Team Silver
2.009 Final Presentation
December 7, 2009
Driven car without removing all ice?

Data collected through online survey of 400 drivers over 18

**Motivation**

**Time to clear ice**
- 49% 5-10 min
- 42% <5 min
- 9% 10-20 min

**Driven car without removing all ice?**
- 73% Yes
- 27% No

Introduction
# Design Targets

<table>
<thead>
<tr>
<th>User Need</th>
<th>Performance Goals</th>
<th>Technical Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficient</td>
<td>Clear windshield in less than 5 min</td>
<td>Effective ice chipping mechanism</td>
</tr>
<tr>
<td></td>
<td>Minimal applied force at grips</td>
<td></td>
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<tr>
<td>Comfortable</td>
<td>Handle diameter and length</td>
<td>Ergonomics and compact design</td>
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<tr>
<td></td>
<td>Reach distance over 2 feet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lightweight (less than 5 lbs)</td>
<td></td>
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<tr>
<td>Durable</td>
<td>Functional in cold weather</td>
<td>Electronics and friction</td>
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<tr>
<td></td>
<td>Minimal component wear</td>
<td></td>
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</tbody>
</table>
Slow Motion Video

Blade in Action
Slow Motion Video
Blade in Action
Eccentric Drive
Eccentric Drive
Eccentric Drive

motor

miter gears
Eccentric Drive

- Motor
- Miter gears
- Eccentric cam
Eccentric Drive

- Motor
- Eccentric cam
- Miter gears
- Axial follower
- Blade
- Positive return
- .045” throw
Actuation Simulation
Powering IceTek

Lithium NanoPhosphate Chemistry

- Excellent cold weather performance
- High energy density: 20 minutes of use
- Safe, eco-friendly
- Lightweight
- Tradeoff: cost

Batteries

26650
A123
LiFePO₄
Cell

26650
A123
LiFePO₄
Cell

Technical
Powering IceTek

Lithium NanoPhosphate Chemistry

Excellent cold weather performance
High energy density: 20 minutes of use
Safe, eco-friendly
Lightweight
Tradeoff: cost

Car Jack → Charging Circuit → Charge Signal
12-14V

Technical
Form Development
Form Development

Anthropometric database
NASA
Form Development

Anthropometric database
NASA

Hand tool ergonomics
Canadian Centre for Occupational Health and Safety
Form Development

Anthropometric database
NASA

Hand tool ergonomics
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User testing
Foam models & Popular scrapers on the market
## Ergonomic User Needs

<table>
<thead>
<tr>
<th>User-Defined Needs</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>High end aesthetic</td>
<td>Sleek contours</td>
</tr>
<tr>
<td>Freedom of grip</td>
<td>Integrated smooth profile</td>
</tr>
<tr>
<td>Increased reach</td>
<td>2.5 feet from blade to end grip</td>
</tr>
<tr>
<td>Grip sized for all user groups</td>
<td>Handle diameter is 1.25 in</td>
</tr>
<tr>
<td>Straight forward user interface</td>
<td>Toggle button switch</td>
</tr>
</tbody>
</table>
Blade

Ice Scoring Head

Brass Blade
Final Design
Market Data

Power tool market: $10.3 billion

Snow & ice tool market: $70 million
  14 million tools sold annually

Our market: 1,000,000 customers
The Bottom Line

Sales Price: $165

NPV: $1.3 million

Investment: $350,000

ROI: 80%
IceTek: The Next Generation

Reduce the size of gearbox (form factor)

Revise design based on mass production

Establish easier assembly methods
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Dick Fenner
Joe Cronin
Steve Haberek
Jim Dudley
Bob Nuttal
Fred Cote
400 User Survey Respondents
Back up
Power Decisions

**Cord**
- Always Ready
- Long Life
- Prohibitively Unwieldy

**Cordless**
- Charging Required
- Limited Battery Life
- Maneuverable
Charging

- Built in Car Charger Circuit
- Charging Procedure:

Phase I - Constant Current

Phase II - Constant Voltage

Voltage: 7.4 V

Current: 2 A
Charging

Discharge Characteristics, 25 deg C

Voltage (V)

1.0
0.5
0.0

Capacity (Ah)

1.0
0.5
0.0

1A
30A
10A
40A

ICETEK
Charging