

Open Source Robotics Projects:

Current Development, Technology Trends and Best Practices

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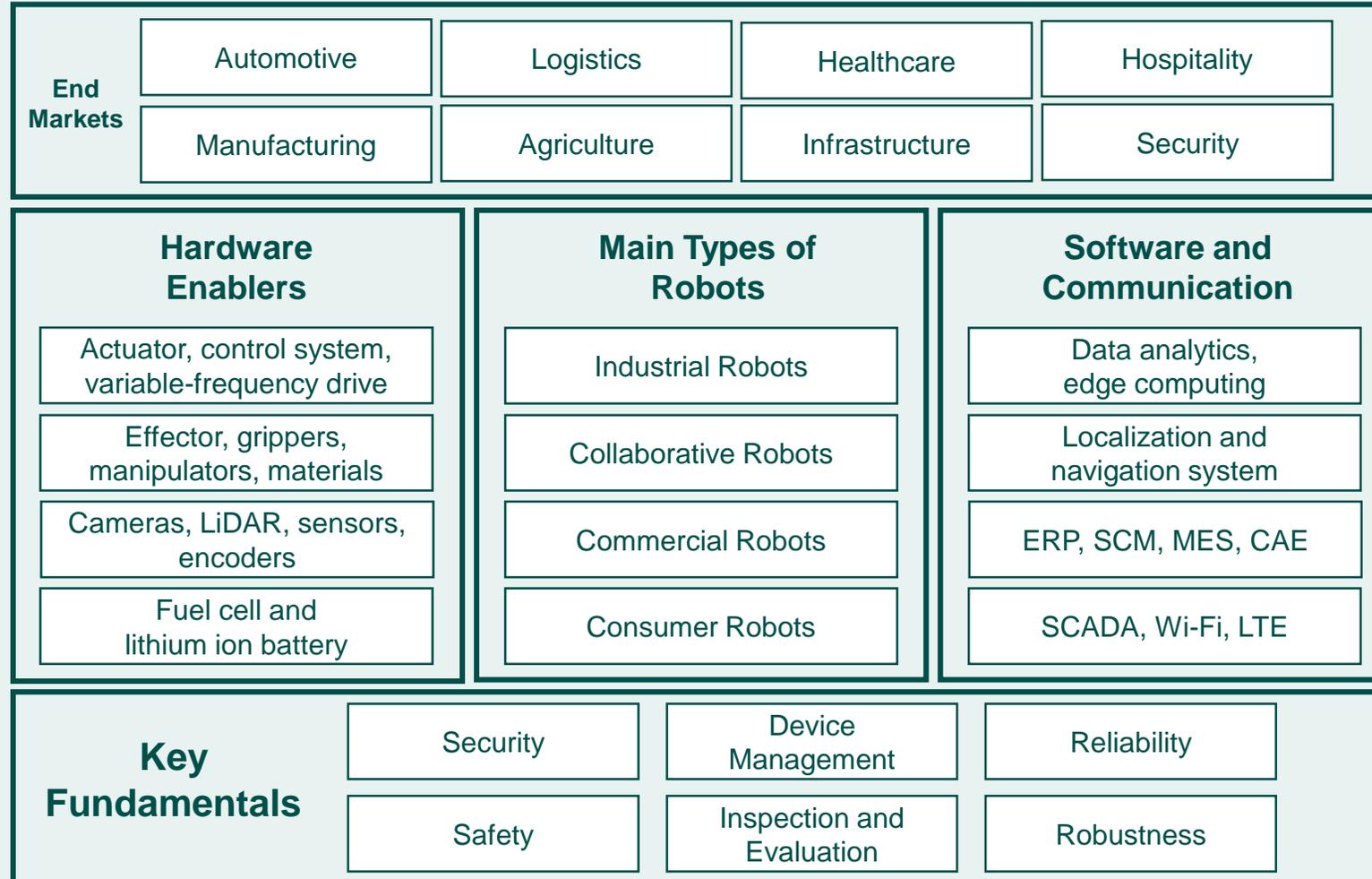
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ROS-I APAC Workshop 2019

ABIresearch
for visionaries

Robotics Value Chain

From the Perspective of ABI Research



Acronyms:

