The 4th Industrial Revolution in ICT-Manufacturing Convergence

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KAIST

K-Industry 4.0 추진본부

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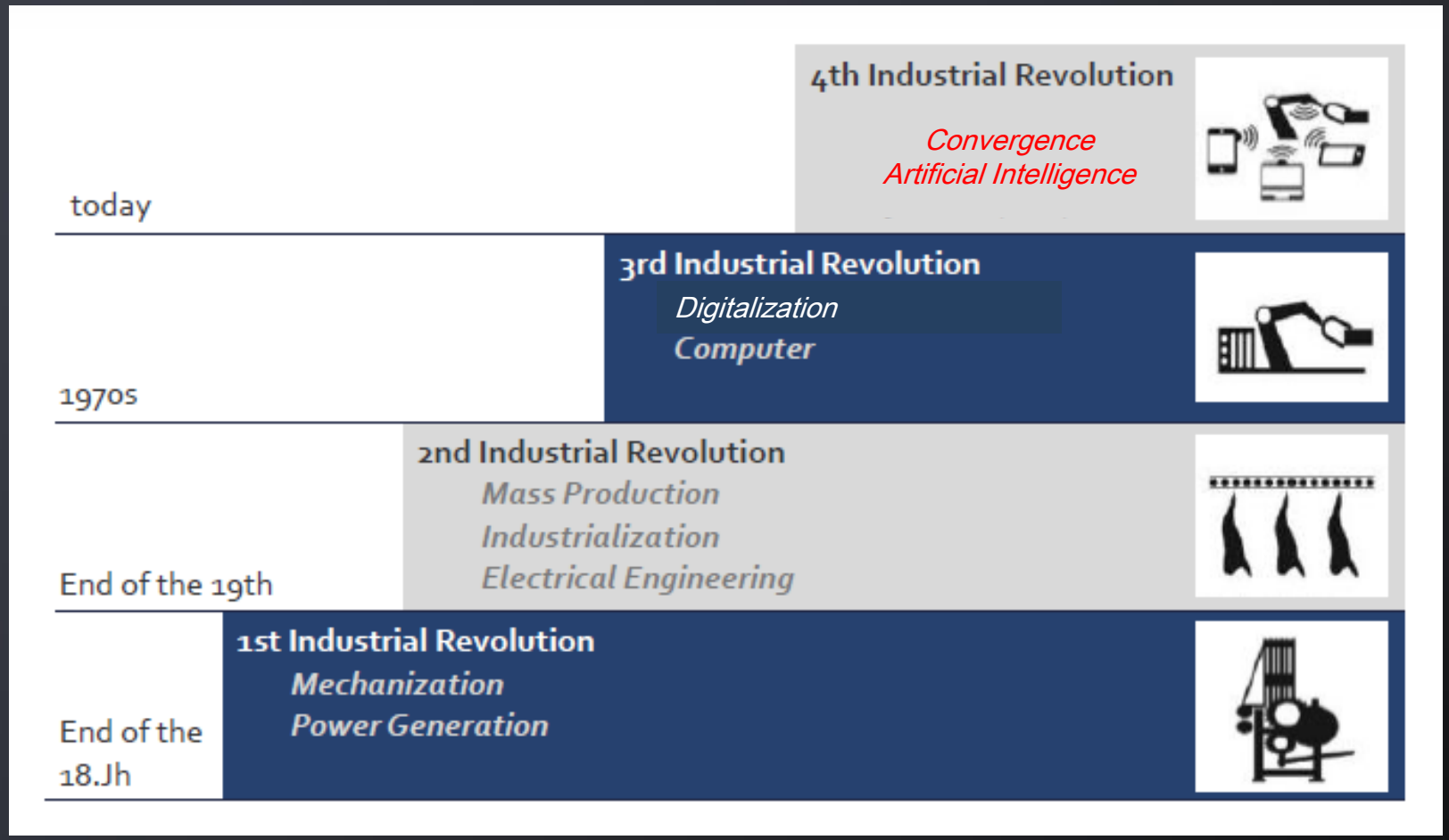
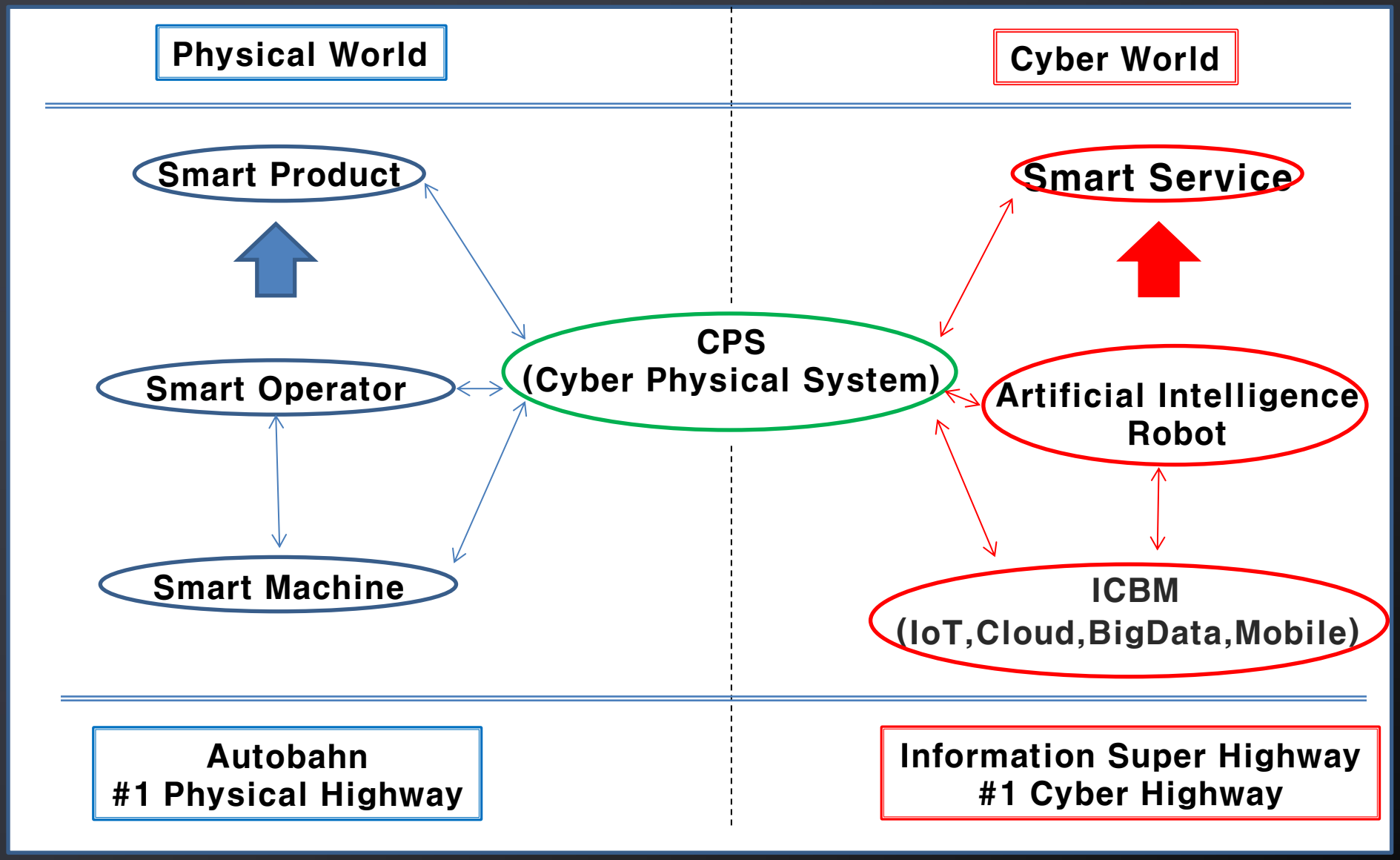
I. Definition and Characteristics

