Battery production systems

State of the art and future developments

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Background

- Electrification altering the industrial landscape, especially automotive sector
- Europe and US are rapidly increasing their battery production capacity
- Net Zero Industry Act setting high manufacturing capacity goals for batteries and other clean technologies in Europe
- European level: many initiatives for upskilling, greener mobility, decarbonization
- National level: Sweden positioned to be a globally leading battery producer/exporter
- Company level: many large battery plants being built around Europe
- **Urgent need for skills and competences to support sustainable battery production, resilient value chains, and an industrial ecosystem from raw materials to finished products**

Purpose

- Stimulate research and development of sustainable and cost-efficient battery manufacturing
- Propose directions for further work based on production research state of the art
- Discuss nine subtopics under three overlapping themes related to Industry 5.0:

Human-centred production

Skill gaps and competence development

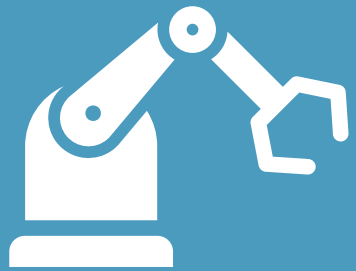
- Developing news ways to measure skill gaps, what competences and knowledge should be developed to meet industrial needs
- Developing new ways to address the skill gap and skill shortage, how to create and deliver training, on-the-job-learning and individualised learning paths

Ergonomics and human factors

- Addressing new ergonomic and cognitive challenges related to the nature of battery and electric vehicle production processes
- Adapting physical and cognitive workload assessments accounting for variable human-robot task distribution (increased automation and flexibility)

Automation and human-robot collaboration

- Promoting human-centred automation to address skill shortage and safety concerns
- Ensuring system integration/interoperability through standardization for higher levels of automation and easing communication between humans and machines
- Using automated systems to capture specialised knowledge and skills, lowering the demand on the human workforce in battery production



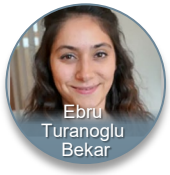
Smart production management

Production planning and control

- Developing new planning and control methods to keep up with the rapidly rising demand for batteries and increased production systems complexity
- Capitalising on greenfield development to build fully digitalised systems, as opposed to upgrading older equipment and systems (brownfield development)

Smart maintenance

- Prioritising production maintenance to ensure stability, efficiency, and quality for continuous production of batteries
- Developing data-driven decision-making enabling smart planning and control, predictive maintenance (predicting failures and risks) and autonomous maintenance (proactive and preventive measures)



Production quality and battery performance

- Optimizing key parameters of production quality with the most impact on battery life and performance
- Assessing battery state of health to extend battery life and identify optimal circular pathways when reaching the product end of life

Sustainable manufacturing value chains

Circular economy

- Prioritising the development of battery materials, battery technologies and industrial processes with minimal ecological impacts
- Developing industrial ecosystems to realise the full potential of battery-powered products through extended battery life and value recovery at the end of life

Service-based business models

- Servitization can support extending the use phase of battery-powered products, increasing value captured and delivered from tangible assets
- Service-based business models can support traceability of critical components and materials, promoting value retention
- Shifting responsibilities and ownership from customers/users to OEMs promote life extension

Transparency and resilience in supply chains

- Digitalizing supply chains to support stakeholder collaboration
- Exploiting IoT and blockchain technologies for more ethical and environmentally responsible battery manufacturing value chains
- Exploiting advanced data analytics to optimize each process in the production value chain accounting for material supply constraints, potential supply disruptions, process efficiency, quality, cost, etc.

Conclusion

Key messages

- Battery manufacturing sector as key enabler for societal green transformation
- Pressing issues related to the transformative vision of Industry 5.0 for Europe

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