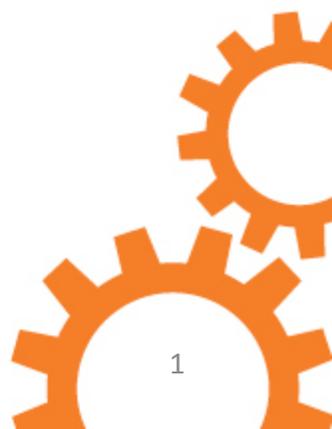


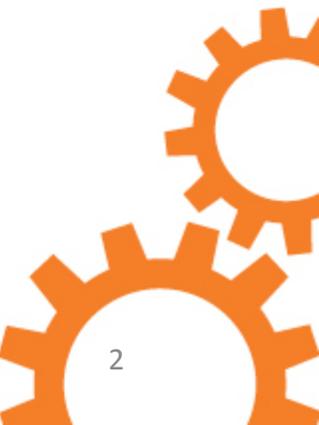
Robotics in Oil and Gas

Matt Ondler
President / CEO

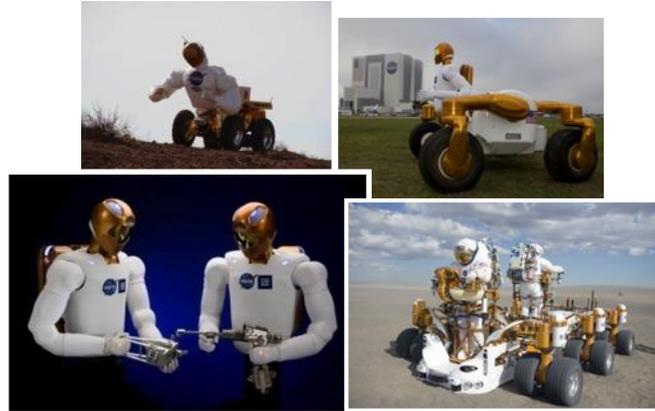


Agenda

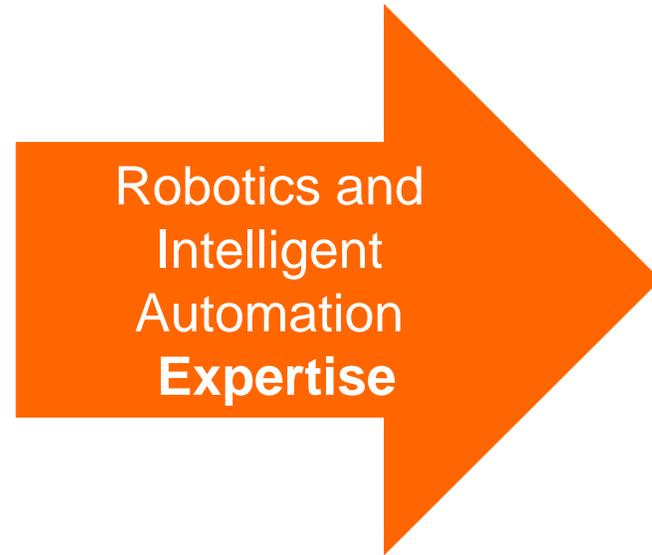
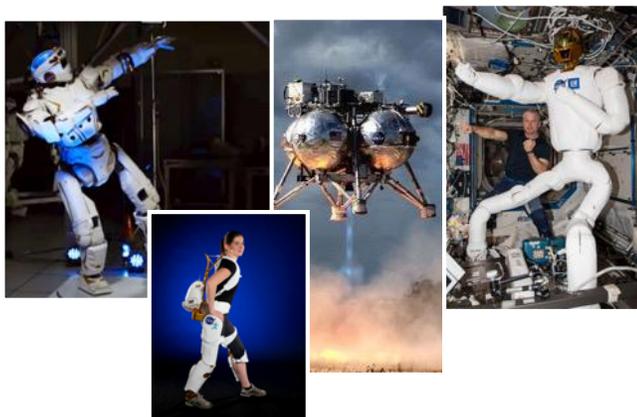
- Quick background on HMI
- State of robotics
- Sampling of robotics projects in O&G
- Example of a transformative robotic application
- Future of robotics
- Lessons learned
- Q&A