The 4th Industrial Revolution

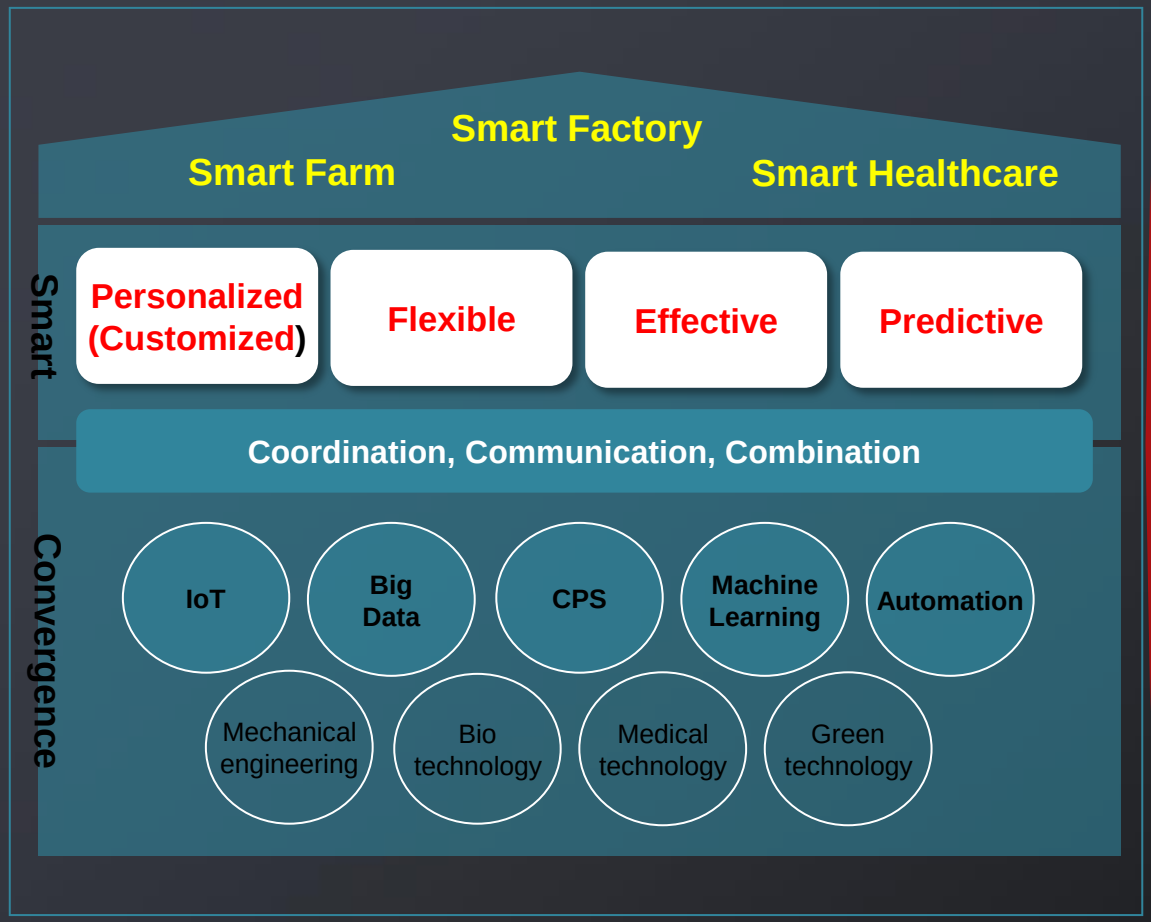


The 4th Industrial Revolution for Connected and Converged World



Ⅱ. ICT-Manufacturing Convergence

ICT-Manufacturing Convergence Model



Research Areas

Future Application & Service

- Service scenario
- Service-oriented architecture
- IoT, M2M

Data Analysis & Understanding

- Big data analysis
- Data mining
- Machine learning algorithm

Smart Factory _ Personalized Product & Digitalization

주요 개인맞춤형 상품: Futurecraft 제품

- 3D 프린팅 기술을 활용한 개인 맞춤형 신발 Mid-sole 생산 기술
- 러닝머신에서 뛴 결과를 바탕으로 발 모양 및 운동 습성을 파악해 즉석으로 신발 생산 가능
- 주요 기술 (Materialise사 제공):
  소재 및 인체공학적 설계 (유연성과 견고성이 고려한 소재 및 다지안)
  3D 프린팅 (유연성과 견고성이 갖춘 제품 3D 프린팅)
  적층 가공(Additive manufacturing)
  데이터 분석 (발모양 스캐닝을 통한 발 굴곡 및 압점 파악, 디자인 연계)

