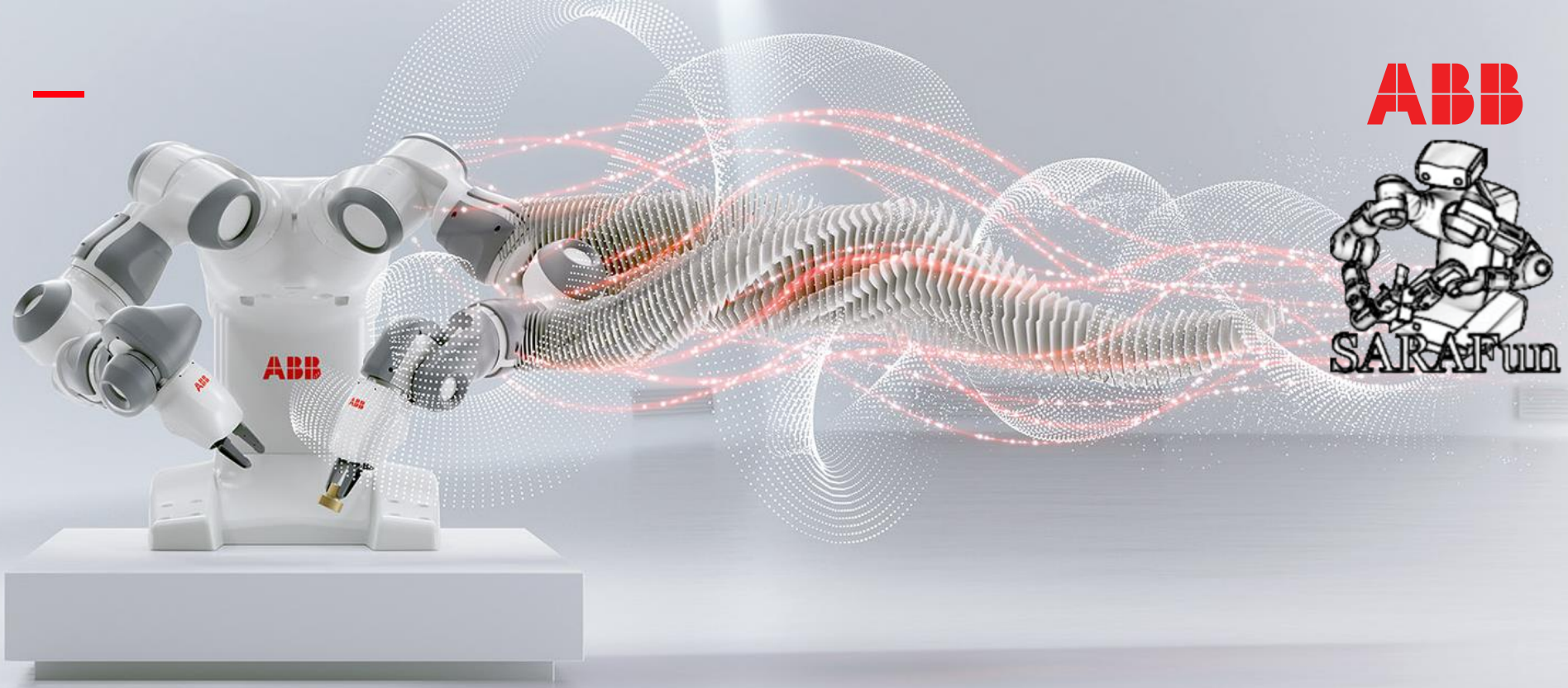


SARAFun
- Towards programming of assembly tasks by demonstration

Dr. Jonas Larsson

ABB Corporate Research, Sweden

Drivers & enablers for future industrial robotics

Disruptive technologies, market growth, & increase in R&D spending

Technology Trends

Digitalization
- Affordable large-scale computing power
- Higher-speed connectivity
- Cloud services
- Data-driven services

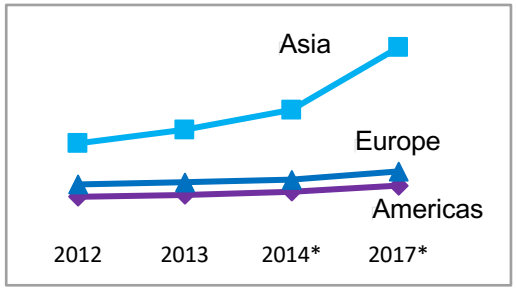
Autonomy
- Adaptivity / machine learning / AI
- Low-cost sensors / advanced sensors

Human Integration
- Ease of use, task-oriented instruction
- Human-robot collaboration