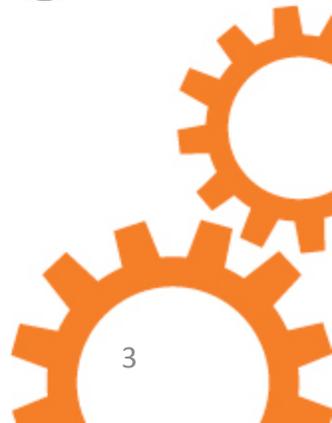
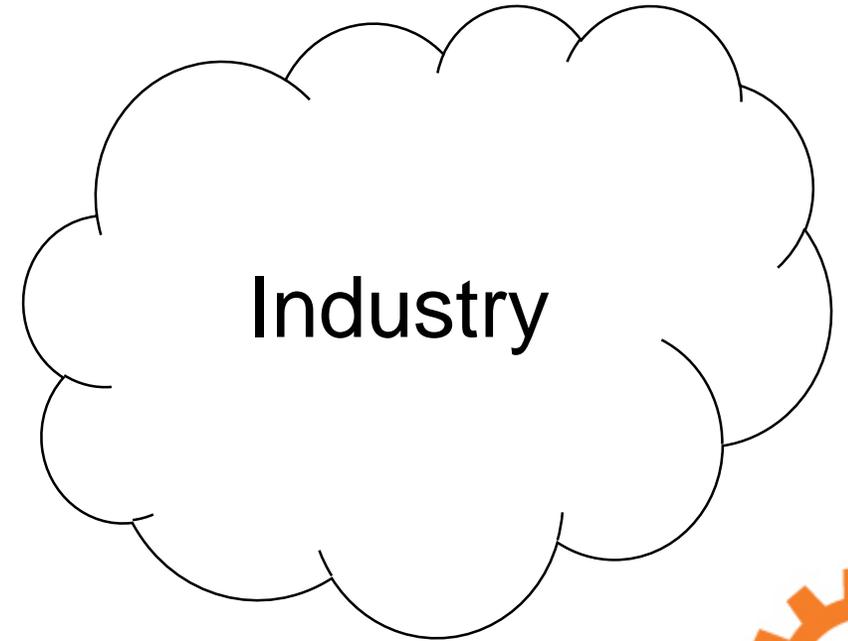
HMI Background



