Moving from “React and Repair” to “Predict and Prevent”
NIST Industry Forum
May 7-11, 2018

SIEMENS
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The Use of Mixed Reality for Manufacturing

Panel: Visualization Tools for PHM

Hasan Sinan Bank – Siemens Corporation Corporate Technology

siemens.com

Outline

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- Introduction Siemens Corporation Corporate Technology,
- The concept of digitalization in Siemens,
- The focus of Siemens in Future of Automation,
- The vision in VR/AR/MxR
- The Market of VR/AR/MxR
- Process Simulate VR

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Our Innovative Power in Figures – Siemens as a Whole and Corporate Technology

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Research and Development at Siemens

€5.2 billion
Expenditures for R&D in fiscal 2017

40,000
R&D employees[1]

Inventions and patents – securing our future

7,500
inventions[1]

3,600
patent applications[1]

University cooperation – our knowledge edge

9
CKI universities[2]

16
Principal partner universities

Corporate Technology –
Our competence center for innovation and business excellence[3]

8,000
employees worldwide

5,400
software developers

1,600
researchers

400
patent experts

1 In fiscal 2017

2 Centers of Knowledge Interchange

3 Employee figures: As of September 30, 2017

Corporate Technology – Innovating Globally

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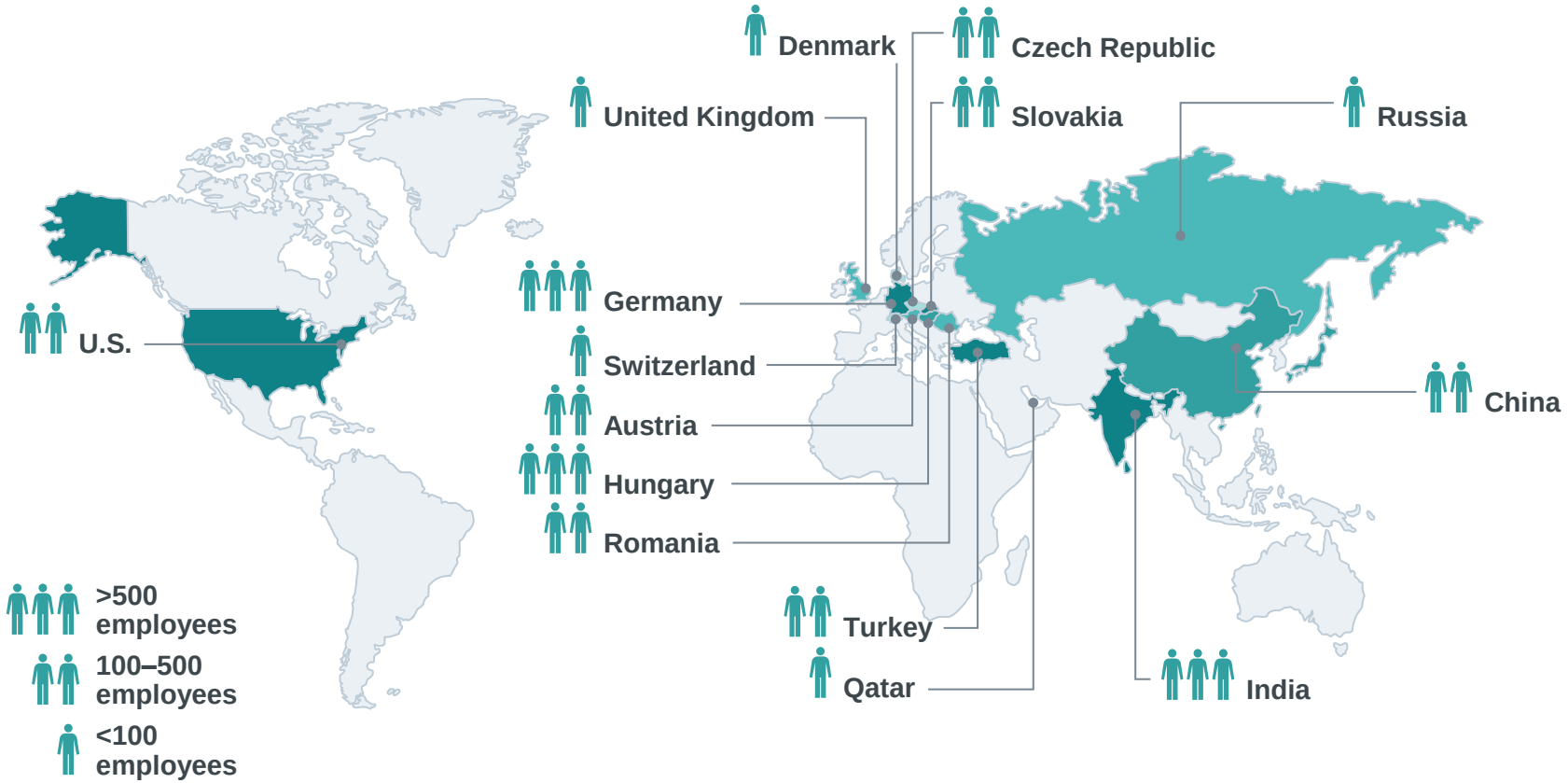
Corporate Technology – worldwide locations



A worldwide presence

is the heart of the Siemens brand – and that goes for us as well.