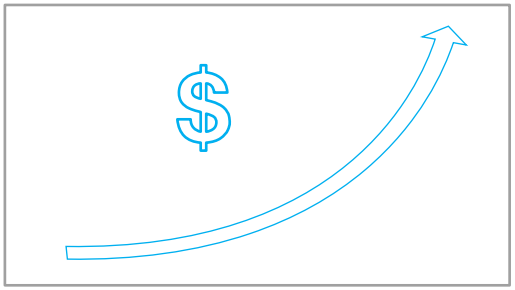
Other
- Open source, shared development
- Additive manufacturing

Drivers

Market



R&D Spending



Customer needs

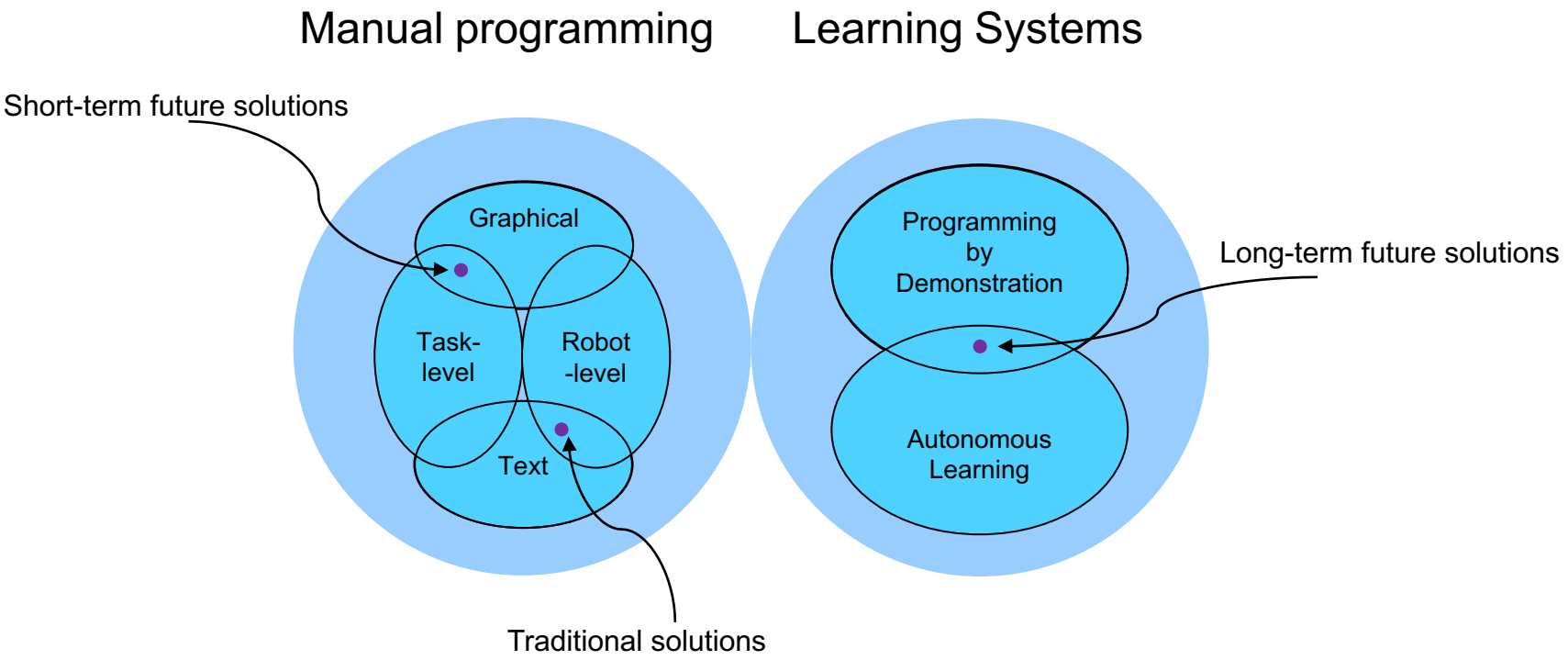
Simplification

Customer needs

Collaboration

Robot programming – current and future

Classification of robot programming systems



”Robot Programming”, Tomaz Lozano-Perez (1983)
”A Survey of Robot Programming Systems”, Georey Biggs and Bruce MacDonald (2003)