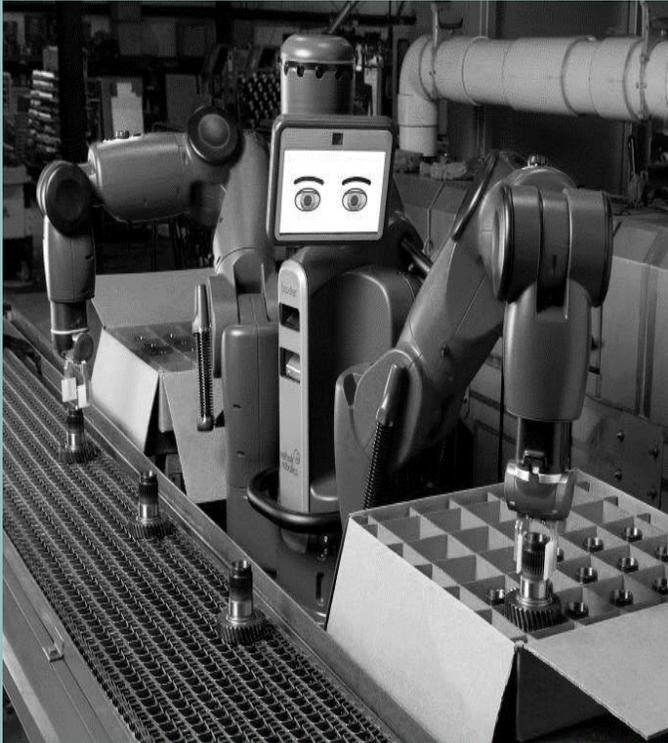
ERP – Enterprise Resource Planning
 SCM – Supply Chain Management
 MES – Manufacturing Execution System

CAE – Computer-Aided Engineering
 SCADA – Supervisory Control and Data Acquisition

Current Trends in Robotics

Shift in Conventional Interaction and Business Models

Cognitive Robotics



Robot Uncaged



Robotics-as-a-Service



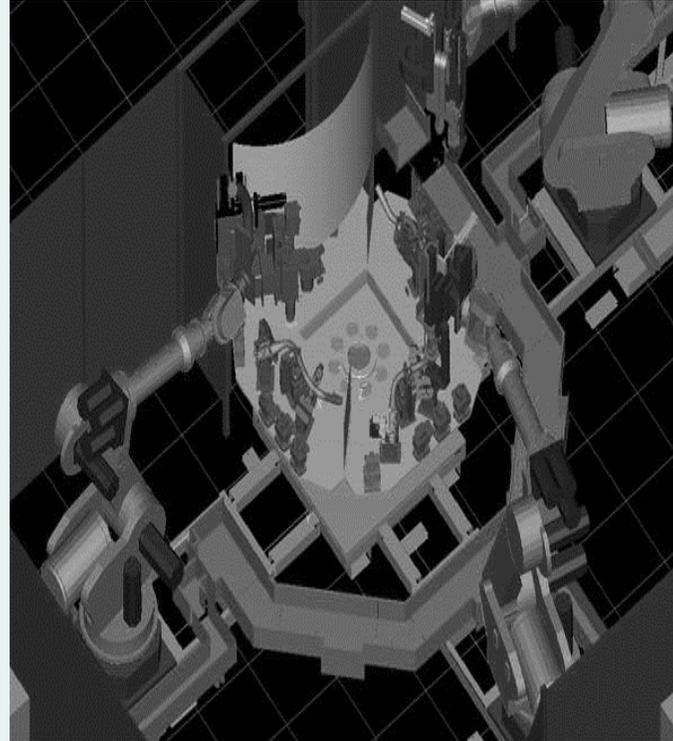
Current Trends in Open Source Robotics Projects

Increase in Capabilities and Capital

Industrial Focused Design



Simulation for Training



Backing from Enterprises



NVIDIA®



Best Practices of Open Source Projects

Applicable to All Industries

- **Governance**
 - Critical in steering the development roadmap in a coherent direction and maintaining control over development guidelines, IP protection and definition of best practices
- **Compliance**
 - Must be compliant with other equipment and systems in the supply chain. Critical for open-source hardware and software projects to embark on routine verification and validation
- **Developer Community**
 - Must feature a sizeable and active developer community – strength in number
- **Visibility on Roadmap**
 - Must be able to support all recent developments in robotics and future upgrades
- **Licensing Model**
 - Must feature a cost-friendly licensing model that will enable all forms of deployment scenarios
- **Wide Ecosystem Support**
 - Must have participation from commercial entities, hobbyists, and academics. Support from commercial entities will steer the project toward use cases with commercial feasibility

