



Module 14: Digital Transformation and Innovation for Enabling Reconfigurable Production Systems

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Funded by
the European Union



Table of Contents

- 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



14.1. Manufacturing Digital Transformation



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Digital Transformation is an uncharted territory, still

Harvard
Business
Review

The Digital Transformation of Business

September 01, 2014



The Digital Transformation of Business

Although the four “megatrends” of cloud, big data, mobile and social technologies are clearly having a positive impact, industry watchers who believe that only a few early adopters have been able to transform their organizations with these technologies are mistaken. Digital transformation is occurring rapidly at a majority of public and private sector organizations. Business leaders are not simply deploying the four technologies to

boost efficiency or otherwise cut costs. Instead, research shows that firms are embracing the megatrends to craft new business models, develop new revenue streams, or drive other material changes that lead to an increase in the top or bottom lines.

FORBES > LEADERSHIP

Digital Transformation As A Catalyst For Growth



Elizabeth Kiehner Forbes Councils Member

Forbes Business Development Council

COUNCIL POST | Membership (Fee-Based)



Apr 1, 2024, 08:30am EDT

Why Do Companies Need Digital Transformation?



Igors Astapciks Forbes Councils Member

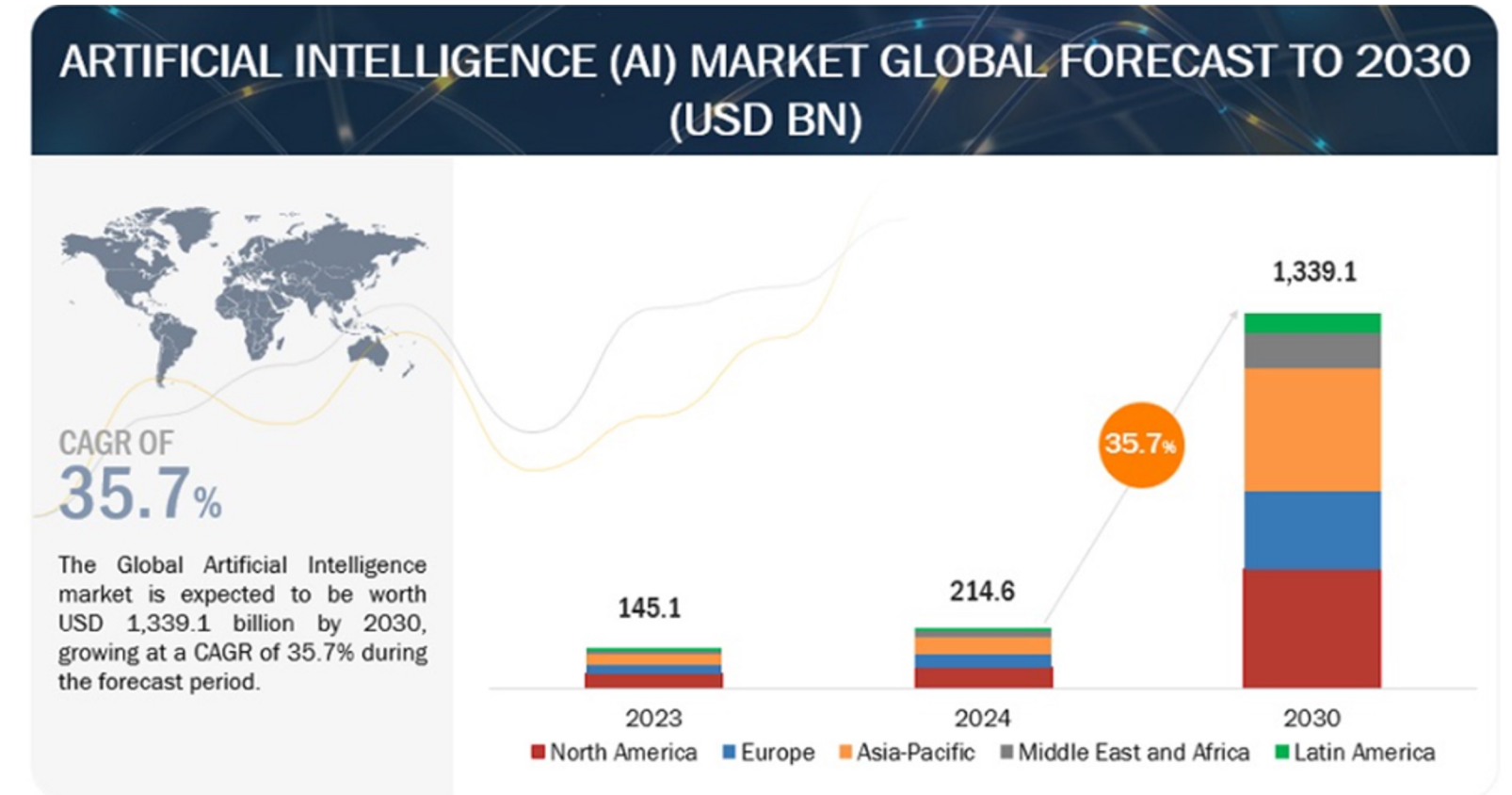
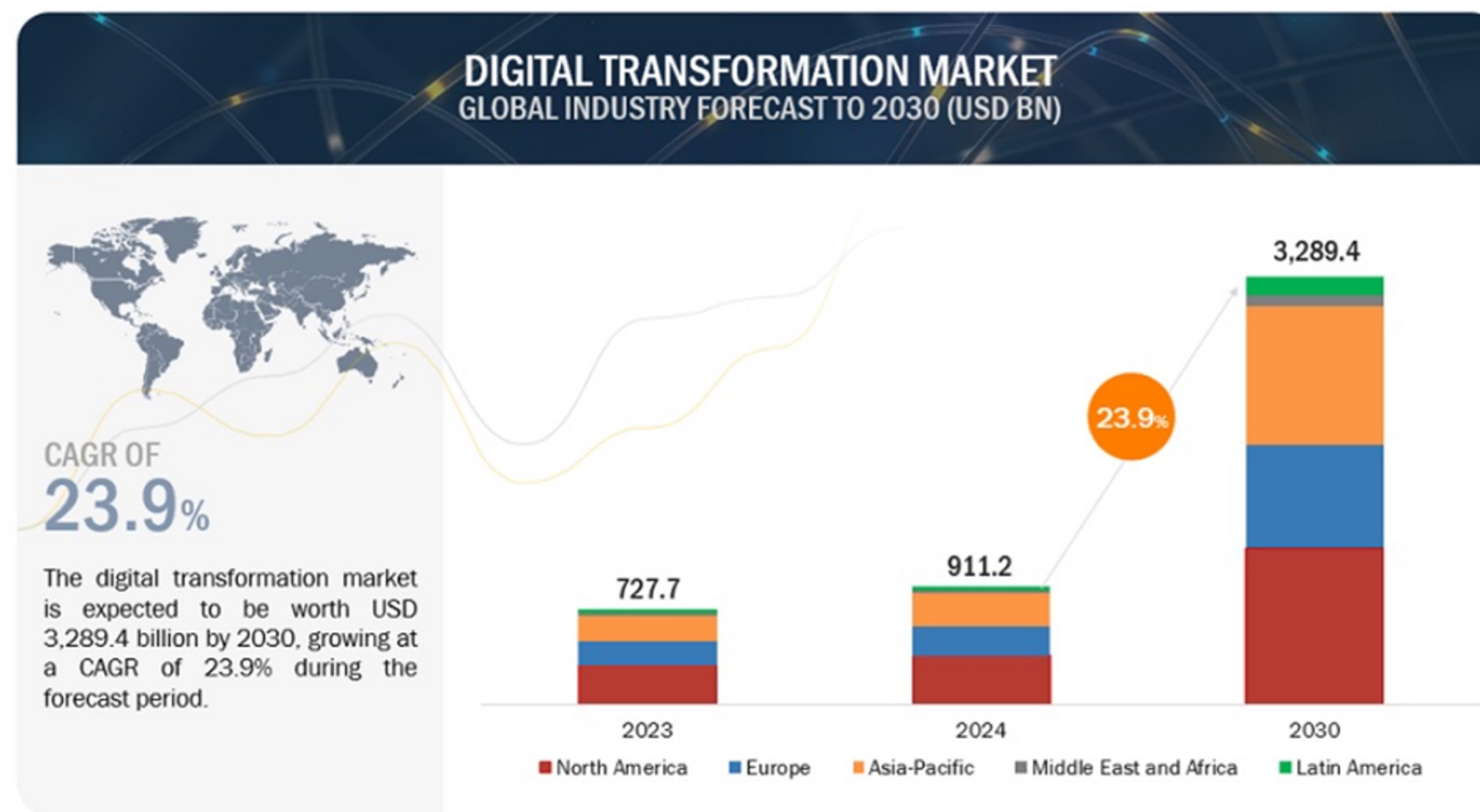
Forbes Technology Council

COUNCIL POST | Membership (Fee-Based)



Mar 20, 2023, 08:15am EDT

Digital Transformation Market is growing rapidly



Source: <https://www.marketsandmarkets.com/>

The **artificial intelligence segment** is expected to experience **the fastest growth rate** among technologies during the forecast period.