adidas & materialise

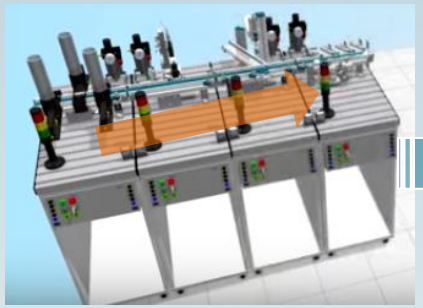
Adidas사 Speed Factory

- 로봇 및 3D 프린팅 기술을 활용한 소비자 맞춤형 신발 대규모 생산 계획
- 배경: 신흥제조국의 임금 상승에 따른 제조비용 상승 및
  소비자의 개인맞춤형 제품 니즈 증가
- 효과:
  1) 현지 생산: 독일 안스바흐 및 미국 애틀란타 공장 설립
  2) 공급망 단순화: 물류/보관 비용 절감, 생산속도 향상
  3) 소비자 맞춤형 대량 생산: 5시간 내 생산 (기존 아시아공장 1주 소요)

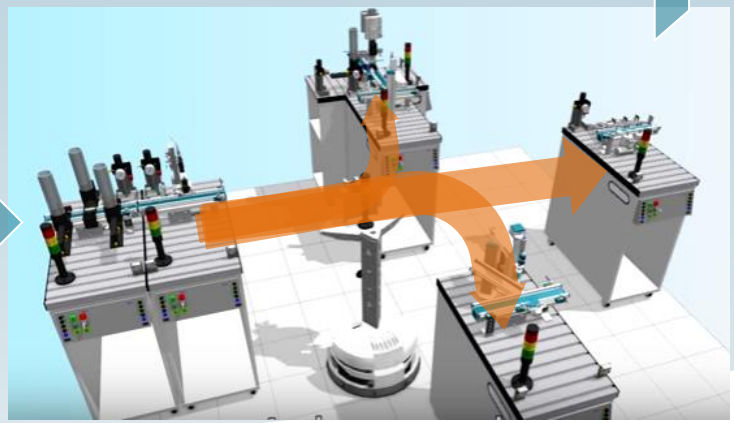
Smart Factory _ Flexible Manufacturing

[Festo's AutoPnP]

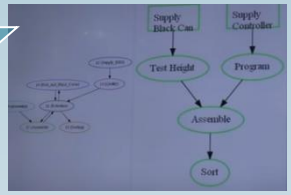
- Open software architecture for 'Plug & Play for Automation System'
- The created production plan can be flexibly executed with configurable plant layout and respective production order (No set-up time)
- AutoPnP demonstration showed 18 different products and variants are manufactured with modular production system
- Key features :
  Auto-configuration (production plans adjusts production lines)
  Modular production system (multi-function and programmable)
  Reference software architecture and standard communication



[Assembled line]



[Flexible line]



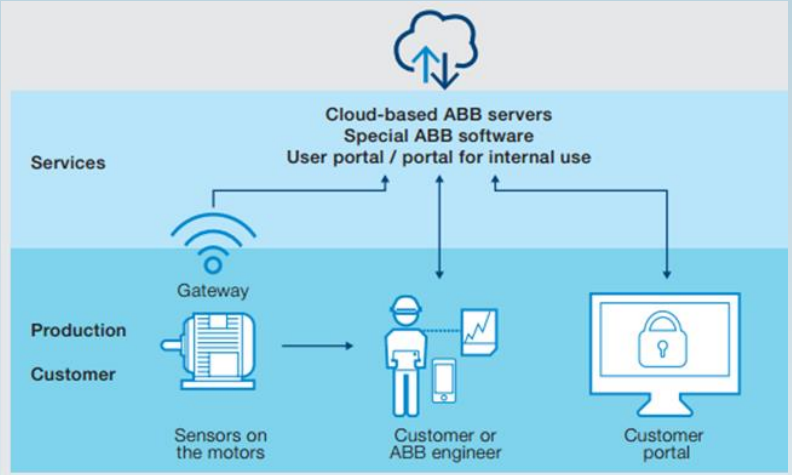
[Production Plan]