This presence enables us to quickly offer targeted solutions that are tailored to regional requirements.

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The Digitalization

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Design & Engineering | Automation & Operation | Maintenance & Utilization

Siemens Software

Siemens Digital Services

MindSphere

The cloud-based, open IoT operating system

Platform as a Service

Enabler: Infrastructure as a Service (storage, processing power, provider agnostic)

Digitally enhanced Electrification and Automation

Holistic IT security concept

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The focus of SCCT in Future of Automation

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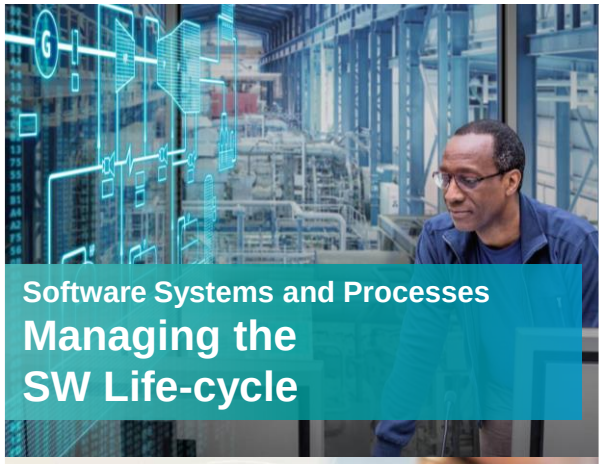

Cyber Security — Enabling Digitalization

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Vision with AR/VR/MxR

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Product Design | Production Planning | Production Engineering | Production Execution | Services

- Single & Collaborative
- Design & Engineering Reviews

- Facility Inspections
- Shop floor Employee Training
- Electronic Work Instructions
- Quality Inspections
- As Planned vs. As Built

- Technician Training
- Service Instructions
- Monitoring and Maintenance (ioT)
- Remote Expert

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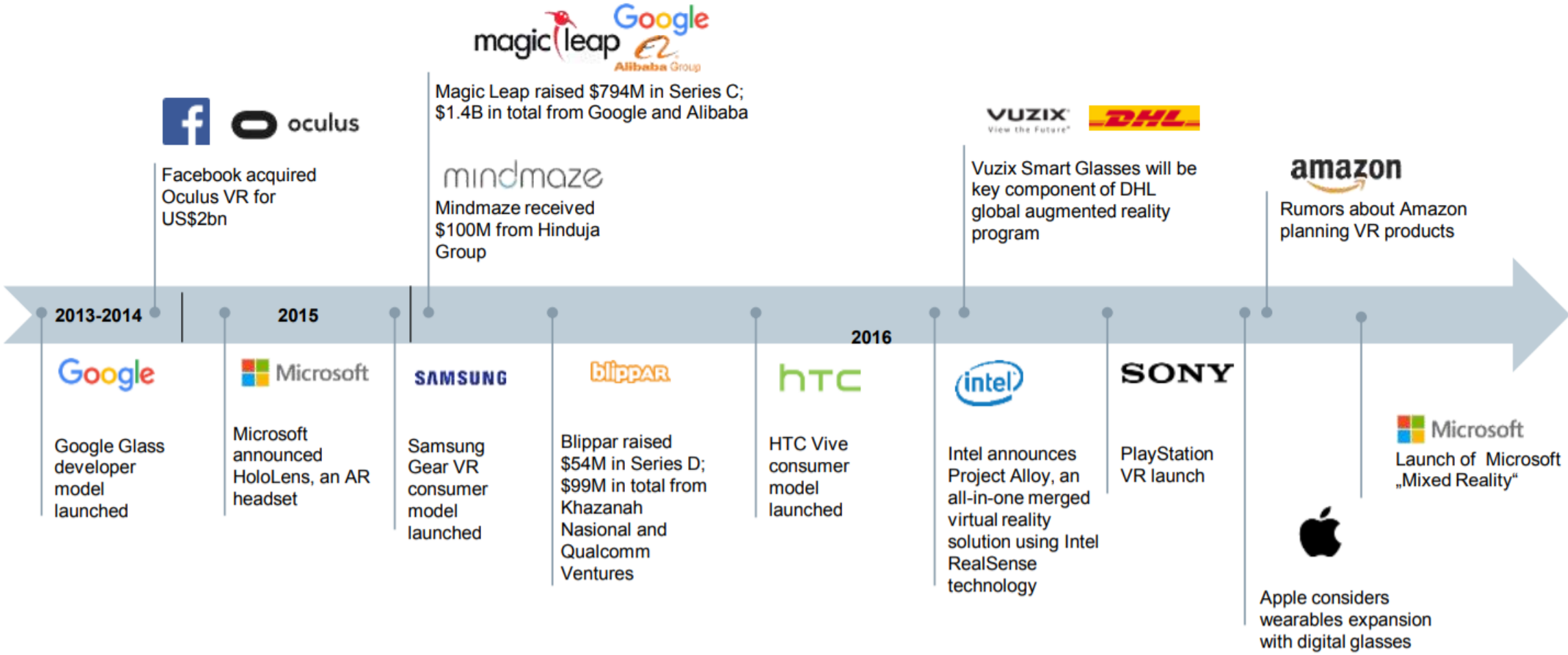
The Market



