IOT IN SMALL SCALL RENEWABLE ENERGY PRODUCTION: BLOCKCHAIN FOR DIGITAL MANUFACTURING OPERATIONS IN WIND INDUSTRY

Michail J. Beliatis, BEng, MSc, PhD Associate Professor, #DBD, #DIGI Lab email: mibel@btech.au.dk @MichailBeliatis



SMALL WIND CONFERENCE MICHAIL BELIATIS 21 SEP 2022 ASSOCIATE PROFESSOR



LOCATED IN DENMARK AT HERNING AU BTECH CAMPUS

Do your research or PhD at a top 100 university Aarhus BSS conducts research within the fields of economics, business, political science, business communication, law, psychology, business development and technology.

- > 80+ nationalities on campus
- International top researchers and lecturers
- > Independent and informal research environment
- > Strong ties to private and public organisations
- > Special Danish tax scheme for foreign researchers









ABOUT ME-MICHAIL J. BELIATIS: BENG, MSC, PHD

I work at Aarhus University in Herning campus. email: <u>mibel@btech.au.dk</u>, office 267 Innovatorium 2nd floor @ DBD Center

Wide background: Electical, Electonics, Software and Nanotechnology Studied in UK: BEng on Electrical, Electronics & Software Engineering

MSc on Telecommunications and digital signal processing

PhD on Nano Materials, and Manufacturing with Laser processing, R2R printing, plasmonics Thin film coatings, PVD (DC, AC magnetron) CVD (carbon), Thermal evaporation, PLD (laser), Wet

coating for Newtonian fluidic solutions, Digital Instruments and Fabrication Tools.

Many years work experience, in engineering, research & project management Worked in Industry as 1 Electronic product design engineer – Mitsumi (BT, Submarine Bat. Apl. PLED) as 2 System Engineer for manufacturing automations – ASH (PLC, SCADA, Mechtr) in Academia at various Research Innovation and Development (RI&D) positions Responsible manager for **#DIGI Microfactory Lab** at BTECH Head of Digital Manufacturing research group at BTECH



AND TECHNOLOGY AND TECHNOLOGY AARHUS UNIVERSITY



NOW DAYS!



Research Interest: Digital Manufacturing, IoT, Industry 4.0/5.0, Robotics, Mechatronics, Digital transformation (Digitalization) for Optimizing Production, Blockchains, Smart buildings, Digital business model innovation, Circular Economy, Sustainability, Recycling Materials, Additive Manufacturing/3D Printing.

Involved in research projects both in managing and RI&D

Leading the development of several new research labs and didactic courses, such as the **#DIGI LAB** and #Enabling Technologies for Digitalization of Manufacturing, Advance Product Development.



DEPARTMENT OF BUSINESS DEVELOPMENT AND TECHNOLOGY



#RESEARCH - TEACHING



SMALL WIND CONFERENCE MICHAIL BELIATIS 21 SEP 2022 ASSOCIATE PROFESSOR



DIGITAL TECHNOLOGY INTERVENTIONS HOW WE DO TYPICALY RESEARCH IN WP6

Interviews + deploy/develop digital systems + evolution of digital maturity + observations / experiments in labs



AGILE DEVELOPMENT PROCESS

Deploy digital systems on site in manufacturing shopfloors.



SMALL WIND CONFERENCE 21 SEP. 2022

MICHAIL BELIATIS ASSOCIATE PROFESSOR



MY LAB: THEME-DIGITAL, LEAN & GREEN FACTORIES OF FUTURE & MANUFACTURING





DEPARTMENT OF BUSINESS DEVELOPMENT

SMALL WIND CONFERENCE MICHAIL BELIATIS 21 SEP. 2022 ASSOCIATE PROFESSOR



LIOT DIGITALIZATION FOR CIRCULAR ECONOMY – CIRCLE GLASS PROJECT

To become green we need to be first competitive at business level -> Industrial IoT (industry X.0) enabler for improved efficiency, business competiveness and green, circular economy supporting material recovery or regeneration.