FESTO fortiss DAI-Labor Distributed Artificial Intelligence Laboratory Fraunhofer IPA

Smart Factory _ Predictive Maintenance

ABB사 Smart Sensor & Condition Monitoring Solution

- ABB사는 로봇, 파워시스템, 자동화 관련 다국적 엔지니어링 회사 (포춘지 500대 기업 선정)
- 공장 구동력인 모터의 주기적 정기검사는 기계상태에 대한 정확한 진단이 어려워 예상치 못한 고장 발생에 따른 손실 발생
- 설치가 용이한 스마트센서 및 클라우드 기반 기계상태 지능적 모니터링 솔루션을 개발을 통해,
  소비자에게 운영중단시간 70% 감소, 기계수명 30% 증가, 에너지소비 10% 절감 효과를 제공
- 주요 기술 :
  스마트 센서 (설치용이한 부착식 센서, 진동/열 등 진단 관련 복수 정보 수집)
  클라우드 기반 기계상태 모니터링 시스템 (산업용 IoT + 데이터 분석 + 사용자 어플리케이션)



부착식 Smart Sensor

모바일 어플리케이션

ABB

Smart Factory _ Best Practice

[Siemens Amberg' Electronics Works Amberg]

- Siemens Amberg: 1989 established with about 1000 employees => still 1300 employees in 2015
- 12 Million PLCs per Year for 60,000 customers worldwide => Transformer Factory
- **Improved defective rate as 0.0012%** [(Before) 500 defects per million product → (After) 12 defects per million products]
- **700% increased production volume with keeping employment** (Highest performance with human-centric production)

People: 1,300 qualified employee
Products: 1,000 variants to control, operate and observe
Processes: 1 product per second

Lean Enterprise Principles
&
Digital Enterprise Principles

Reducing time-to-market

- 5,000 work plan changes
- 120 variant types based on 75% automation
- 50M process & product data

Enhancing flexibility

- 350 changeover per day
- 99.5% delivery reliability
- 20% personal capacity flexibility

Increasing efficiency

- 75% line utilization (plus 20% flexibility)
- 99,9988% non-defect product
- 33% increase of utilization per year

Smart Factory _ Best Practice

[Siemens Amberg' Electronics Works Amberg]

- Key features :
  Industrial IoT: data collection with sensors
  Big data analysis and automatic process optimization

1 Data Collection (IoT)

- Attaching sensors to each facility.
- IoT communication system construction

2 Store and Analysis(Cloud/Big Hata)

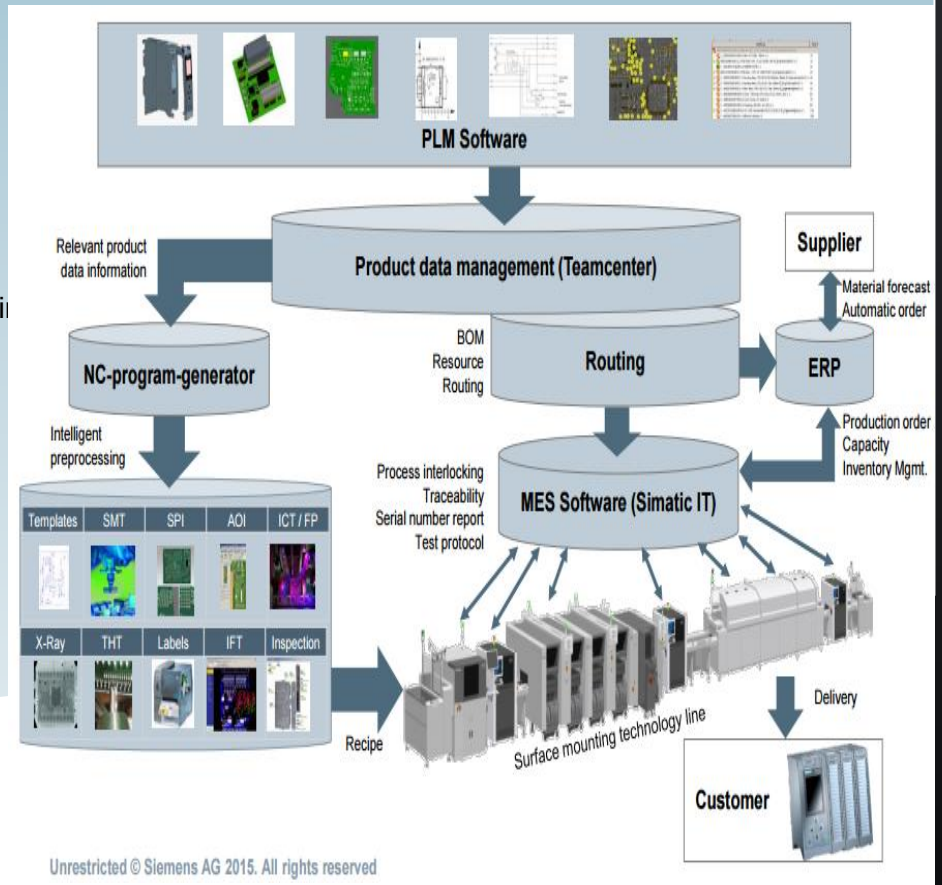
- Operation information, production information, and quality i
  ion between assembling processes
- Real-time automatic analysis