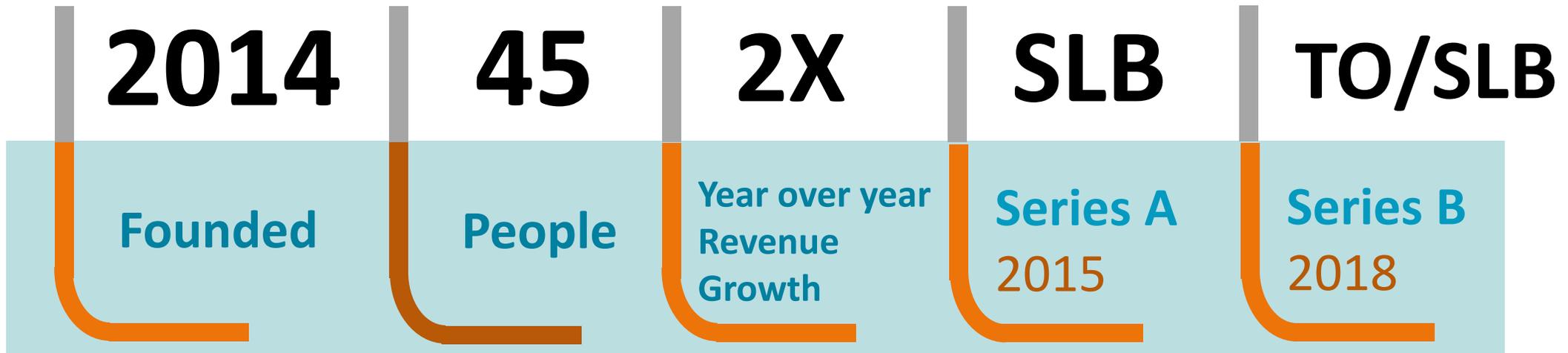
Former NASA
Roboticists



Robotics and
Intelligent
Automation
Expertise



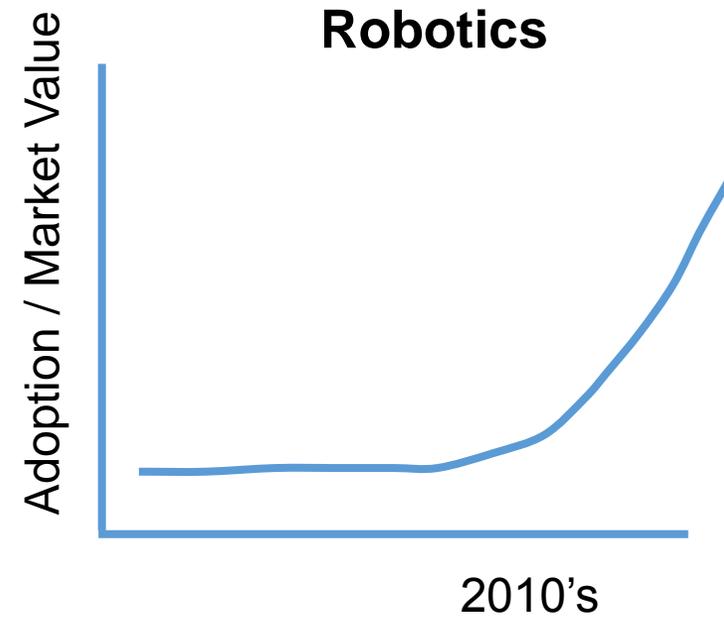
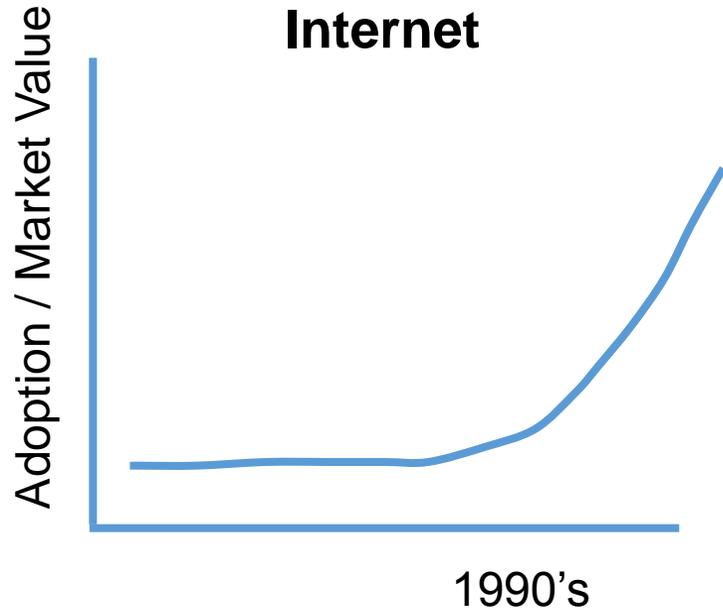
HMI Background



Engineering Services – Products – Robotics as a Service



Inflection Points

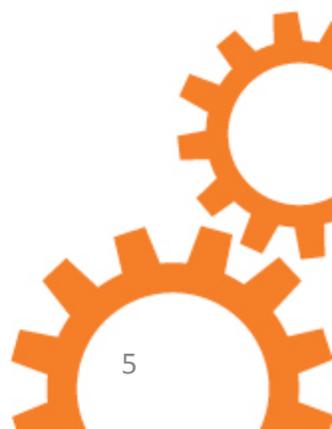


CS Workers

*PC's HTML Bandwidth
Protocols*

Roboticians ROS

*Embedded Computing
Protocols
Sensors*



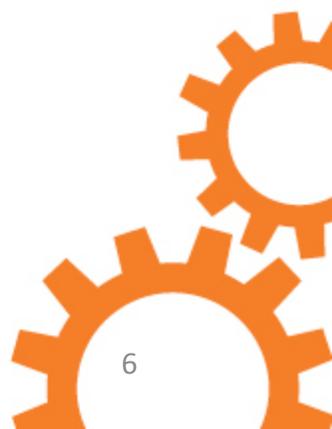
Robotics Is Ready For Prime Time



Universities and Government Labs



Solving Real World Problems



Sample Projects

Rig of the Future

Automated Land Drilling



- Reduces well completion time 30%
- Increases determinism
- Future reduction of workers in hazardous environment