The Market (con't)

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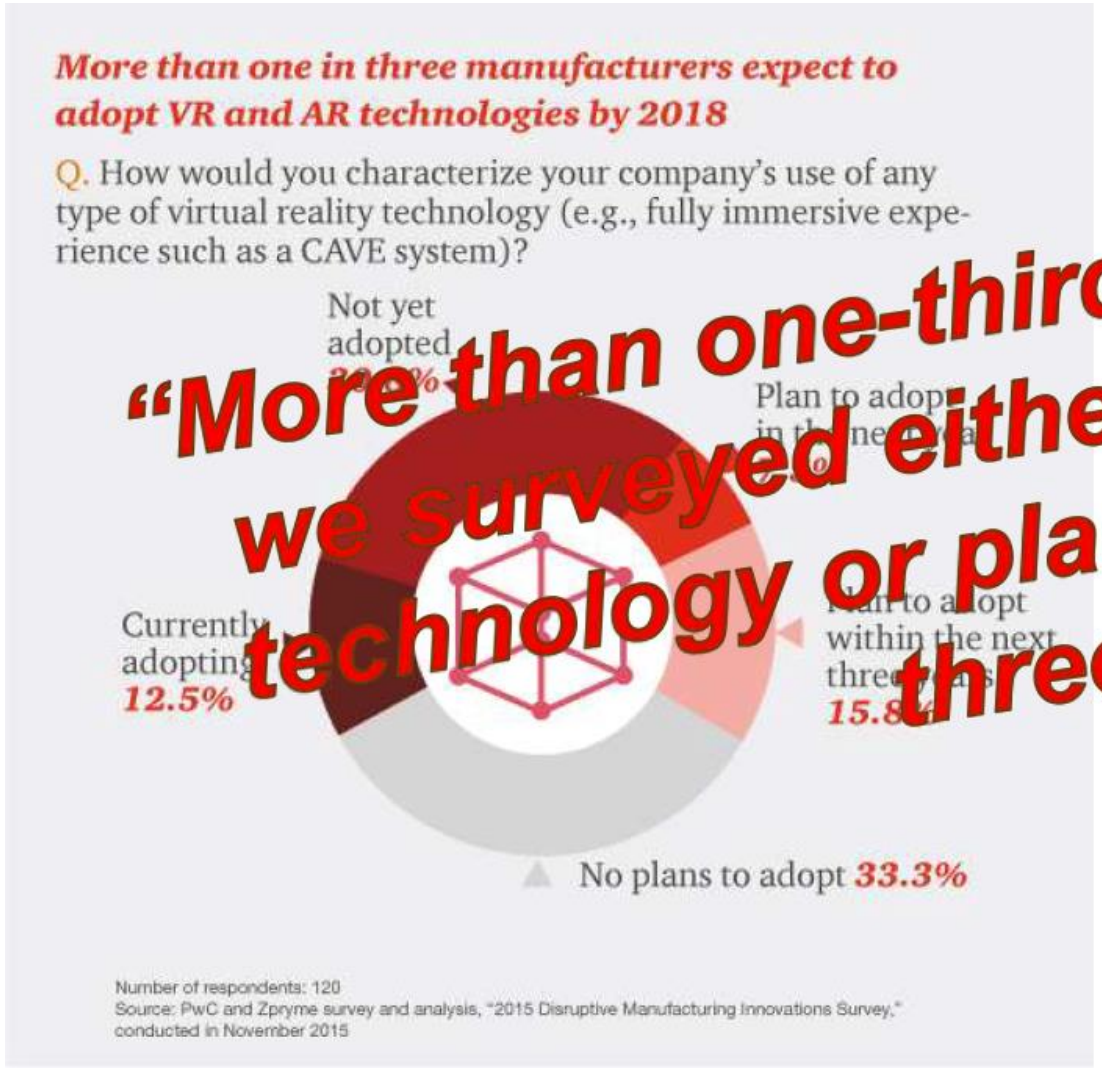