3 Value Creation (AI)

- Analysis and control of real-time factory operation status

4 Optimization (Convergence)

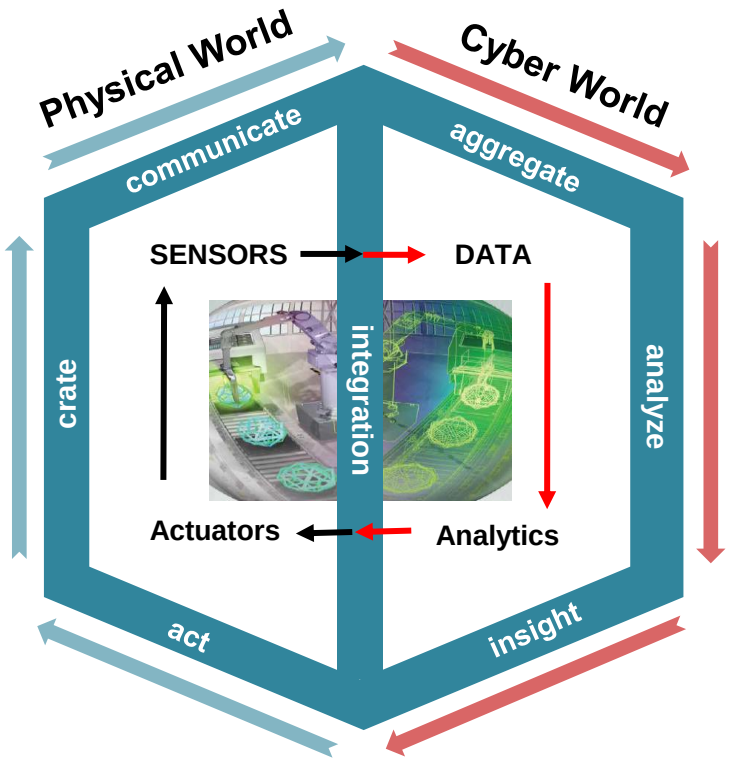
- Intelligent automation
- Defect ratio 1/40, energy cost reduced by 30%