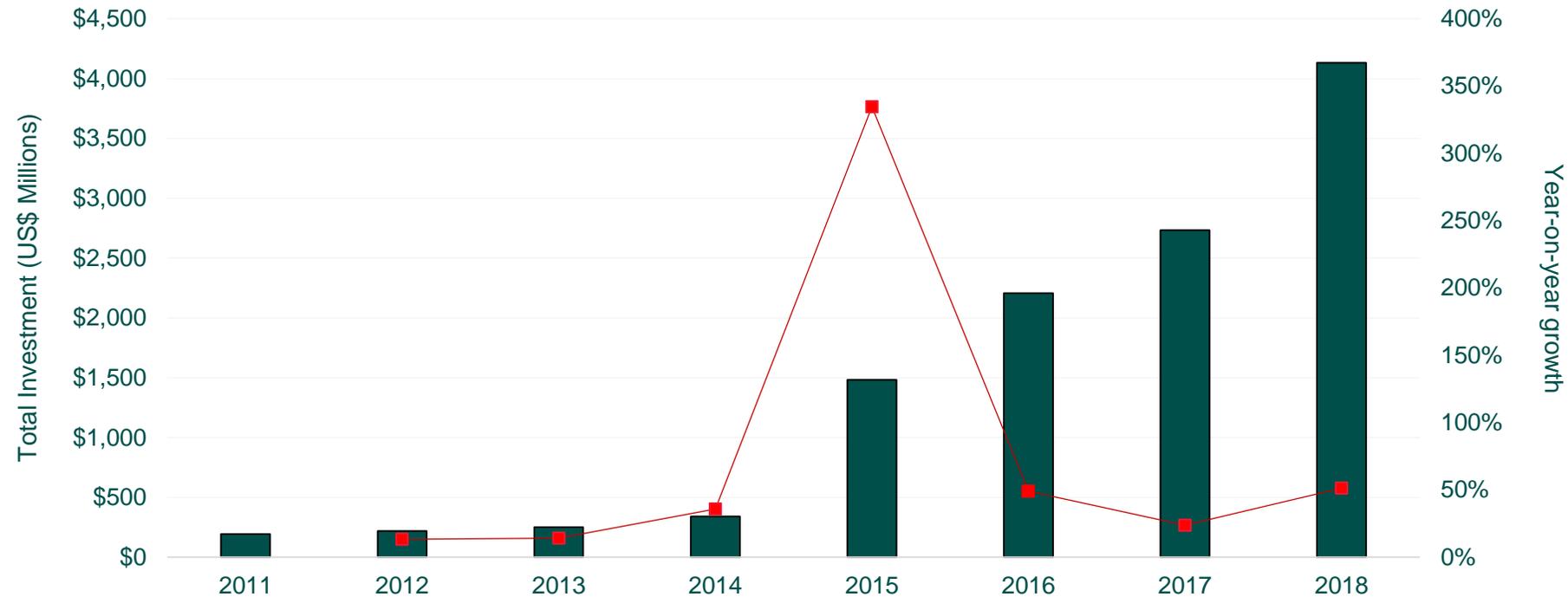
■ Top Open Source Robotics Projects

Robotics Middleware, Simulator, Library and Toolkit

- **Top open source project related to robotics is OpenCV**
 - Also the most forked
 - Not surprising given it covers much wider range of industries
 - Ironically autonomous vehicle vendors, like Toyota (TRI), insists to categorize car as robot
- **Drone-related projects are hugely popular and successful**
 - Also heavily forked
 - ArduPilot, PX4, Paparazzi Projects are critical to the development of drone industry
 - Great mix of active community engagement and commercial successes
- **Other key open source projects include Drake, YARP, and ViSP**
 - Most of them are interoperable, which is also a key characteristic of ROS
 - Great for research, but some distance away from commercialization
 - Consolidation is already happening with the increasing popularity of ROS
- **Lack of open source hardware projects**
 - Extreme heterogeneity
 - Not robust and sufficiently compliance for industrial applications

Total VC Investment Reached US\$4.1 Billion in 2018

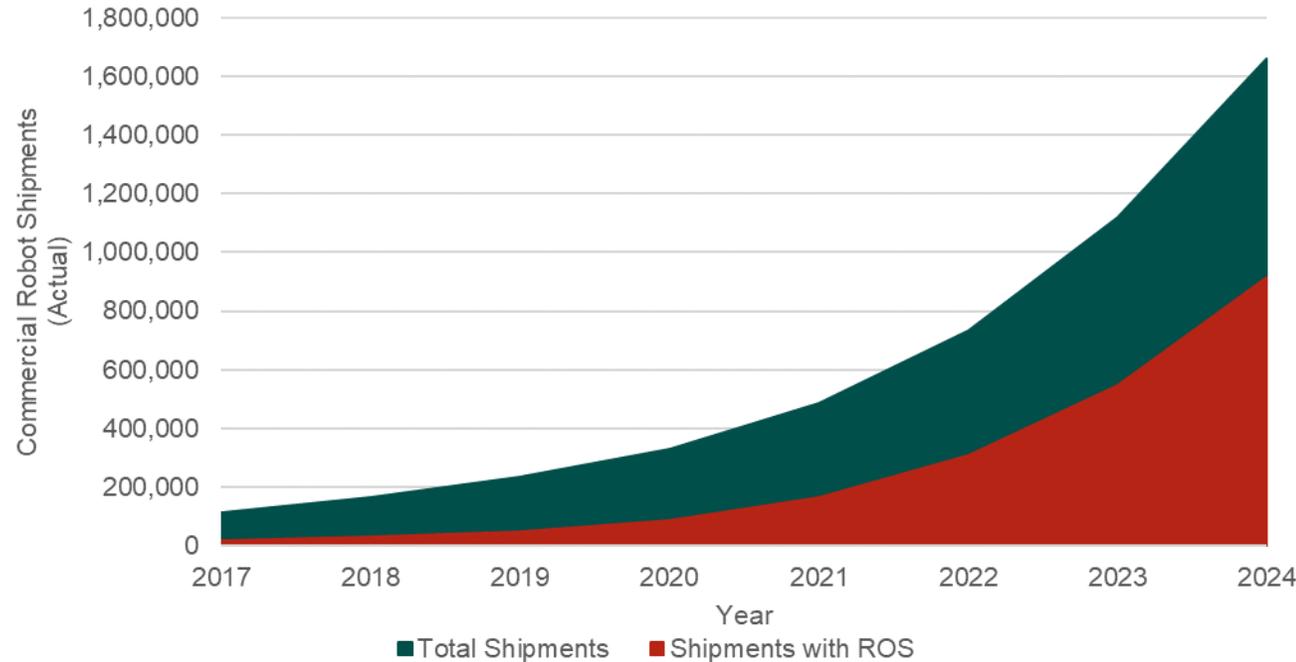
Investment Figures Are Growing In A Slow and Sure Manner



