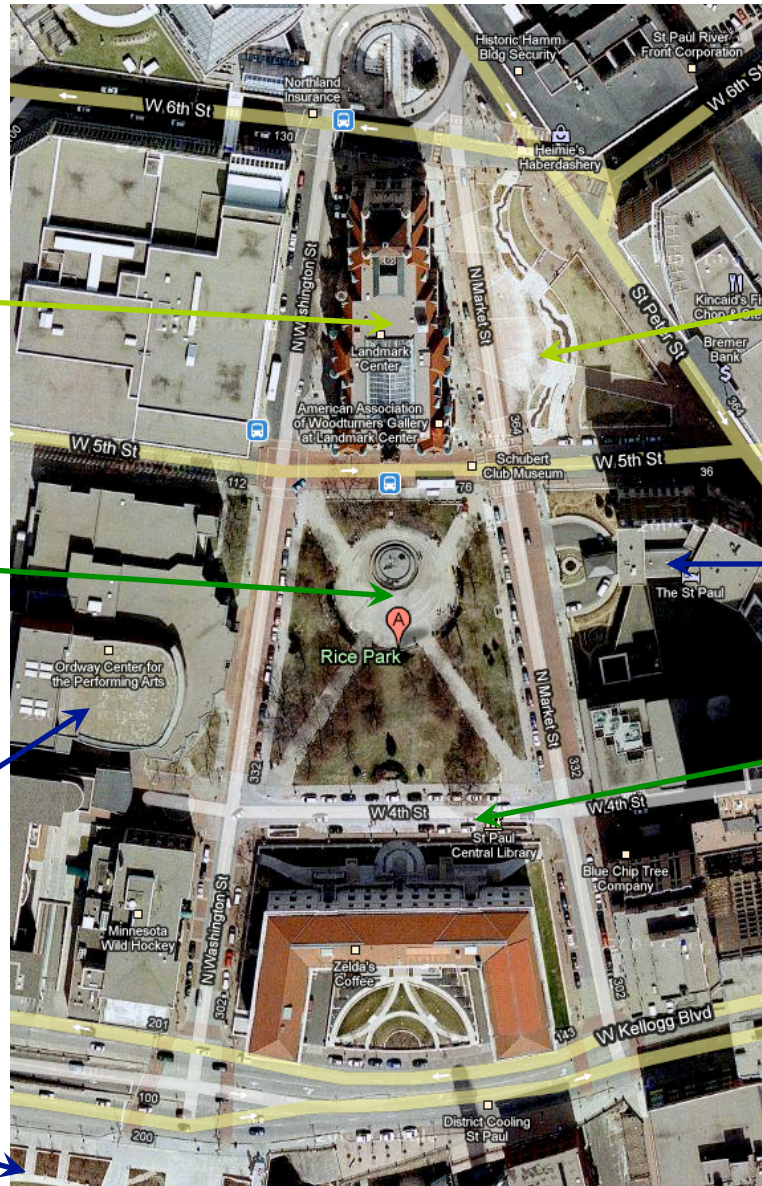
Rice Park

The St Paul Hotel

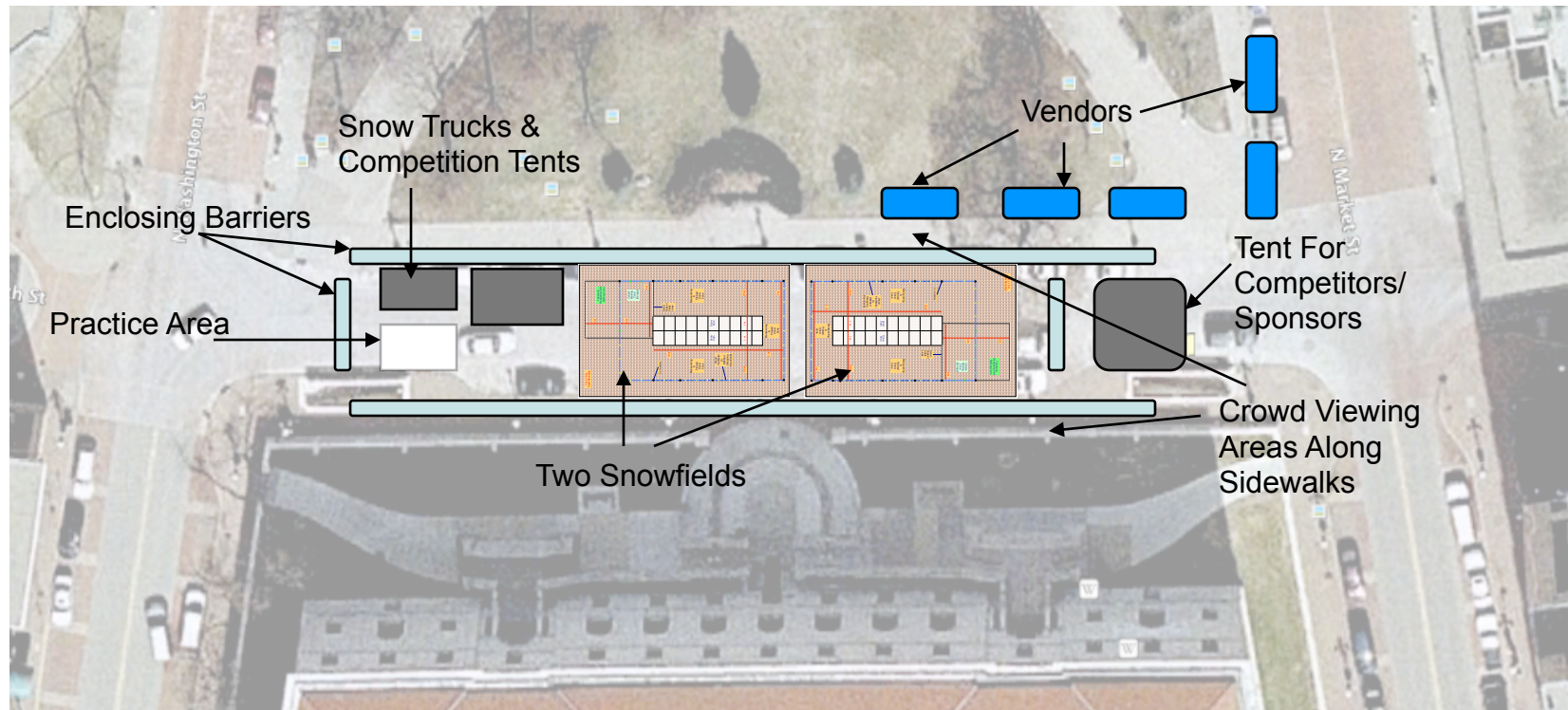
Ordway Center

W 4th Street

Science Museum



# Saint Paul Road Use



- 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 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>

The screenshot shows the product page for 'Super Snow 1lb' on the Discover This website. The page includes a navigation bar with 'Discover This' logo and 'Educational Science Kits & Toys'. A search bar and a 'Gift Certificates via email!' button are visible. The main content area features a product image of a bag of Super Snow, a price table showing a sale from \$19.99 to \$14.99 (25% off), and a 'Add to cart' button. Below the price table is a 'DESCRIPTION' section explaining that the snow is made from a polymer that expands 100 times its size when mixed with water. A 'CUSTOMER PRODUCT REVIEWS' section is also present. The page footer includes contact information for Steve Spangler Science, Inc. and various logos for retail partners like Amazon, eBay, and Walmart.

From the Spangler Science Labs  
www.SteveSpanglerScience.com  
<http://www.stevespanglerscience.com/product/1581>

**Insta Snow - Makes 4 Gallons**  
Just add water to Instant Snow and create an eruption of fluffy snow.

**Insta-Snow™ POWDER**  
Blue Slope Size - Insta-Snow  
Item #: WSNO-625 In Stock  
