Redefining Digital Transformation for Societal Well Being
in a Sustainable Environment

ACHIEVING GLOBAL SUSTAINABLE DEVELOPMENT GOALS IN INDUSTRY 4.0 CONTEXT THROUGH COLLABORATIVE INNOVATION

International Conference on Computing and Applied Informatics 2020
1 December 2020

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Examples of Collaborative Research and Innovation Projects

Part I

THE INDUSTRY 4.0 AND ITS IMPLICATIONS

WHAT IS INDUSTRY 4.0?

(Ovtcharova & Wicaksono 2017)

INDUSTRY 4.0 TECHNOLOGIES

Advanced and
Multimodal
Interaction

AR, VR, MR

Advanced
Robotics

3D Printing

Intelligence

Big Data
Analytics

Artificial
Intelligence

Infrastructure and
Interconnection

IoT

Linked Data

Cloud
Computing

THE PILLARS OF INDUSTRY 4.0 END-TO-END SOLUTION

(Wicaksono 2018)

IMPLICATIONS ON INDUSTRIES: DATA DRIVEN SERVICE

Airplane engine +
real time monitoring,
predictive maintenance,
optimization service

Farming machines +
Farm monitoring, social media
<https://myjohndeere.deere.com>

Sport shirt +
Health monitoring, early
warning system

Physical product (local) + digital service (global)

(Wicaksono 2019)

IMPLICATIONS ON JOBS

Self-driving cars could cost America's professional drivers up to 25,000 jobs a month, Goldman Sachs says

Anita Balakrishnan | @MsABalakrishnan
Published 2:45 PM ET Mon, 22 May 2017 | Updated 7:57 PM ET Mon, 22 May 2017

APR 25, 2016 @ 02:02 AM 170,532

3 Free Issues of Forb

Surprisingly, These 10 Professional Jobs Are Under Threat From Big Data

- Some jobs won't exist anymore, even service based jobs
- Less amount of jobs and more specialized jobs
- Jobs requiring care will still survive

JOBS AT HIGH RISK OF AUTOMATION

Source: UNIDO

Source: UNDP

4 PILLARS OF INDUSTRY 4.0 SOLUTION IN MANUFACTURING

Smart Process/
Operation

Connected department,
organizations,
suppliers

Smart Product

Self-identifying and
reporting product everywhere

Smart Resource/
Infrastructure

Smart factory, human-robot collaboration,
3D printing

Data Driven Service

4 PILLARS OF INDUSTRY 4.0 SOLUTION IN AGRICULTURE

Smart Process/ Operation

Connected farmers,
suppliers, market

Smart Product

Self informing crop

Smart Resource/ Infrastructure

Automatic watering,
smart transport,
smart warehouse

INDUSTRY 4.0 IN DIFFERENT SECTORS

Industry
4.0

Part II

THE ROLES OF INDUSTRY 4.0 IN ACHIEVEING GLOBAL SUSTAINABLE DEVELOPMENT GOALS

THE GLOBAL SUSTAINABLE DEVELOPMENT GOALS

Integrated approach
for a better future
through the balance of
social, economic and
environmental
sustainability.

Source: Stockholm Resilience

ENERGY 4.0: SMART CITY AND VPP

Technologies

Virtual Power Plants (VPP)

Source: BMWI

SDG

AGRICULTURE 4.0 AND AQUACULTURE 4.0

Technologies

Image: <https://www.agroberichtenbuitenland.nl/>

<http://fish4intl.eu/>

SDG

WHAT SHOULD BE IMPLEMENTED IN INDONESIA?

1. Wider impacts especially for people living in villages
2. Optimizing the value and efficiency of key natural resources of Indonesia.
3. Focusing on *human skill*, not *human strength*
4. Optimizing the roles of all societal elements through ecosystems (villagers + start-ups+ SME+ government + researchers/academia).
5. Bringing Indonesia to be *leader*, not *follower*.

Agriculture 4.0

Aquaculture 4.0

Mining 4.0

Energy 4.0

Healthcare 4.0

Part III

THE COLLABORATIVE INNOVATION MODEL

THE TRIPLE HELIX INNOVATION MODEL

Model 1

Model 2

Model 3

TYPICAL INNOVATION FUNNEL (CLOSED)

OPEN INNOVATION MODEL

(Tidd & Bessant, 2009)

TRIPLE HELIX IMPLEMENTATION IN GERMANY

2: OPEN RESEARCH AND INNOVATION PROJECTS

Project Examples

TRIPLE HELIX MODEL AND SUSTAINABILITY

(based on Carayannis et al 2012)

Part IV

EXAMPLES OF COLLABORATIVE RESEARCH AND INNOVATION PROJECTS

ecobalance

- **IoT and cloud** architecture
- Statistical analysis and **machine learning** approach to identify **energy profile of each industrial machine** and process
- **Forecasting of costs and power consumption** and costs of customized product
- **Hyper heuristics optimization** model for production planning and control with power peak avoidance, having lowest costs, and on-time lead time
- Applied in a metal processing SME

INTEGRATED SMART ENERGY SYSTEMS USING KNOWLEDGE GRAPH AND MACHINE LEARNING

- District model of smart energy system integrating local renewable energy source
- Linked-data/ knowledge graph to integrate heterogeneous datasources (open data, metering data, simulation data) on semantic level
- **Machine learning** to forecast power generation and building specific power consumption
- **Energy simulation** to estimate energy and heating demand
- Hyper heuristic optimization for optimal renewable energy infrastructure planning

- Changing the power demand side to meet the availability of green energy
- **Machine learning** for forecasting of power consumption and generation
- **Semantic middleware** based on knowledge graph for system interoperability and realtime communication between electricity provider and consumer
- **Dynamic price estimation**
- **3D simulation** for manufacturing planning and renewable energy integration

CONCLUSIONS

- Smart PPR and data driven business are pillars in industry 4.0 ecosystem
- Triple helix model 3 is required to accelerate innovation
- Open innovation instead of closed innovation
- No interdisciplinary, no innovation
- Sustainability is both impulse and constraint of innovation

**THANK YOU FOR
YOUR ATTENTION.**

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