Easy Robot Programming in Industry

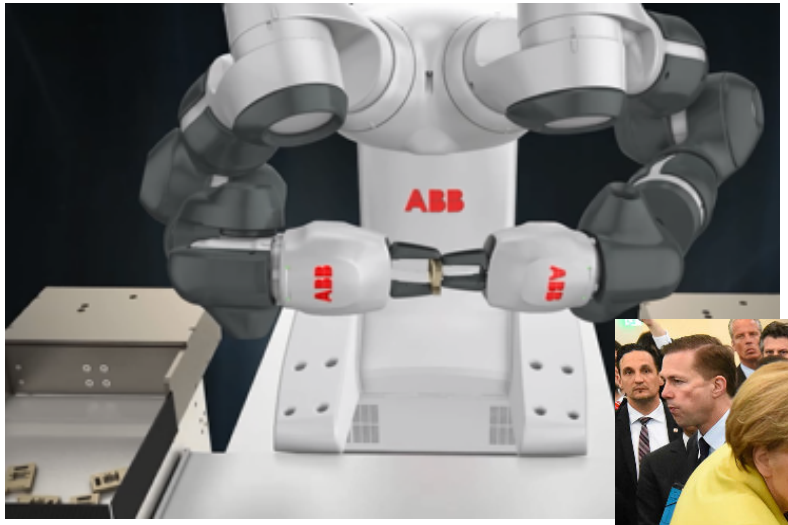
Simplification is more than a user-centred programming language

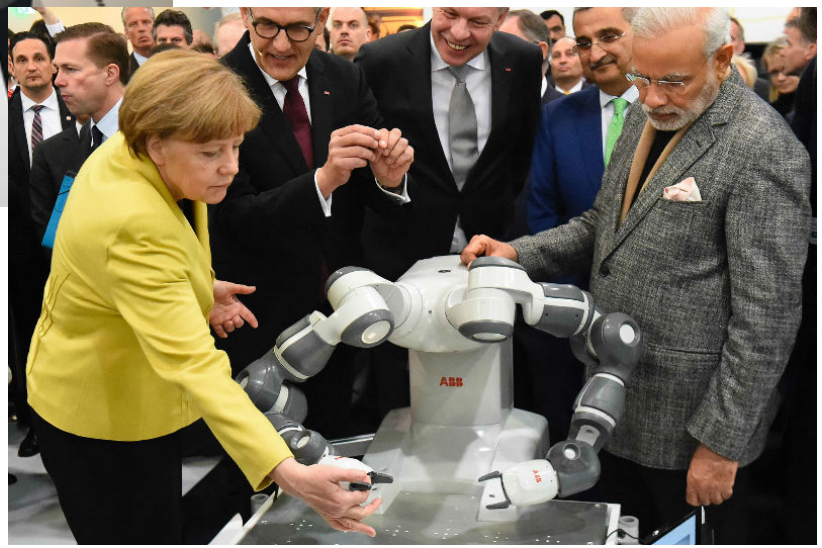
Robot Studio

Lead-through programming

Integrated
- hand
- in-hand vision
- force sensing

Integrated Part Feeding





(Hannover Messe 2015)

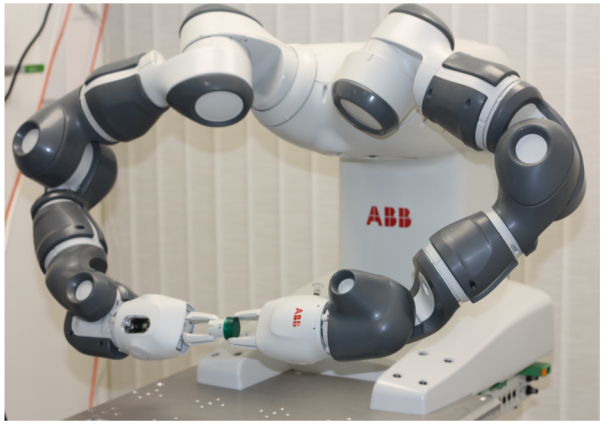
Holistic approach to usability needed to achieve true Simplification

SARAFun: Smart Assembly Robot with Advanced Functionalities

Enable a non-expert user to integrate a new dual arm assembly task on a robot in less than a day with

- zero-programming robot instructions, multimodal robot interaction & force controlled dual arm assembly
- automatic grasp planning and finger design

Platform



Start date: 2015-03-01
End date: 2018-02-28

Innovation Action under the Horizon 2020 ICT
www.sarafun.eu

Objective: *To develop a bi-manual robot system that will be capable to learn the assembly of two parts by human demonstration*

Objective: *To develop a bi-manual robot that enables teaching of assembly with advanced physical human-robot interaction*