**\$14.95**

**LOWEST PRICE!** Just add water to Insta-Snow, the Instant Snow powder, to create an eruption of snow! This is what we call the Blue Slope or Beginner size. Once you buy the 225 gram Blue Slope size, you'll be returning to buy more. Makes roughly 4 gallons of fluffy white snow. Includes mixing instructions, science explanation and measuring scoop that guarantees a perfect batch every time.

Mix contents with 5.5 quarts of water to make approximately 4 gallons of snow.  
Coverage area: 14' x 20' x 4"

Don't be fooled by imitations! Steve Spangler's Instant Snow was recently featured on the Tonight Show, Live with Regis and Kelly, The Today Show, ABC's Good Morning America, The CBS Morning Show.

See the video of Steve Spangler demonstrating Insta Snow, the original Instant Snow powder.

See All Insta-Snow Products

**What's included?**

225 grams of Instant Snow powder, measuring scoop and an activity guide.

[Insta-Snow Frequently Asked Questions](#)

[Cool Ideas for Using Insta-Snow](#)

**How does it work?**

Instant Snow is an amazing superabsorbent polymer that turns ordinary water into a white fluffy substance that looks like real snow! Add a little water and your Insta Snow expands to 100 times its original size. Go ahead, spread it around, it's fluffy and light like real snow! When the party's over, just store it and use it again.

