Digital Twin Based Industrial Services - Just Hype or Real Business?

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- Mr. Jukka Hemilä, M.Sc. (Tech.) is working as a Senior Scientist at VTT Technical Research Centre of Finland Ltd.
- His core competencies are business development from strategy to operations, business models, and organizational development.
- He has over 20 years' experience in product-service ecosystems and business innovations in different industrial sectors.
- His recent studies are focusing on sustainability in manufacturing industries by utilizing data and digital twins in operations and smart services.
- He has participated both national and international innovation projects as a consultant, researcher and a project manager.
- He has an international experience as a visiting researcher in Vietnam, USA, Italy and Germany.
- He is also International Project Management Association (IPMA) Level C Certified Project Manager.

Digital Twin?

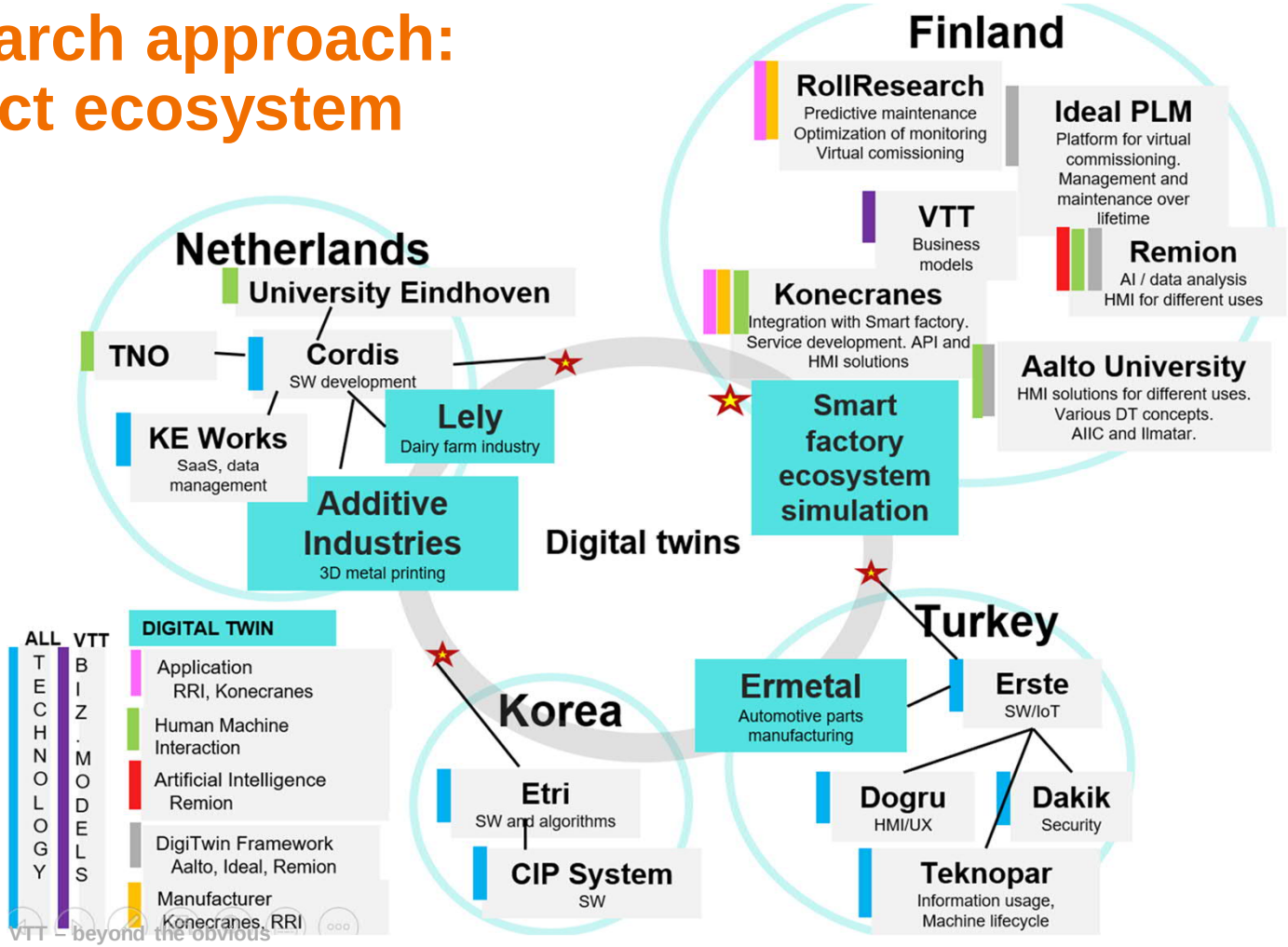
Introduction (1/2)