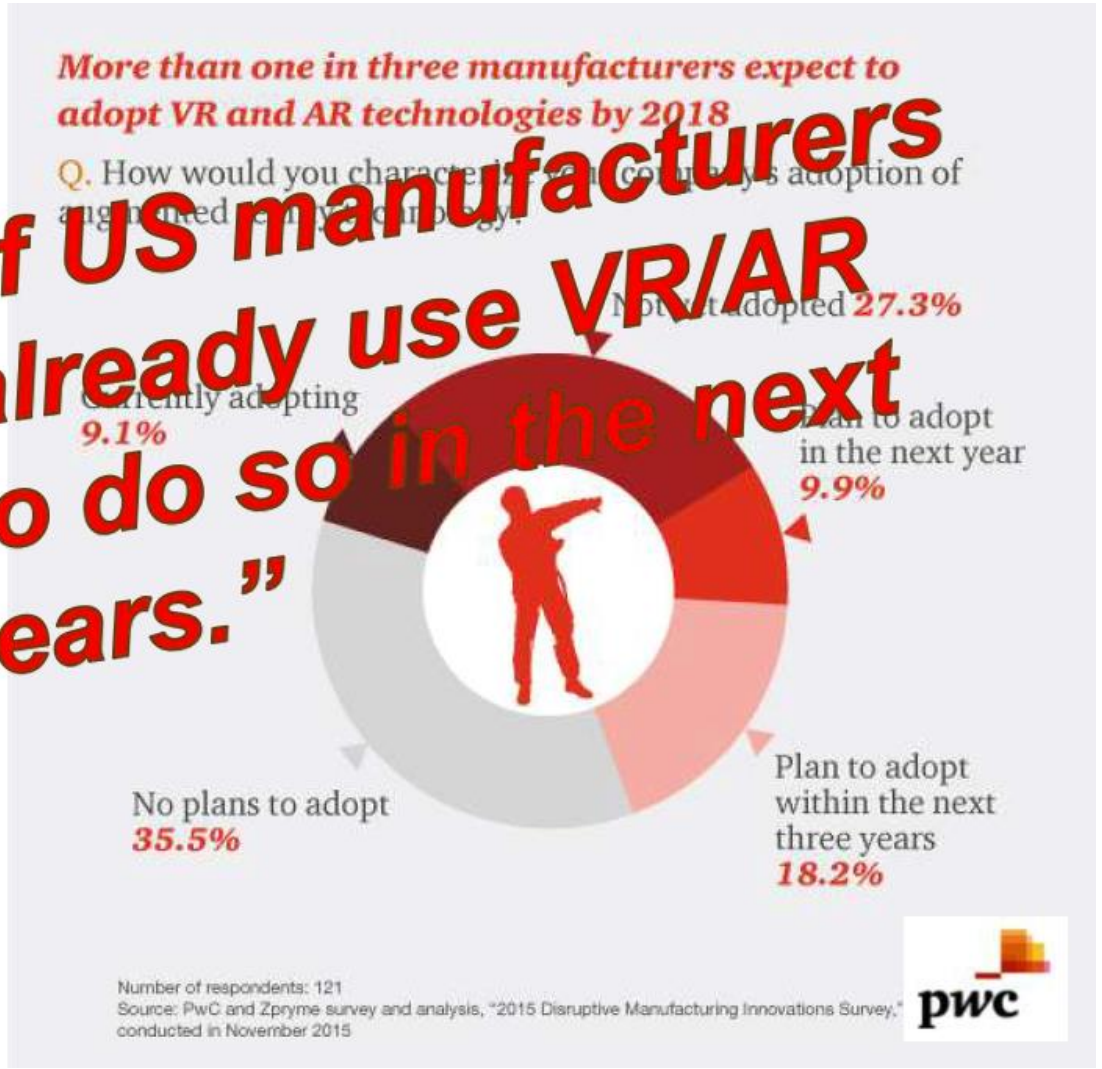

"More than one-third of US manufacturers we surveyed either already use VR/AR technology or plan to do so in the next three years."