**What does it teach?**

Explore the ever-changing science of polymers as students experiment with Instant Snow. Each Insta-Snow product comes with an activity guide with suggestions for science fair projects, classroom demonstrations, experiment ideas, and fun ways to explore the science of polymers. Insta-Snow, the original Instant Snow, is an amazing polymer that turns ordinary water into a white fluffy substance that looks

# Changes for 2013

- Run and Set up Time
  - Single 20-minute run for entire 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 in depth along the snowpath for either snowfields
- Simulated Posts
  - Simulates a tree or parking meter near the snowpath
  - Two (2) randomly placed this year
- No After-Hours Operations within Competition Area
  - Due to insurance and safety, as well as snowfield protection

# Changes for 2013

- Garage
  - Starting position for vehicle
  - Vehicle to 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 snowpaths 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 even for all teams

# 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
- Always looking for additional sponsors & funding!!



[www.toro.com](http://www.toro.com)



# PDR Presentation Rules

- PDR presentation slides must follow the provided outline
  - Standardize judging for all Teams
- PDR presentation slides held in confidence until the end of competition
  - All Team materials eventually made public
- PDR presentation slides submission deadline: final version
  - 9:00 PM (Central); 18 October 2012 (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)

Dr. Vibhor Bageshwar  
1985 Douglas Drive  
MN10-122B  
Golden Valley, MN  
55422

# PDR Presentation Rules

- PDR presentation day: 20 October 2012 (Saturday)
  - Presentation medium: conference call
  - ASC Committee will call each Team 2 minutes before your PDR presentation time
  - Teams provide a call-in number by 15 October 2012
    - Email call-in number: [vibhor.bageshwar@honeywell.com](mailto:vibhor.bageshwar@honeywell.com)
- PDR presentation time: each Team is allotted 25 minutes
  - Teams provide their 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> choices of time slots starting 15 October 2012 (please see slide 22)
    - Email time selections: [vibhor.bageshwar@honeywell.com](mailto:vibhor.bageshwar@honeywell.com)
    - ASC Committee will make every effort to assign Teams with their first choice
  - First Team presentation begins on 20 October 2012 at 9:00 AM (Central)
  - Presentation time: 20 minutes maximum
  - Q&A time: 5 minutes maximum



# PDR Presentation Rules

- Team scoring and reviews
  - Team scoring and reviews will be returned to Team contacts:  
10 November 2012
  - Team standings will be updated on website in November 2012
    - [www.autosnowplow.com](http://www.autosnowplow.com)

# PDR Presentation Outline

- Title Slide (1 slide)
  - Team university/name/logo
- Objectives (1 slide)
  - Team objectives
  - Snowplow vehicle plowing strategy (1 pass or multiple passes)
  - Team composition
- Snowplow Vehicle Program Top-Level Requirements (1 slide)
  - Table format
  - ASC Committee hint: a requirement is a metric that indicates when a design satisfies an objective
    - Ex: Navigation system position accuracy: 0.25 m

# PDR Presentation Outline

- Snowplow Vehicle Description (please follow the given order)
  - Concept/Plowing strategy (1 slide)
  - Snowplow vehicle design (minimum 1 slide)
    - Snowplow vehicle and blade design
    - Snowplow vehicle physical dimensions
    - Sensor and processor component housing
  - Navigation system design (minimum 1 slide)
    - Concept
    - Sensors
    - Navigation augmentation system
      - Placement of navigation aids in competition field
  - Guidance system design (if applicable) (minimum 1 slide)
    - Way-point selection concept
  - Control system design (minimum 1 slide)
    - Concept and available actuators
    - Bandwidth and actuator response speed
  - Processor and Software design (minimum 1 slide)
    - Timing and action sequence flowchart

# PDR Presentation Outline

- Safety System (1 slide)
  - System description
  - Emergency shut-off options
    - Physical and remote
  - Stopping distance from maximum speed
    - Identify surface
- Failure Modes and Recovery Actions (1 slide)
  - Identify failure mode and recovery actions
  - Table format
- Overall Risk Assessment Summary (1 slide)
  - Evaluate each subsystem
  - Identify known issues
  - Table format

# PDR Presentation Outline

- Commercialization and Implementation (2 slides)
  - Identify components and their cost
  - Identify snowplow vehicle and navigation aid cost for sale to the general consumer
    - ASC Committee hint: convey cost to a consumer buying the product at the local hardware store
  - Identify steps consumers would follow to set-up the snowplow vehicle and navigation aids in an operating environment
    - Operating environment example: garage and driveway
  - Identify time to set-up the snowplow vehicle and navigation aids in an operating environment
    - ASC Committee hint: convey the ease or difficulty the consumer would encounter setting up the snowplow vehicle and navigation aids
  - Table format

# PDR Presentation Schedule

Team	Presentation Time (Central)
	9:00 AM
	9:30 AM
	10:00 AM
	10:45 AM
	11:15 AM
	11:45 AM
	12:30 PM
	1:00 PM
	1:30 PM



# PDR Scoring

- PDR Presentation Scoring: 5% of total Competition Score

Category	Scoring
Quality of Presentation Slides & Technical Presentation	80
Ability to Engage Audience	<u>20</u>
<b>Total Points</b>	<b>100</b>

# 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



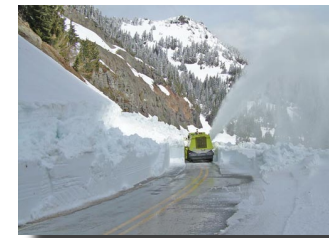
RC Plow

- **Snow Blow**

- Eject snow from one area to another through air



Hand-Wheeled Blowers



Heavy Wheeled Blowers