

EAGER: Cybermanufacturing: Enabling **Production as a Service** (PaaS)

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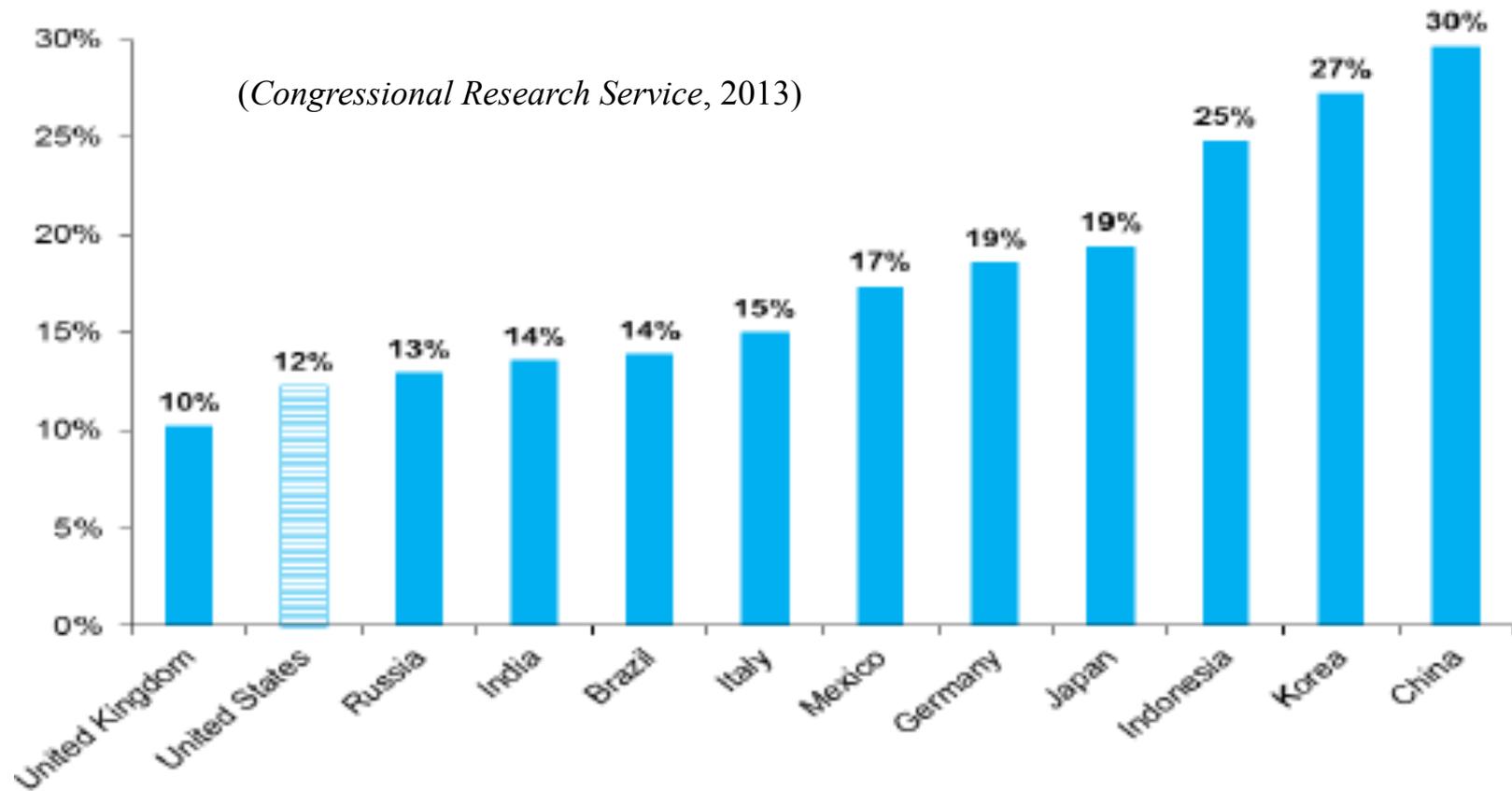
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CPS PI/Co-PI Meeting

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Manufacturing in the U.S.