The Market (con't)

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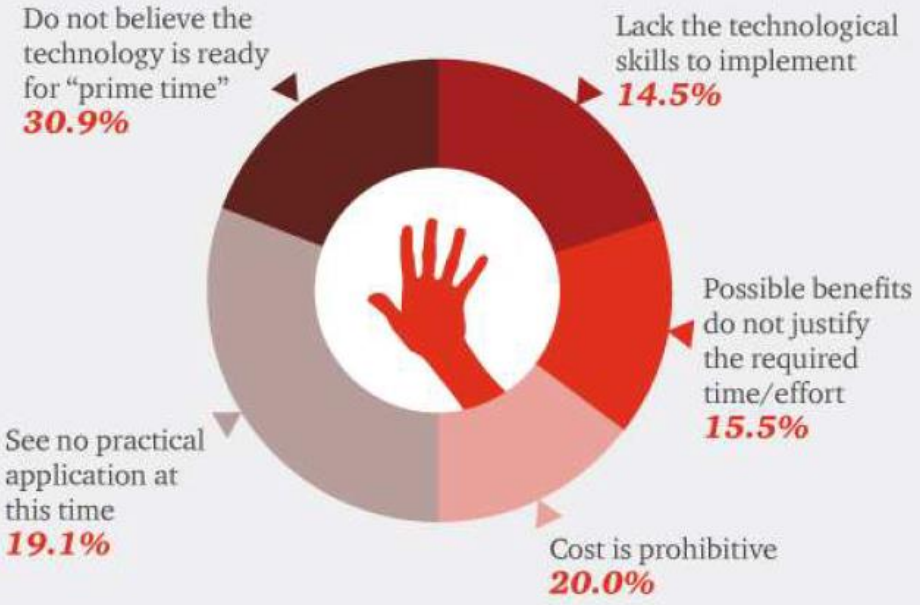
Cost and perceived lack of need are top reasons for manufacturers not using VR/AR

Q. If your company has not yet adopted virtual and/or augmented reality technology, what is the main reason? Please select one.



Number of respondents: 110
Source: PwC and Zpryme survey and analysis, "2015 Disruptive Manufacturing Innovations Survey," conducted in November 2015

pwc

Product design, worker safety and training are most popular VR/AR applications among manufacturers

Q. How is your company using virtual and/or augmented reality technology? Please select all that apply

- **38.8%** Product design and development
- **17.3%** Virtual assembly/improved process design
- **27.6%** Safety and manufacturing skills training
- **19.4%** Maintenance, repair or operation of equipment
- **19.4%** Data and information access
- **19.4%** Remote collaboration
- **13.3%** Customer engagement and communications
- **7.1%** Supply chain collaboration/communications
- **18.4%** Other (please specify)

Number of respondents: 98
Source: PwC and Zpryme survey and analysis, "2015 Disruptive Manufacturing Innovations Survey," conducted in November 2015

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Process Simulate VR

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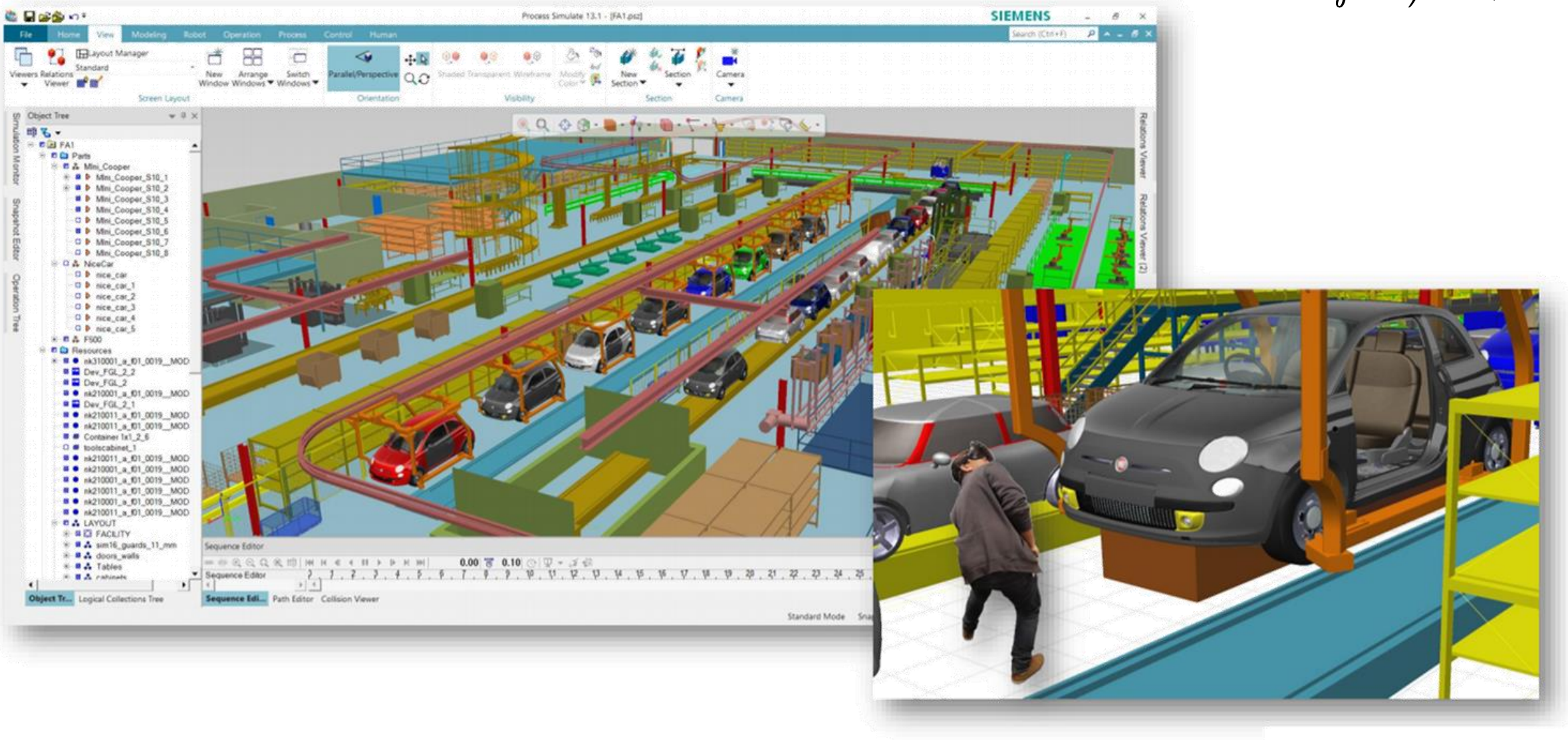