- Digital Twin is a multiphysical & multiscale **virtual model** of a component, product, system and/or process which is **connected to real-world** by ways of data through its entire lifecycle
- The level of data integration marks the difference of DT compared to the concept of Digital Model (DM), sometimes called a Virtual Model (VM), and the concept of Digital Shadow (DS).
- These mentioned concepts are often used synonymously

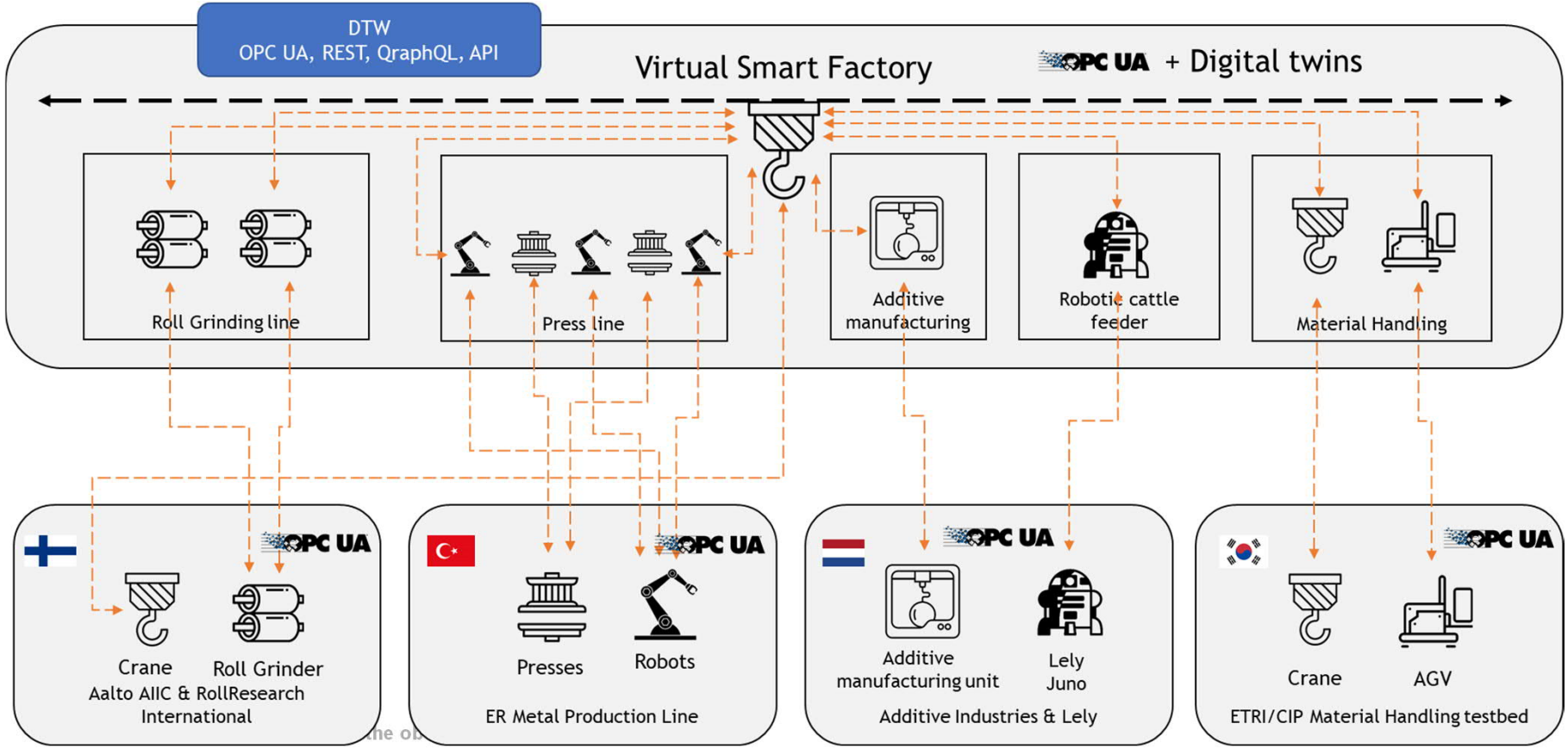
Introduction (2/2)