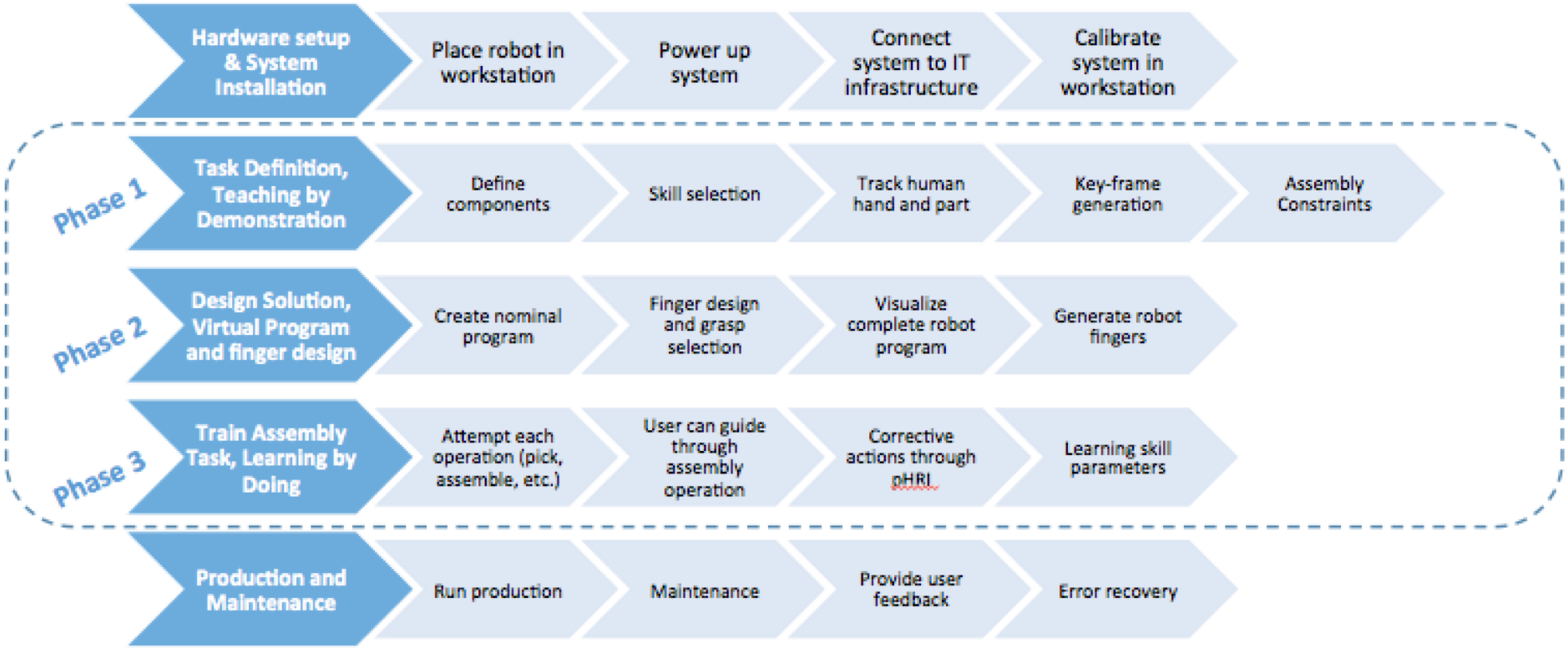
Objective: *To develop an integrated planning framework to plan grasps and optimize the finger design for industrial grippers to facilitate the clamping and mating of parts*

Objective: *To develop strategies to improve and maintain grasp stability for industrial grippers*

Objective: *To validate SARAFun project results in real assembly scenarios*

SARAFun – Integration process

Overall Workflow of Robot Integration



SARAFun Consortium

Participant No	Participant organisation name	Country
1 (Coordinator)	ABB AB [ABB]	Sweden
2	CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS [CERTH]	Greece
3	KUNGLIGA TEKNISKA HOEGSKOLAN [KTH]	Sweden
4	LUNDS UNIVERSITET [ULUND]	Sweden
5	UNIVERSITÄT BIELEFELD [UNIBI]	Germany
6	FUNDACION TECNALIA RESEARCH & INNOVATION [TECNALIA]	Spain

Expertise: control, perception, cognition, sensor integration, human movement analysis

ABB Sweden

TECNALIA

Royal Institute of technology

Lund University

Centre for Research and Technology Hellas

Bielefeld University

Partner Tasks

- CERTH - Assembly key frame extraction using visual feedback, pHRI control for teaching assembly with safety, automatic motion generation between key frames, assembly via deformation and insertion, teaching by demonstration using visual feedback and pHRI
- Bielefeld - grasp planning, integrating tactile sensors, learning to improve the robustness of grasping and to monitor grasp stability in an online fashion
- KTH - Controllers for bimanual folding assembly under uncertainties, Behavior trees to execute and monitor tasks
- ULUND - robotic force control and force estimation for use in assembly and contact operations in the SARAFun teaching and learning, as well as the knowledge base and task modeling
- Tecnalia - Human studies and monitoring of how humans perform assembly operations

Thank you!