Workflow and Functionality

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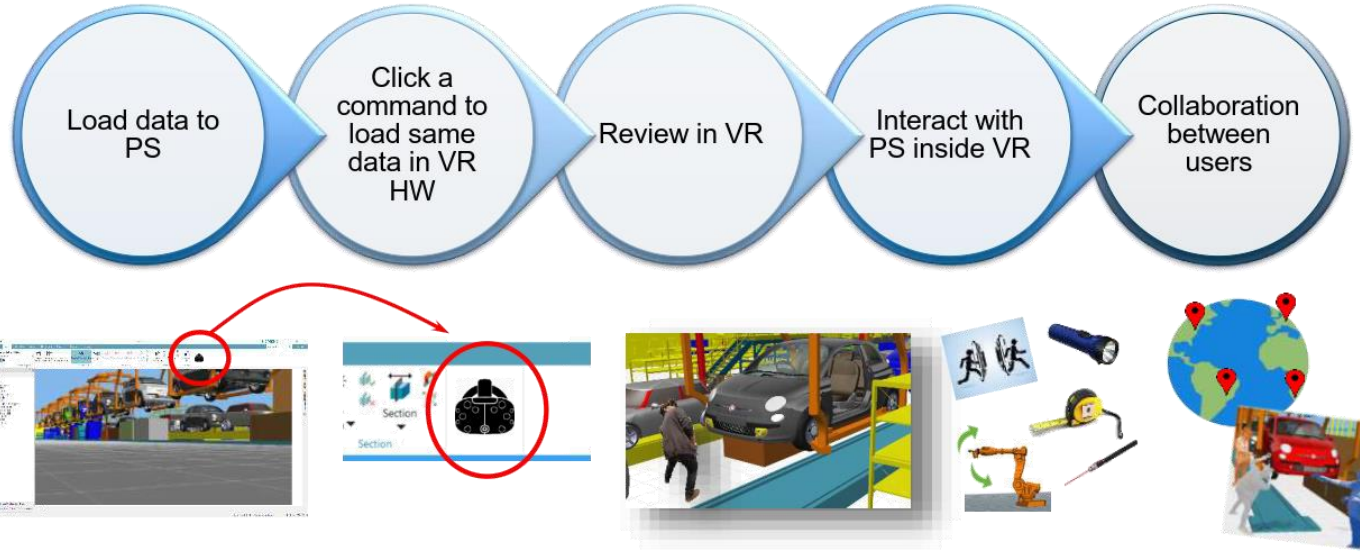
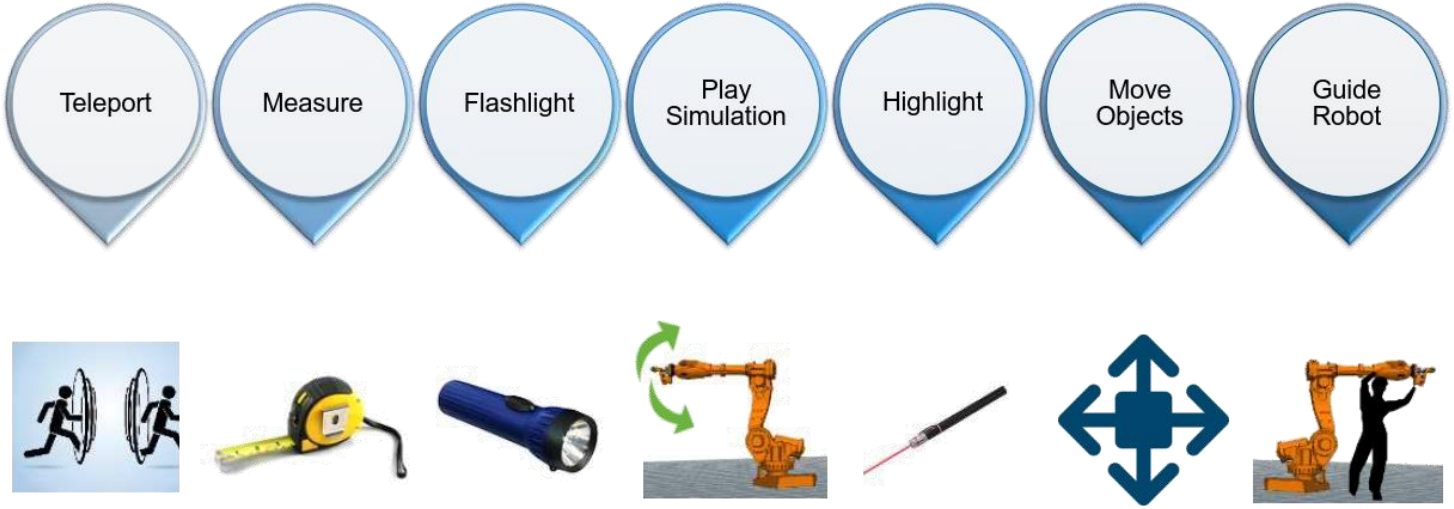
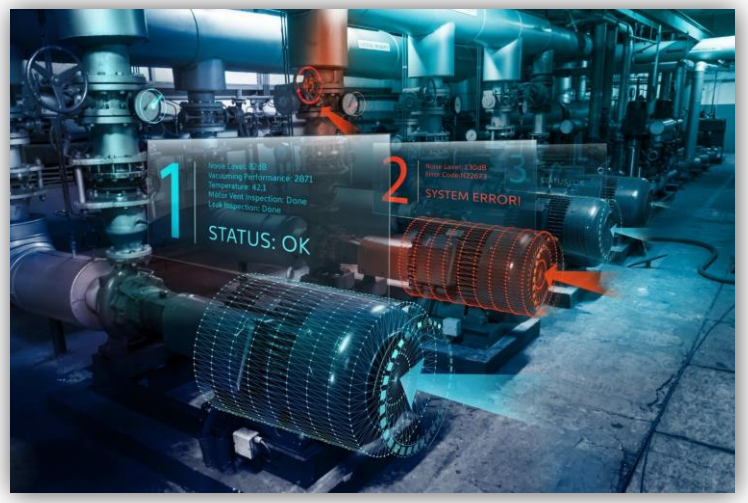
Workflow