- This paper uses the DT concept to refer to fully automated data exchange between real physical object and its digital replication.
- Therefore, because of real-time and automated data exchange, DTs can be the basis of new kinds of industrial services with entirely new value offerings.
- Often digitalization helps the machine manufacturer themselves, but the added customer value is just a nice to know or a nice to have type of benefit.
- The purpose of this paper is to explore DT-based industrial service opportunities and examine how to develop and commercialize DT-based services successfully.

Research approach: Project ecosystem



Research approach – Tech view



Research approach

Ecosystem	Company role in the ecosystem
Ecosystem in Turkey	Company 1: Manufacturing company innovating and offering new digital twin enabled services for their customers, large-scale company. Company 2: Service development partner, Software (SW) provider, Small and medium sized (SME).
Ecosystem in Netherlands	Company 1: Manufacturing company innovating and offering new digital twin enabled services for their customers, SME Company 2: Manufacturing company innovating and offering new digital twin enabled services for their customers, SME Company 3: Service development partner, SW provider, SME. Company 4: Service development partner, SW provider, SME. Research institute 1: Software Research and Development (SW R&D) partner University 1: SW R&D partner
Ecosystem in Finland	Company 1: Manufacturing company innovating and offering new digital twin enabled services for their customers, large-scale company Company 2: Manufacturing company innovating and offering new digital twin enabled services for their customers, SME Company 3: Service development partner, SW provider, SME Company 4: Service development partner, SW provider, SME Company 5: Service development partner, SW provider, Large University 1: SW R&D partner Research institute 1: Service development partner

Interviews / workshops			
Country	Date	Workshop theme	Participants
Turkey	October 12th, 2021	Mapping the DT enabled service process by service business blueprinting	2 R&D engineers, large manufacturing company; 4 SW developers, SME SW provider
The Netherlands	January 25th, 2022	Same as above	1 SW developer, research institute; 1 Research and Development (R&D) engineer, SW provider; 1 SW engineer, University; 1 SW engineer, SME SW provider
The Netherlands	January 25th, 2022	Same as above	2 R&D engineers, SME machine manufacturer
The Netherlands	January 26th, 2022	Same as above	1 R&D engineer, SME machine manufacturer
The Netherlands	March 22nd, 2022	Future vision of DT enabled services	1 R&D engineer, SME machine manufacturer
The Netherlands	March 22nd, 2022	Future vision of DT enabled services	1 R&D engineer, SME machine manufacturer
Finland	June 11th, 2021	DT solutions in the Smart Factory domain	3 researchers, 1 professor, university; 3 SW engineers, SME SW provider 4 Engineers, large machine manufacturer; 1 engineer, SME machine manufacturer; 1 SW engineer, SME SW provider; 4 research scientists, research institute
Finland	February4th, 2022	DT solutions in the Smart factory ecosystem and roles	3 researchers, 1 professor, university; 1 SW engineer, SME SW provider; 4 Engineers, large machine manufacturer; 1 engineer, SME machine manufacturer; 1 SW engineer, SME SW provider; 4 research scientists, research institute
Finland	March 8th, 2022	DT solutions in the Smart factory ecosystem and roles	3 researchers, 1 professor, university; 2 SW engineers, SME SW provider; 3 Engineers, large machine manufacturer; 1 SW engineer, SME SW provider; 4 research scientists, research institute
Finland	March 23rd, 2022	DT solutions in the Smart factory ecosystem and roles	3 researchers, 1 professor, university; 2 SW engineers, SME SW provider; 3 Engineers, Large machine manufacturer; 1 SW engineer, SME SW provider; 4 research scientists, research rnstitute