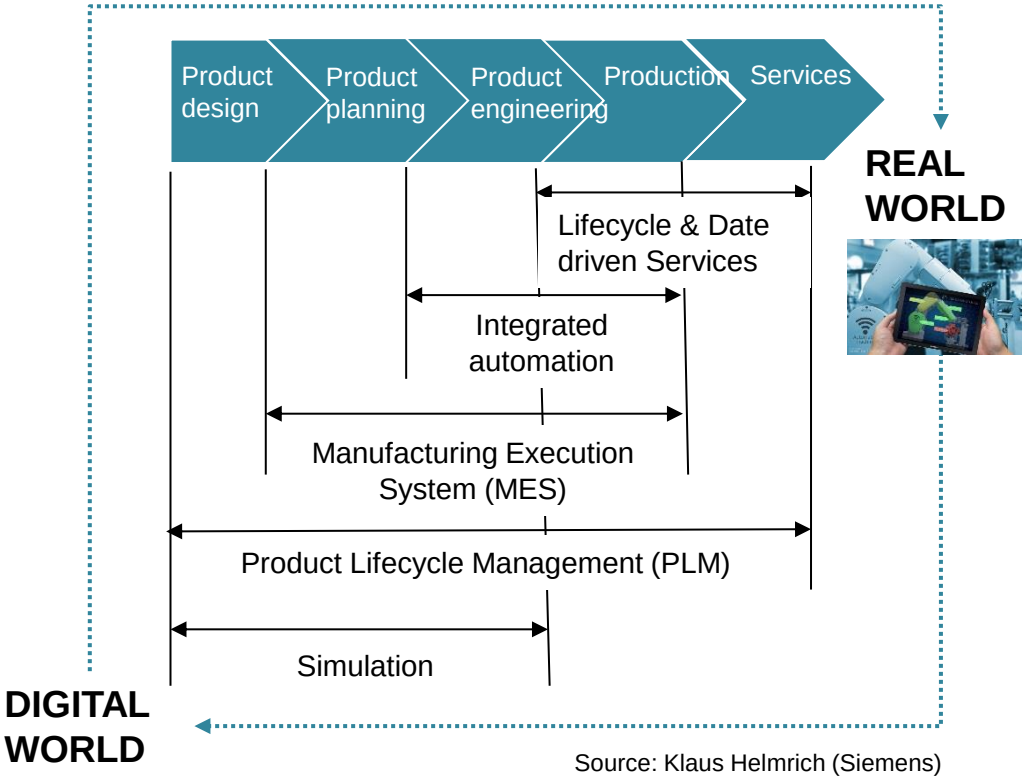
Manufacture Twice!

- First in Cyber World, Second in Physical World -

a dynamic digital representation of an industrial asset across the whole business value-chain, that enables companies to better understand & predict the performance of their machines and find new revenue streams, and change the way their business operates.



Source: based on Deloitte University Press.

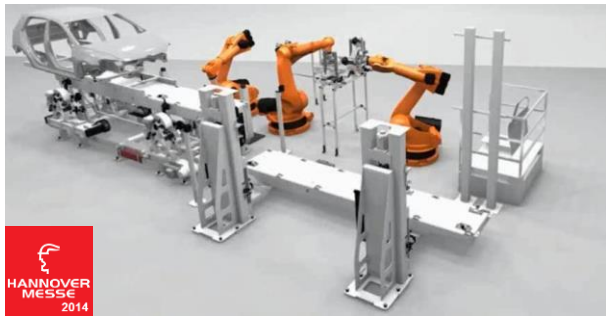


Source: Klaus Helmrich (Siemens)

DIGITAL TWIN

- One of Gartner's Top 10 ICT Strategic Technology 2017 & 2018 -

At the last year, **the focus was on applications for larger enterprises…**



Production line for the automated installation of VW

Nowadays, **on scalability of solutions in small- and medium-sized enterprises.**

Digital model

Realized vacuum packaging machine

SIEMENS

Personalized	More than 500 different product models managed and updated
Flexibility	6 new product models designed every year from scratch
Time to market	Working prototypes ready one month after design completion

Ⅲ. Strategy for 4th Industrial Revolution

We are facing to ...

New Innovative Economy

4th I.R. = 3C

4th Industry Revolution

- **Convergence**
- **Creation**
- **Commercialization**

3 Steps and Action Strategy

	Convergence	Creation	Commercialization
Culture	▪ Open/Share/ Participation ▪ Convergence Forum	▪ Think Different ▪ Open Innovation	▪ Challenging Spirit ▪ Entrepreneurship
System	▪ Project for Convergence Research ▪ Inter-agency Staffing	▪ IP Protection/Compensation ▪ Support Trial Manufactured Goods	▪ Investment-based Financial Aid ▪ Regulation Sandbox
Infra.	▪ Joint Research Center ▪ Open Lab.	▪ Fabrication Lab ▪ Do-It-Yourself room	▪ Incubator ▪ Market for Innovation

Vielen Dank!

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