From Chasing Shiny Objects to Creating Economic Value

How Vecna’s Lessons Learned inform the founding of MassRobotics

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About Vecna

- Privately funded automation company founded in 1998
- Focus on advanced technology with applications in healthcare and logistics
- Hundreds of implementations worldwide
- 2011 Tibbetts Award for a strong track record of commercializing R&D
- 10% working time devoted to community service
- Leading the MassRobotics effort
Vecna’s Mission

To create robots that provide real economic value by working *safely* alongside humans
NASA-funded Development

- Machine Perception
- Navigation
- Manipulation
- Human-Robot Interaction
- Multi-Agent Coordination

Intelligent solutions for real-world challenges.
Worldwide Robotics Market Growth

*Excludes Low Level Electronic Toys
Source: Japan Robotics Association
Opportunity

• Trillions of dollars of unmet market needs
• The ability to empower the human race to accomplish more than ever before
• The opportunity to create prosperity for all segments of society
Global Market Values

Service Robotics
$3.4 Billion

Industrial Robotics
$8.5 Billion

2016 Industrial Robots
Estimated yearly shipments

USA
Europe
China
Japan
South Korea
**McKinsey:** Twelve potentially economically disruptive technologies

Advanced robotics across health care, manufacturing, and services could generate a potential economic impact of $1.7 trillion to $4.5 trillion per year by 2025, including more than $800 billion to $2.6 trillion in value from health-care uses.

Industrial robots with features such as machine vision and high-precision dexterity typically cost $100,000 to $150,000. These prices will come down substantially opening many new markets.
The Shiny Object Conundrum

• 9 out of 10 startups fail
• Technologist are focused on The Shiny Object
• Results in poor startup performance and poor investor confidence
The Solution: MassRobotics

To nurture the world's largest robotics cluster

• Independent non-profit industry association
• Designed with input from investors to reduce risk
• Information sharing, standards and contract support
• Quality & cost-effective prototyping and testing facilities
• Curated business services & mentorship
• Introductions to strategic contacts & investors
• STEM education support
The world's largest robotics cluster

Over 150 innovative companies over 11 different markets
Over 35 robotics R&D programs across 18 institutions
Technology must solve problems with real economic value to be successful
Workplace Fatalities

• 4,585 workers killed on the job in 2013
• $188.9 billion in productivity and wages are lost each year in the U.S. due to safety-related death and injury
• Powered industrial trucks are #5 on OSHA’s list
Forklifts injuries – by the numbers

• 110,000 major forklift accidents occur every year
• Forklifts account for 1 in 6 workplace deaths and 34,900 serious injuries
• 90% of all forklifts will be involved in some type of serious accident during their useful life

<table>
<thead>
<tr>
<th>Fatal Accident Type</th>
<th>%</th>
<th>Where fatalities occur</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushed by vehicle tipping over</td>
<td>42%</td>
<td>Mining</td>
<td>1.2</td>
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<tr>
<td>Crushed between vehicle and a surface</td>
<td>25%</td>
<td>Construction</td>
<td>23.8</td>
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<tr>
<td>Crushed between two vehicles</td>
<td>11%</td>
<td>Manufacturing</td>
<td>42.5</td>
</tr>
<tr>
<td>Struck or run over by a forklift</td>
<td>10%</td>
<td>Transportation</td>
<td>11.0</td>
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<tr>
<td>Struck by falling material</td>
<td>8%</td>
<td>Wholesale trades</td>
<td>12.5</td>
</tr>
<tr>
<td>Fall from platform on the forks</td>
<td>4%</td>
<td>Retail trade</td>
<td>9.0</td>
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</table>
Accident: 201924669 - Employee Is Killed When Caught Between Forklift And Vehicle

Accident: 201924669 -- Report ID: 0626700 -- Event Date: 11/27/2008

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Open Date</th>
<th>SIC</th>
<th>Establishment Name</th>
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</table>

At approximately 1:40 a.m. on or about November 27, 2008, Employee #1, a forklift operator, had dismounted a manually operated forklift that he had used to retrieve a pallet of product from space EEA02F. An automatically guided vehicle (AGV), operating in the same area as Employee #1, turned a corner, failed to detect the manually operated forklift, and collided with it, striking Employee #1. Employee #1 was caught between the AGV (HK Systems Model Number 35/LCF-257Q, serial Number 4330050, Frito-Lay Unit Number 19) and his manually operated forklift (Cascade Side Shifter Number 55E-SS-A062, Truck Type E, Model Number RC3020-40-S, Serial Number 1A194660, Frito-Lay Unit Number 53). Employee #1's head was crushed, and he was killed. The AGV's laser collision avoidance system did not sense the presence of older type forklifts. The company required forklift operators to set a single plastic cone a distance from the manual forklift. The presence of the cone was intended to increase the probability that the AGV's presence sensing field would detect the cone, causing the AGV to stop. Employee #1 had not set the cone.

Keywords: caught between, crushed, industrial truck, vehicle, unmanned, ind trk operator, head, work rules

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Age</th>
<th>Sex</th>
<th>Degree</th>
<th>Nature</th>
<th>Occupation</th>
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<td>311960876</td>
<td></td>
<td>Fatality</td>
<td>Fracture</td>
<td>Occupation not reported</td>
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</tbody>
</table>
The Safety-to-Autonomy Curve

The glide path on which an organization successfully adopts robotic systems
Safety First. Autonomy Second.
Forward collision avoidance

Sideview assist
How we will get there

• Use R&D funding to create technology with clear path to commercialization
• Safety first. Autonomy second.
• Buy time for industries and workforces to adopt and accept sensorized platforms
• Don’t just sense the environment; make sense of the environment
• Use general purpose world models rather than 'hard-coded' safety sensors
• Work as an industry to establish reasonable standards
Thank you.

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