Findings

- Digitalization has reached a mature level in industries, as the companies have modern Information and Communication Technology (ICT) tools for supporting operations.
- Enterprise Resource Planning (ERP) solutions support many kinds of industrial operations, not only production.
- Customer Relationship Management (CRM) software supports every kind of customer interaction from marketing, to sales and aftersales.
- For service operations, like installation and maintenance, markets offer dedicated solutions.
- The latest trend of Industry 4.0 brings the Internet of Things (IoT) to manufacturing industry.
- Artificial Intelligence (AI) and machine learning can be utilized for data analytics, operative predictions and maintenance optimization.

Findings

- Mentioned solutions mostly support manufacturing companies internally, and the value of the software solutions is clear for the manufacturers themselves.
- The customer value is questionable, as it is not clear how digitalization helps the customers who are using the machines.
- Customer understanding is the key for success.
  - Which kind of information does the customer need?
  - Do they need information at all or are they just interested in operational efficiency or the minimized downtime of the machines?
- According to our case studies, typically, value is created in the
  1. Selling (not sellable services, but visualization of the solution)
  2. installation and operations
  3. maintenance phases of the machine lifecycle.

Installation and operation phase DT advantages

- The main activity is ensuring Overall Equipment Effectiveness (OEE) by making sure that machine and all necessary software are functioning as expected and that is updated accordingly.
- DT can support installation when all requested documentations can be achieved via DT, and machine operational setup can be simulated with DT to ensure operations at the customer site.
- Training at the customer site can utilize virtual replication of the real world by using Virtual Reality glasses and 3D models of the machine and the surrounding factory environment.

Installation and operation phase DT advantages

- Machine works as expected (availability guarantee, e.g., 98%), easier for the customer to know what happens inside the machines
- The customer is able to visualize in a real-time what the machine is doing
- Formally proves what is wrong and proves what has been fixed, detailed view from each component on what has gone wrong
- Time savings, money savings
- For moving robots, DT supports route planning, as well as management of unexpected situations in operations
- Improved interaction with the customer
- The customer is able to have customized views (control room/ Human-Machine Interface (HMI) solutions) of the factory and machine situation for different users (production managers, machine operators, service personnel).

Maintenance stage DT advantages

- Easiness for the customer when service operations are well planned and predicted
- Time savings in service operations
- Fewer ad hoc situations
- Added revenue for the customer can be collected from the end-users by providing updates
- Make sure that the software system is without any errors (simulations with DT)
- New business model for services/maintenance: Make a model that provides constant updates for end-users

Conclusions

- Because of the growing volume, complexity, and strategic importance of data in industry, manufacturers need to create DT-based services together with selected strategic partners.
- The realization of DT requires new kinds of competencies, because of the need for data analytics, visualization, simulations and other functionalities that might be new for manufacturers.
- Therefore, collaboration is needed between manufacturers and SW providers to consolidate data collection, aggregation and analytics for making data and insights available across different business functions and units.
- As the value proposition change, new outsourced SW elements are needed and the customer base needs to be segmented differently, since traditional customers might not be interested in DT offerings -> Entire new Business Models needed

Thank you!