Global Manufacturing Enterprise

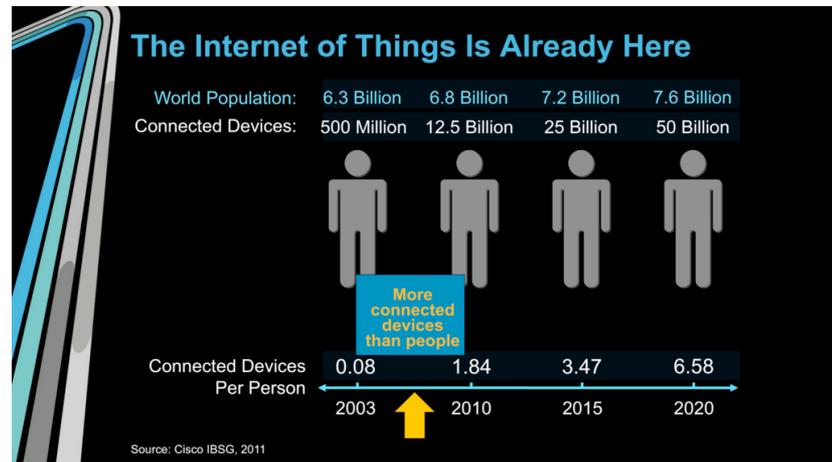
Manufacturing companies are under pressure to constantly modify their portfolio in order to adapt to an ever-changing social, economical, political, and commercial environment.

- Sustain positive growth
- Rapid introduction of new products
- Acquire new markets

And do this **quickly** and **cost-effectively**.

Cyber-Manufacturing Enablers

- Internet of Things (IoT)
 - Uniquely identifiable objects and their virtual representations



- Service Oriented Architectures (SOA)
 - Provides application functionality as services to other applications/vendors, cooperative service

SOA for Manufacturing Systems

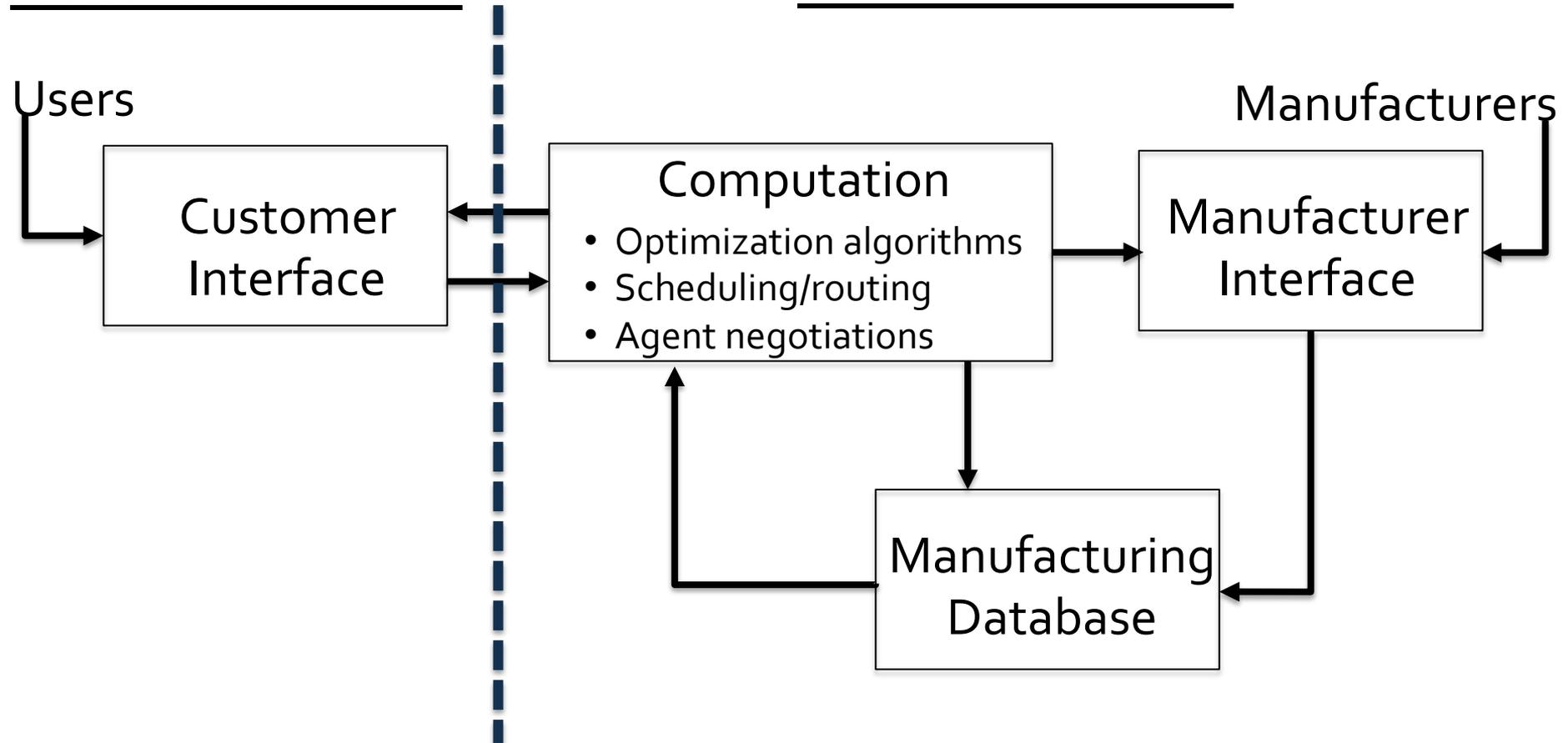
- Europe has been leading the charge with research in government funding but little evidence of implementation^[3,4,5].
- Gaps in existing approaches:
 - Only considered a single plant
- need ability to handle multiple resources
 - Security threats – minimize threats, preserve proprietary information
 - Costs analysis \$\$\$