Pipe Inspection

Industrial Heater Inspection



- Industry leading 100% wall thickness measurement
- Unique data analytics
- Modular design

Subsea Electrification

Replace hydraulics with Electric Actuation



- Leading industry toward electrification
- Reduces overall system complexity and cost
- Decreases environmental impact

Advanced Manufacturing

Hazardous, craftsmen manufacturing

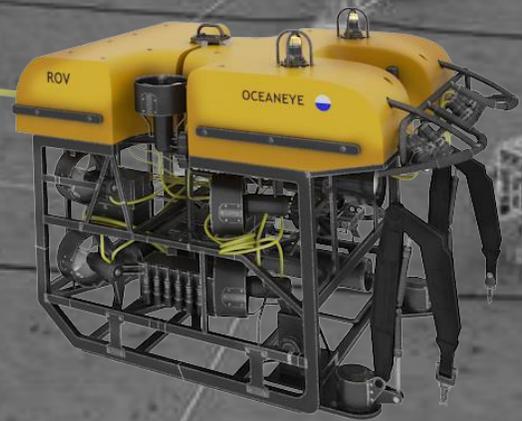


- First of its kind robotic manufacturing
- Increased quality and repeatability
- Removes workers from hazardous ops

PROBLEM



Subsea services are too expensive
Intervention is currently impossible
without a tether
Tethers increase operational time, costs,
and add constraints



\$227M

Average Annual Payments by Majors

SOLUTION



Remove the ship

Remove the tether

Replace the ROV

\$227M/2

Average Annual Payments by Majors

Innovating Subsea Services

Transformable tetherless subsea vehicle (AURV) for inspection and intervention

Stable Work Platform
(Hoverable, dexterous intervention ROV)

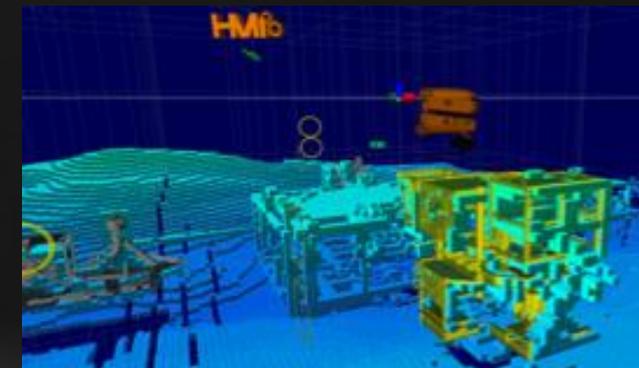
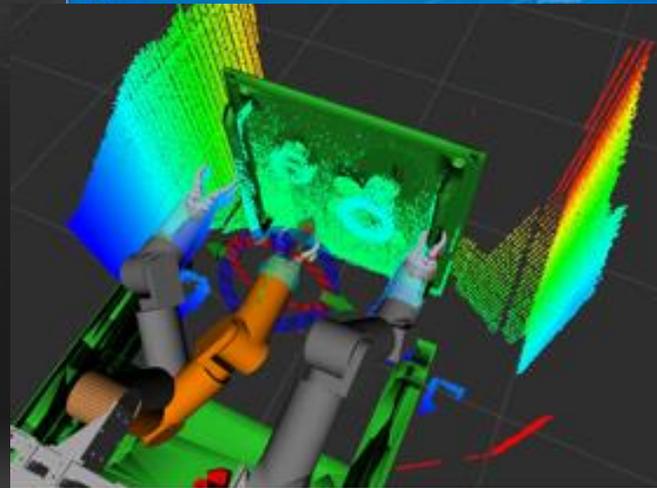
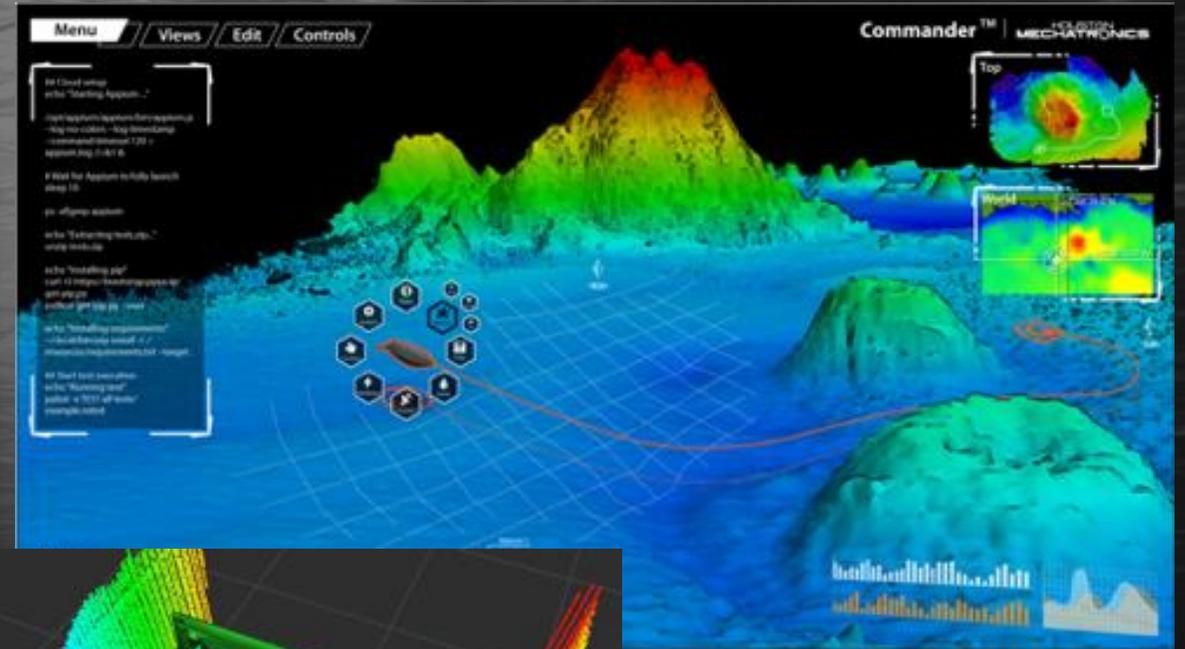
Efficient Long Range Cruiser
(Shore, light vessel, or platform deployed AUV)