Functionality





Video

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Tecnomatix Process Simulate
Direct load and interaction with Virtual Reality

Roadmap

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- Collaboration – multiple people from different locations join the same session.
- Performance improvements (loading and runtime)
- Point cloud support
- Human deformable skin support
- Cable simulation support
- Event-based simulation support
- Display options (e.g. hide/show objects on filtering definition, change transparency based on selected criteria)
- Integration with motion capture and haptic devices
- Improved user interaction (e.g., joint jog devices etc.)
- Use of new features of VR technologies by hardware providers

Other MxR Research in SCCT

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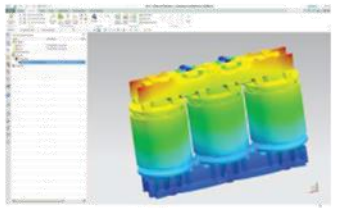
Interactive simulation is not meant to replace today's solution but to expand simulation assistance along the whole life cycle

Autonomous simulation based design assistance without any user inputs to boost innovative concept designs

Established simulation tools to validate and tune designs



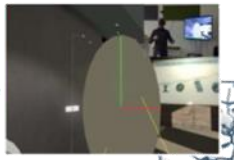
Machines with build in simulations / digital twin to make informed decisions autonomously

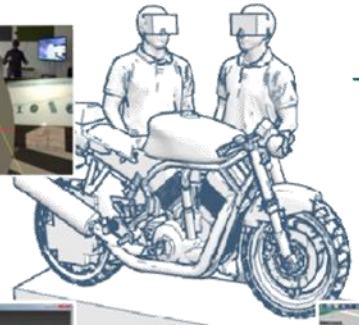
Ideation → Realization → Utilzation

Today's complexity requires new computer aided engineering paradigms: Interactive Virtual Design Worlds

Design Generation

Design 3D CAD models in virtual spaces instead of lengthy CAD operations

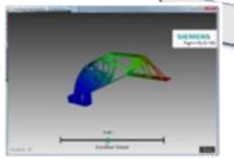


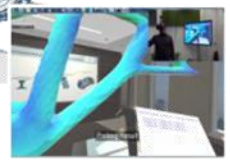


Meet, design and try out. Together, in virtual reality. With real physics, inside your design.