- 2018 represented another strong year for robotics investment growth
- Prospects for 2019 are a little more uncertain, due to market consolidation, slowing global growth and recent trade war between the United States and China
- Both countries accounted for just under 85% of total investment funding for 2018, with other notable players being Canada, the UK and Israel

ROS Will Play A Key Role in the Rise of Commercial Robotics

In 55% of Commercial Robotics Shipments Globally by 2024



- It is in commercial robotics where ROS has the most momentum.
- Overall, ABI Research believes commercial robotics will be growing at CARG of 42.2% from 2017 to 2027. Robotics systems shipments that contain ROS packages and leverage ROS software libraries and Software Development Kits (SDKs) will grow from 18% in 2017 to 55% in 2024.
- Industrial robotics vendors slowly warming up to ROS adoption,

Recommendations to Users of Open Source Projects

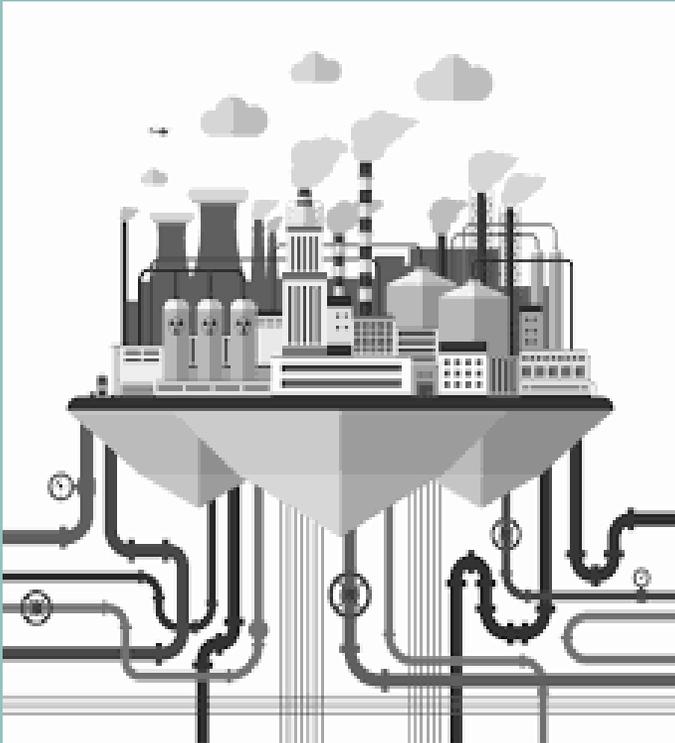
Applicable to All Industries

- **Looking for strong governance**
 - Critical in steering the development roadmap in a coherent direction and maintaining control over development guidelines, IP protection and definition of best practices
- **Looking for wide ecosystem support**
 - Must have participation from commercial entities, hobbyists, and academics. Support from commercial entities will steer the project toward use cases with commercial feasibility
- **Avoid forking**
 - Or at least minimize it
 - Forking for a user's own benefit could induce higher maintenance costs and fragmentation in the future
- **Do not stop at using open-source codes and hardware designs.**
 - Actively contribute and influence the project roadmap so that the future project development will fall in line with corporate robotics strategies and visions
- **Continuous education**
 - Educate in-house workforces and engineers on the open-source projects and encourage them to contribute

Future of ROS

Food for Thought

Industrial Focused Design



Android for robots



Robot as a Strategic Technology



Thank you

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