

## Module 14

### Digital Transformation and Innovation for Enabling Reconfigurable Production Systems

Welcome to Module 14, Digital Transformation and Innovation for Enabling Reconfigurable Production Systems. This module consists of 5 parts as follows:

1. Manufacturing Digital Transformation
- 2. Modapto under the lens of Digital Transformation**
3. Innovations in Manufacturing Business Models
4. Assessment Questionnaire for Reconfigurable Manufacturing Maturity of SMEs
5. Business Models of MODAPTO
6. References – Extra Reading Material

Each has its own set of slides and accompanying explanations that you can read in parallel. To do so in this series of accompanying texts the Reference Slide is presented in line with the supportive text.

#### 14.2. Modapto under the lens of Digital Transformation

[Slide #4]

A **reconfigurable manufacturing system (RMS)** is a system designed to rapidly and cost-effectively adjust its structure, hardware, and software in response to changing market demands. Unlike dedicated manufacturing lines (which are high-volume but inflexible) or flexible manufacturing systems (which are highly adaptable but expensive and have lower throughput), an RMS provides **customized flexibility**. It achieves this by being built from **modular components** that can be easily added, removed, or rearranged. This allows a factory to scale its production capacity or convert its functionality to produce a new product family without a complete system overhaul, reducing lead time and investment costs. The core goal of an RMS is to provide "exactly the capacity and functionality needed, exactly when needed" to maintain competitiveness in a fast-paced global market.

Therefore an An RMS should be capable to (Kim et al., 2020):

- (1) Swiftly adapting to customer demands,

- (2) Effectively retooling machinery, modifying operational parameters to address unexpected system failures and maintain product quality, and
- (3) Upgrading older systems to integrate new technologies

As such, RMS place a strong emphasis on **modularity** (the system is made up of independent, interchangeable modules), **convertibility** (the system can be readily changed or reconfigured), **integrability** (the modules can function together efficiently) and **interoperability** (the system can work with other systems) (Kim et al., 2020).

[Slide #5]

A SWOT analysis is a strategic planning tool used to assess a situation, business, project by examining four key factors: strengths, weaknesses, opportunities, and threats. It helps decision-makers understand both internal and external influences that could affect success, making it easier to create effective strategies.

The first two elements, strengths and weaknesses, are internal factors. Strengths refer to the advantages, unique resources, or capabilities that give an edge—things that are done particularly well. Weaknesses, on the other hand, are the internal limitations or challenges that hinder performance.

Opportunities and threats focus on external factors. Opportunities are favorable trends, changes, or situations in the environment that could be taken advantage of. Threats are external challenges or risks that could negatively impact success.

By combining these four perspectives, a SWOT analysis offers a clear and balanced view of where things stand. This structured approach allows for informed decision-making, helps prioritize actions, and encourages both a realistic and forward-looking strategy.

As can be seen in case of RMS and MODAPTO there are several strengths that are inherent in the new proposed modular system as well as several weaknesses that need be addressed for its successful adoption (or even consideration of adoption and Digital Transformation).

[Slide #6]

Furthermore, several opportunities are presented and of course, there are also different threats.

[Slide #7]

The Value Proposition Canvas is a strategic tool used by businesses to ensure their product or service is designed to meet the specific needs and values of a target customer.

Developed by Alexander Osterwalder, it is an extension of the Business Model Canvas, focusing in detail on the "Value Proposition" and "Customer Segments" sections.

The canvas is composed of two main parts:

**Customer Profile (The Circle):** This side is all about the customer. It helps you gain a deep understanding of their world by breaking down their reality into three areas:

**Customer Jobs:** The tasks, problems, or needs the customer is trying to get done in their work or life.

**Pains:** The negative experiences, frustrations, risks, and obstacles the customer faces while trying to do their jobs.

**Gains:** The positive outcomes, benefits, and desires the customer expects or hopes for.

**Value Map (The Square):** This side focuses on your company's offering. It outlines how your product or service creates value for the customer:

**Products & Services:** A list of the specific products or services you offer.

**Pain Relievers:** A description of how your products or services alleviate the specific pains identified in the customer profile.

**Gain Creators:** A description of how your products or services create the benefits and outcomes that your customers want.

The ultimate goal of the Value Proposition Canvas is to achieve "**product-market fit**," which is achieved when your value map (your products and services) effectively and uniquely addresses the most important jobs, pains, and gains of your customer profile. By using this tool, businesses can create offerings that are truly customer-centric, reducing the risk of developing products that nobody wants.