Target sectors

- Local Industry
- Wind Industry
- Food Industry
- EV Automotive Industry









DEPARTMENT OF BUSINESS DEVELOPMENT

ARHUS UNIVERSITY

SMALL WIND CONFERENCE MICHAIL BELIATIS 21 SEP 2022 ASSOCIATE PROFESSOR

#DIGI LAB – I ESTABLISHED A LAB FOR RI&T





DEPARTMENT OF BUSINESS DEVELOPMENT AND TECHNOLOGY AARHUS UNIVERSITY

WIND CONFERENCE MICHAIL E 21 SEP. 2022 ASSOCIAT

MICHAIL BELIATIS ASSOCIATE PROFESSOR



#DIGI LAB – ESTABLISHED A LAB FOR RI&T

#Digi lab is a testbed/playground microfactory for students, researchers and companies with many digital technologies focusing on:

- Efficient Assembly/Disassembly of Robotic Autonomous Electric Vehicles (mini RC)
- IoT / IIoT / Industry X.0
- Edge / cloud computing
- Digital LEAN Boards
- AI / ML / DL, Manufacturing Vision, PLC
- Telecoms 4G, 5G-LoRa etc.
- Robotics, Mechatronics
- 3D hybrid manufacturing Materials/ Biomimetics
- SCADA, PLC Digital warehouse/supply chair
- Sustain. Energy PV, Hydrogen, Wind, Batteries, Biofuels







TOOLS FOR PROJECTS AND ASSIGNMENTS IN DIGI MICROFACTORY LAB





BLOCKCHAIN FOR ECONOMY OF SCALE IN WIND INDUSTRY: A DEMO CASE

Special thanks to the entire project team: Parwinder Singh, Kristoffer Holm, Andrei Ionita, Mirko Presser, Prinz Wolfgang, René C. Goduscheit



SMALL WIND CONFERENCE MICHAIL BELIATIS 21 SEP 2022 ASSOCIATE PROFESSOR



USE CASE OVERVIEW

Danish wind industry related study is conducted under project "Unwind" to:

- How to keep transparent and traceable all manufacturing and service operations for wind turbines of small and large scale over their entire life (25 years)?
- Identify and map component/processes of supply chain with potential benefits from Blockchain technology.
- Focus on bolts and fasteners life-cycle oriented challenges such as digital traceability, cross organizational data sharing and relevant quality assurance/validation.
- □ The stakeholders of wind industry supply chain consists:
 - Wind turbine manufacturers (owners, operators, decommissioning staff..)
 - First tier (bolt and fastener) suppliers of commodity components
 - Turbine maintenance related service organizations.

Demo developed leveraging modern digital technologies:

Blockchain, QR/Bar codes, IoT, Node-Red and Edge computing.







#DIGI MICROFACTORY LAB

WHY BLOCKCHAIN ?

Immutable	 Data Manipulation not possible
Transparent	 Transparency to all stakeholders
Traceable	 Ownership and Accountability
Highly Secure	 Encrypted and Tampered proof
Trustable	 Promote Trust among stakeholders
PKI(X.509)	 Similar at core to traditional VPN/HTTPS
Distributed	 Fault tolerance and highly available
Peer2Peer	 Intermediary agnostic



[K. Wüst and A. Gervais, "Do you Need a Blockchain?," 2018 (CVCBT)]



SMALL WIND CONFERENCE MICHAIL BELIATIS 21 SEP. 2022 ASSOCIATE PROFESSOR

ARCHITECTURE





THE DEMO IN DIGI MICROFACTORY LAB





SMALL WIND CONFERENCE MICHAIL BELIATIS 21 SEP. 2022 ASSOCIATE PROFESSOR



REGISTRATION INTERFACE – INPUT/OUTPUT

Bolt registration Bolt Supplier: Location: uk Batch size: Model: 100 Employee ID: Material: 123 Documentation: Choose File No file chosen Submit

Bolt batch data was successfully saved in the blockchain.

Please scan the QR code to retrieve the bolt batch from the blockchain.





DEPARTMENT OF BUSINESS DEVELOPMENT

AARHUS UNIVERSITY

SMALL WIND CONFERENCE MICHAIL BELIATIS 21 SEP. 2022

ASSOCIATE PROFESSOR



PROGRAMMING INTERFACE (NODE-RED)



AND TECHNOLOGY

AARHUS UNIVERSITY

SMALL WIND CONFERENCE MICHAIL BELIATIS 21 SEP. 2022 ASSOCIATE PROFESSOR



VALUE ADDITION

- Digital identification of physical assets in supply chain and semantic mappings to the relevant events.
- □ IoT enabled real time data driven and error prone operations.
- During maintenance phase, any anomalies on component such as broken bolt can be identified, traced back to others and correlated for pro-active actions.
- Blockchain is providing capability of:
 - digital traceability of wind turbine events in its life cycle.
 - transparent data sharing in trustable manner among different stakeholders
 - improvement in quality assurance/validation during operations
 - guaranteed immutability of information.
 - event associated decisive ownership in multistakeholder environment.







DEPARTMENT OF BUSINESS DEVELOPMENT AND TECHNOLOGY AARHUS UNIVERSITY

Michail J. Beliatis, BEng, MSc, PhD Associate Professor, #DBD, #DIGI Lab email: mibel@btech.au.dk @MichailBeliatis