Technology Enabler

Commander™

- Creates an immersive 3D environment for enhanced situational awareness
- Software for inspection and intervention in low bandwidth environments
- Supervised autonomy at acoustic data rates
- Model based so easily adaptable to other robots and environments



Robotic Applications

- At it's most basic a robot **perceives** (collects data) and **manipulates** the environment
- Being able to collect data in remote or hazardous environments, or to collect ad hoc data in response to mission needs is the next step in oilfield digitization and can be enabled by robotics
- Collecting data is important but you then must act on the data (manipulation)

Robotic and Intelligent Automation Opportunities

Reduce Cost

Increase Quality

Reduce Variability

Reduce Human Toll

Maximize Competitiveness



Potential Robotic Applications

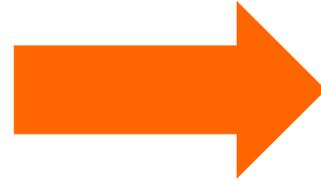
- Automated Drilling
- Intelligent BHA
- Pipe inspection
- Confined space inspection
- Autonomous vehicles
- Emergency response
- Asset monitoring
- Advanced Manufacturing.....

Process Harms the Human

Human Harms the Process

Dirty – Dull – Dangerous

Robot Expectations are High



But the reality is completely autonomous systems are a long way off...

...and turns out humans are really good at some things...



We Want Humans AND Robots



“Collaborative”
Robot

Supervised Autonomy



Complimentary Advantages

Humans

- Mission planning and re-planning
- Safety and abort overrides
- Perception – especially in austere data environments
- High level problem solving
- Anomaly resolution

Robots

- Closed loop control
- Hazardous environments
- Repetitive precision
- High accuracy
- Number crunching
- Physical prowess (speed, strength, etc.)



Lessons Learned

- Need patience and managed expectations
- Need an internal champion, often at a high level
- Roboticists need subject matter experts – need your understanding of the market and industry
- Need to be aware of internal anti-bodies...and suspicious of subject matter experts
- Iterative development is best – experiment, fail, improve, repeat

QUESTIONS?