[Slide #8]

In order to examine the value proposition brought forth by Modular Manufacturing and the MODAPTO system, the different representative cases can be examined through the Value Proposition Canvas to uncover the perceived benefits of such a system in parallel to the needs of the end users.

[Slide #9]

For the FFT case and starting from the **Customer Profile (The Circle)** we see that there are several customer jobs that take place and upon which the MODAPTO system will have an effect on. Currently these customer jobs have several pains and the end users require specific gains from a MODAPTO like system.

[Slide #10]

The same stand for the SEW case

[Slide #11]

And the ILTAR & CRF Case.

It is evident that across the different cases there are different customer jobs, pains and expected gains from the MODAPTO system. This leads to the need for a system that will cater to different contexts and as such MODULARITY will have to account for different levels, to be able to provide the envisaged and sought after “product-market-fit”

[Slide #12]

Moving to the **Value Map (The Square)** that focuses on the MODAPTO offering, the key technologies brought forth that create value for the customer and alleviate pains as well as ultimately offering gains include: Simulation Services, Optimization Services, Advanced Analytics & Monitoring, Predictive Maintenance, Support & Decision-Making Tools, Modular Production Units, Integrated Digital Twins, User Experience Platform, Comprehensive APIs & Interfaces, Communication & Coordination Framework, Security & Access Management

[Slide #13]

In order to be able to understand MODAPTO in parallel with the offered value proposition and the business related aspects the following slides give an outline of the MODULE concept, the MODAPTO Architecture as well as its base pillars, so as to understand how it can be utilized to transform manufacturing.

[Slide #14]

[Slide #15]

[Slide #16]

[Slide #17]

As can be seen from the enabling technology of MODAPTO all aspects relevant to Digital Transformation are affected. In particular, it is evident that Customer Experience, Business Processes, Business model and Organizational changes are closely related to the Modapto enablers unlocking different benefits (gain creators in the sense of the aforementioned value proposition)

[Slide #18]

Diving deeper per Digital Transformation Pillar, and starting from the Customer-Experience (CE) pillar, it can be seen that the technological enablers of modular manufacturing unlock very important outcomes.

[Slide #19]

The same stands for the Business-Processes (BP) Pillar

[Slide #20]

As well as the Business-Model (BM) Pillar

[Slide #21]

Summarizing the findings, relevant to the Customer Experience (CE) of Digital Transformation through MODAPTO, **Products/services (PS)** lead to better product quality and faster delivery times, enhancing the customer experience. They also ensure consistent quality to customers. **Simulation services** allow for the testing and development of more customer-tailored products and services and the **Enhanced Digital Twins** allow businesses to offer superior products by closely monitoring and adjusting production processes in real-time, ensuring high quality and customisation.

Continuing to the Business Processes (BP) of Digital Transformation, PS enhance business process efficiency through optimised scheduling and decision support tools. They also aim to optimise and innovate internal processes through simulation and experimentation, streamlining maintenance planning, optimising asset performance, and minimising downtime. Additionally they facilitate the implementation of precise measurement and storage of energy and carbon data at the module level that enables businesses to make informed operational efficiency and sustainability decisions. Furthermore Reconfiguring modules streamline internal processes, making them more adaptable and efficient. Lastly, the products and services support employees' daily tasks, centralising essential production knowledge and offering intelligent services.

Lastly, relevant to the Business Model (BM) Pillar of Digital Transformation, Virtual commissioning enables the pilots to adapt to customer requirements, leading to mass customization and personalisation. Overall MODAPTO was found to enable new digital services/products/business models

[Slide #22]

The different value propositions identified from a system that enables modularity can be also found in the academic literature. In particular the most prominent KPIs include Supply chain costs, Lead time, Manufacturing costs, Productivity, Production Time, Reconfigurability,

[Slide #23]

Production capacity, Assembly stability, Due-date performance, Reconfiguration time, Ramp-up time, Energy consumption and Emissions.

[Slide #24]

The different Key Drivers that shape the future of Manufacturing include Human-Centric Approach, Sustainability focus, Customization of products, Advanced technologies integration, AI-Driven collaboration, Resilience and Agility, Workforce Transformation and decentralization of production. A modular manufacturing system as MODAPTO can play an important role in achieving (at different) degrees these Key Drivers.