EAGER: PaaS Platform

Front-End Interface

Back-End Interface



PaaS: Research Approach

- Extensible API and software interfaces
- Scheduling and routing algorithms
 - Balance production requests and existing tasks.
 - Optimize over cost, time, and quality.
- Agent-based negotiation / Hierarchical abstraction
 - Decouple manufacturing details from scheduling
 - Preserve proprietary information
- Model-based simulations
 - Predict outcome through simulation-based analysis

PaaS: Case Study - BorgWarner

BorgWarner – Cadillac, MI

- Manufacture shutters, fan drives, etc
- Dedicated lines: automated and manual
- Transport between facilities
- Sister facilities with similar products



Acknowledgements



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WHERE DISCOVERIES BEGIN



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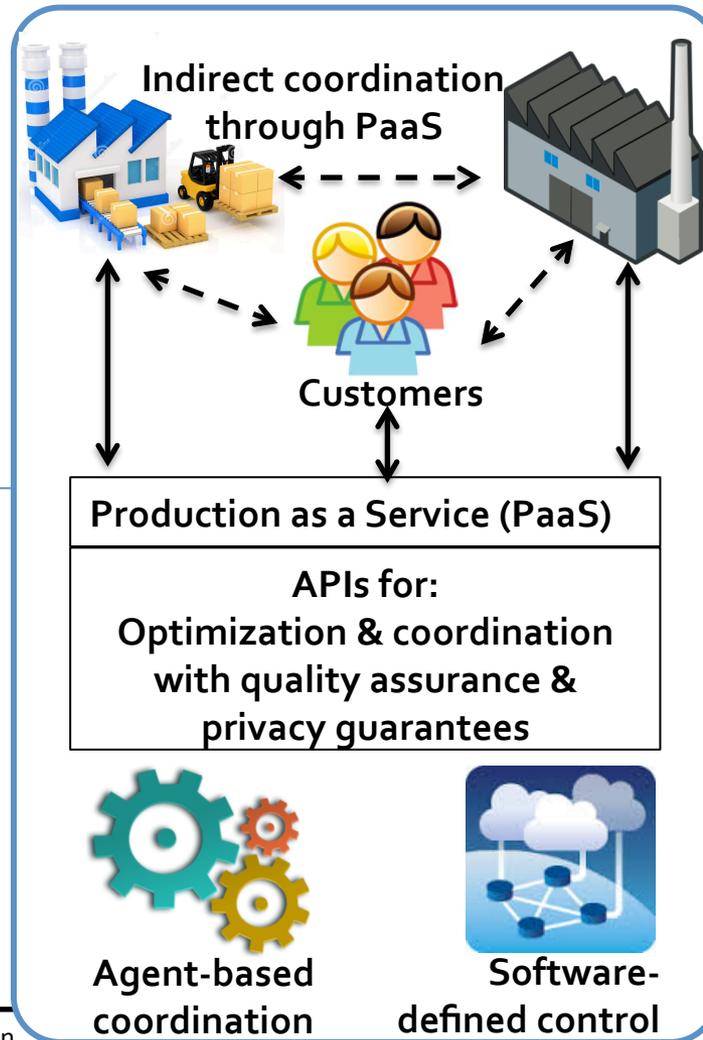
Project Summary (EAGER: Cybermanufacturing: Enabling Production as a Service (PaaS))

Challenge:

- Connecting customers to manufacturing facilities
- Multi-facility part fabrication
- Cost-effect and efficient fabrication options

Solution:

- Flexible interface for scheduling and routing
- Adaptive agent-based negotiations
- Hierarchical abstraction and management
- Extensible APIs



Scientific Impact:

- New science in software-defined networking (SDN)
- CP-API framework with information and physical interfaces
- Can extend to hospital logistics

Broader Impact:

- Leverage underutilized capital equipment and labor
- Mid-/small manufacturing compete for new customers
- Results integrated into CSE and ME courses