Industry 4.0 – Overall Significance and Implications to NDT

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Industry 4.0
Answer to Technological Developments

In
Digitization, Networking, Internet, Cloud Computing
Artificial Intelligence, Internet of Things, …

To be Used for
Increase in Production, Manufacturing
Considered as 4th Industrial Revolution

Industrial Revolutions

Wikipedia
In Germany Project Industry 4.0 founded 2011 at Hannover Fair
Supported by Government (BMBF) with Large Financial support**

** Today mostly used by Research Institutes and Large Companies
(Offering Solutions and Equipment)

Industry 4.0
Support For
Small and Medium Sized Business

- Increase Participation in Innovations
- Strengthen Innovation Competence
- Improve Support for R&D and Innovation
- Strengthen Innovation Possibilities in East Germany
- Improve Participation in Technical Programs in R&D

Result:
Smart Factory
Consequences for NDT – NDT 4.0

e.g. Mercedes, May 2018
Factory 56
Including Industry 4.0
Smart Factory and NDT 4.0
Implications to NDT 4.0

SMB in NDT:
Production of NDT Equipment with/without Machining Tools

Material, Raw Product With Intelligent Sensor

Automated Handling In All Process Steps
Predictive Maintenance

Automated Inspection IO, NIO

Inspection 1 → NIO
Inspection 2
Inspection 3 → IO

Big Data!

Digital Twin

ImplicationstoNDT 4.0

Digital Twin
Automated Systems in NDT with Automated Decision (examples), Magnetic Powder Technique

Karl Deutsch GmbH 1981
Dr. Sauerwein Isotopenforschung GmbH 1989
K+D Flux-Technic GmbH 2008
Included in Big Data!

Archiving Traceability

Images: Helling GmbH; Image Processing System: BAM ic
Big Data!

Cloud
IOT
Cyber Phys

Surveillance
Raw, Machining, Inspection, Assembly, Statistics,
Quality Assurance,
Archiving, Reprocibility, Traceability, Connectivity, Interface

Customer
Supplier
Platform

Big Data!
Analytics Algorithms*

All Data in Principle Available for All Interesting Parties

*Complicated Situation: Solution by Algorithms versus Complex Situation: Solution by AI
After Assembly

In Operation With Sensor

Service Information Through SHM

Predictive Servicing

Big Data
German Society for Non-Destructive Testing DGZfP

Technical Committee: ZfP 4.0

Sub-Committees:
- Additive Manufacturing (WG)
- Interface, Documentation
- Intelligent Sensors
- Machine-Human Interaction
- Education and Training
## SWOT Analysis

### Strengths:
- Digitized Information
- Easy Provided for All Parties
- Data Analysis

Horizontal and Vertical Exchange of Data through:
- Cloud
- Cloud Computing
- Platforms

### Weaknesses:
- Connectivity between Machine and Humans
- Standards of Digital Interfaces
- Available Personal with Adequate Qualification
- Lack of Support for SMC
- Cost for Personal and Investment in Equipment

### Opportunities:
- Increase of Production
- Digital Interface between All Internal and External Procedures
- Completely Automated NDT System
- Real Time Analysis
- Real Time Detection of Problems in Development, Production, Inspection
- New Business SHM
- New Training, Education
- Use of AI

### Threats:
- Acceptance by Employees
- Loss of Know How through Internet Connections
- Lack of Qualified Personal
- Hacker Attacks
- Acceptance by Society
CEO’s of SMB Reluctant to Join NDT 4.0!

- Lack of Qualified Personal
- Cost of Qualified Personal
- Cost of Equipment
- Lack of Immediate Advantage

Hype (Duden)
Powerful promotion, inducing euphoric excitement for a product!

Not essentially bad!

Question: When to Join the Hype-Curve?

CEO: Wait and See?

Exp

Peak of Inflated Expectations

Direct Transition?

Plateau of Productivity

Slope of Enlightenment

Trough of Disillusionment

Enthusiasm

Innovation Trigger
Whatever Could be Thought of
  • If Physically Achievable
  • If it Makes Sense
Will be Realized!!!

(Sometimes it Will be Realized
  • Even if it Makes No Sense!)
Smart Factory and NDT 4.0

Supplier

Cloud IOT Cyber Phys

Platform

Customer

Surveillance
Raw, Design, Machining, Inspection, Assembly, Statistics, Quality Assurance

Machining 1

Machining 2

Machining 3

Inspection 1

Inspection 2

Inspection 3

NIO

IO

Assembly

SHM

Operation With

Material, Raw Product With Intelligent Sensor

Automated Handling In All Process Steps

Automated Inspection IO, NIO

Service Information Through SHM
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