Design Generation

Computer aided creativity instead of computer aided documentation and validation



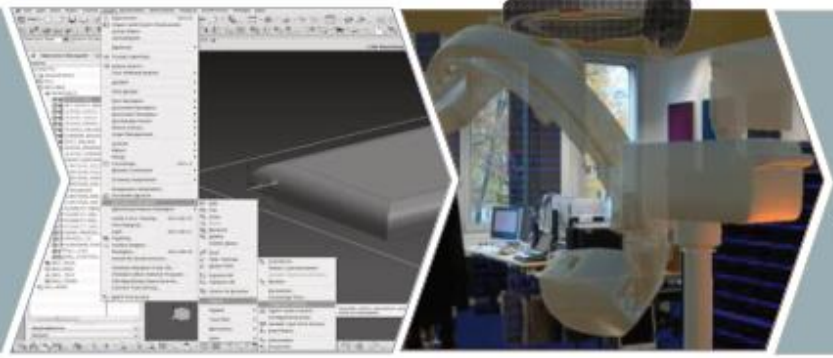


Design Exploration

Immediate evaluation in virtual reality instead of waiting for hours classical CAE tools to finish

Today

Simulation is restricted to dedicated simulation experts in late R&D phases



Tomorrow

Boost simulation in early phases by intuitive virtual design worlds for everyone

The Use of Mixed Reality for Manufacturing

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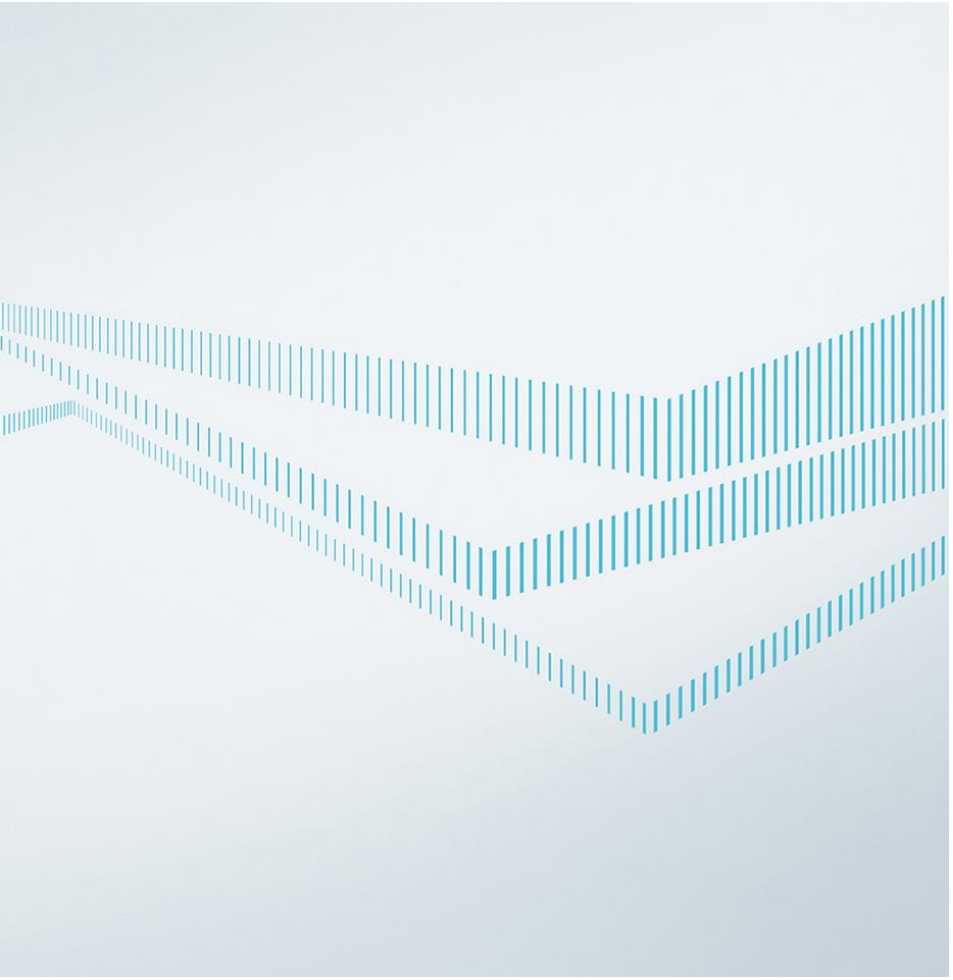

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