The new wave: From Digital to AI Transformation

FORBES > SMALL BUSINESS

AI Transformation: A Three-Step Blueprint For Organizations



Pooja Kohli Former Forbes Councils Member
Forbes Business Council
COUNCIL POST | Membership (Fee-Based)



Feb 5, 2024, 08:00am EST

Forbes

FORBES > LEADERSHIP

EDITORS' PICK

How To Make An AI Transformation In Your Business

Plus: The Priorities Of Private Businesses, Wall Street Starts To Settle, Disney Invests In Experiences As Its Magic Takes A Beating, Judge Rules Google Is A Monopoly

Megan Poinski Forbes Staff

I'm the writer for the Forbes C-Suite newsletter series.

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Aug 12, 2024, 12:47pm EDT

FORBES > INNOVATION

From Digital Transformation To The AI Revolution



Michel Tricot Forbes Councils Member
Forbes Technology Council
COUNCIL POST | Membership (Fee-Based)



Mar 29, 2024, 08:45am EDT

Digital Transformation projects often fail

Book publication announcement

8th April 2024

\$2.3trillion Wasted Globally in Failed Digital Transformation Programs – Costly and Complex Business Strategies are ‘Not Necessary’



Taylor & Francis
Taylor & Francis Group

Digital Transformation....still means different things to different people!

FORBES / INNOVATION

Why Digital Transformation Often Fails (And How To Succeed)



Expert Panel® Forbes Councils Member
Forbes Technology Council
COUNCIL POST | Membership (Fee-Based)




Jun 28, 2024, 02:15pm EDT

(Oludapo et al. 2024)

Proper Digital Culture is crucial for a successful digital transformation

FORBES > LEADERSHIP > LEADERSHIP STRATEGY

Without The Right Culture, Your Digital Transformation Efforts Will Fail

Larry English Contributor 

I write about innovation, the future of work and remote work.

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Mar 21, 2023, 07:55am EDT

(Farmakis et al, 2025D))

For businesses digital transformation is mainly about the adoption of digital technologies

Harvard
Business
Review

Competitive Strategy

Digitizing Isn't the Same as Digital Transformation

by Paul Leinwand and Mahadeva Matt Mani

March 26, 2021



HBR Staff/NASA

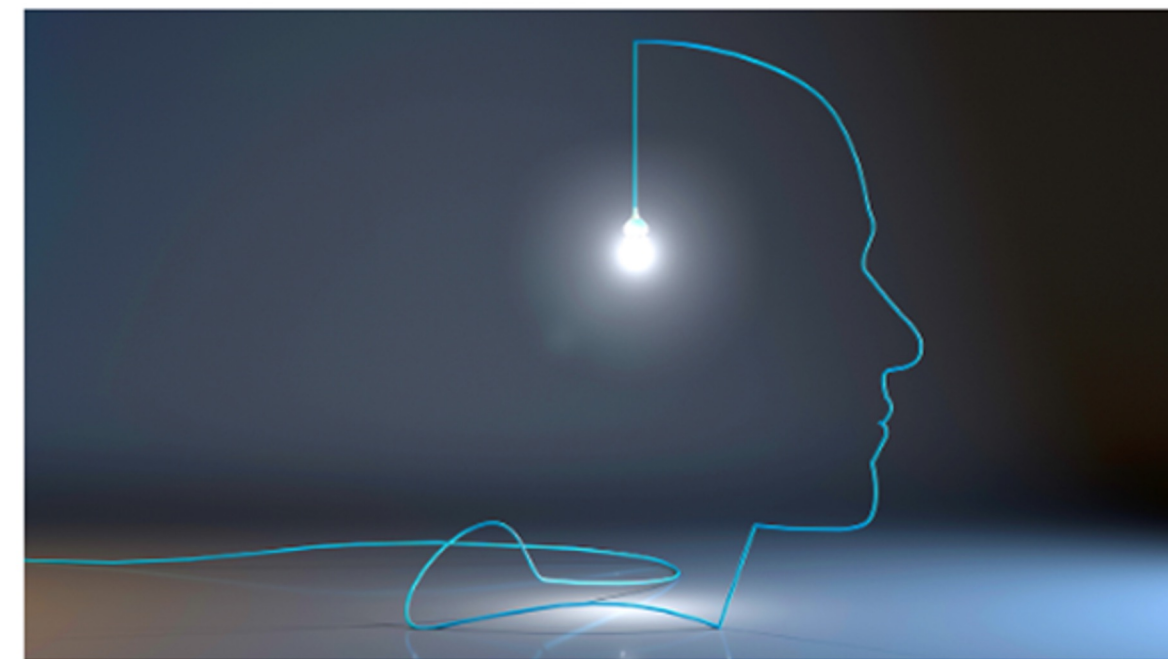
Harvard
Business
Review

Digital Transformation

Digital Transformation Is Not About Technology

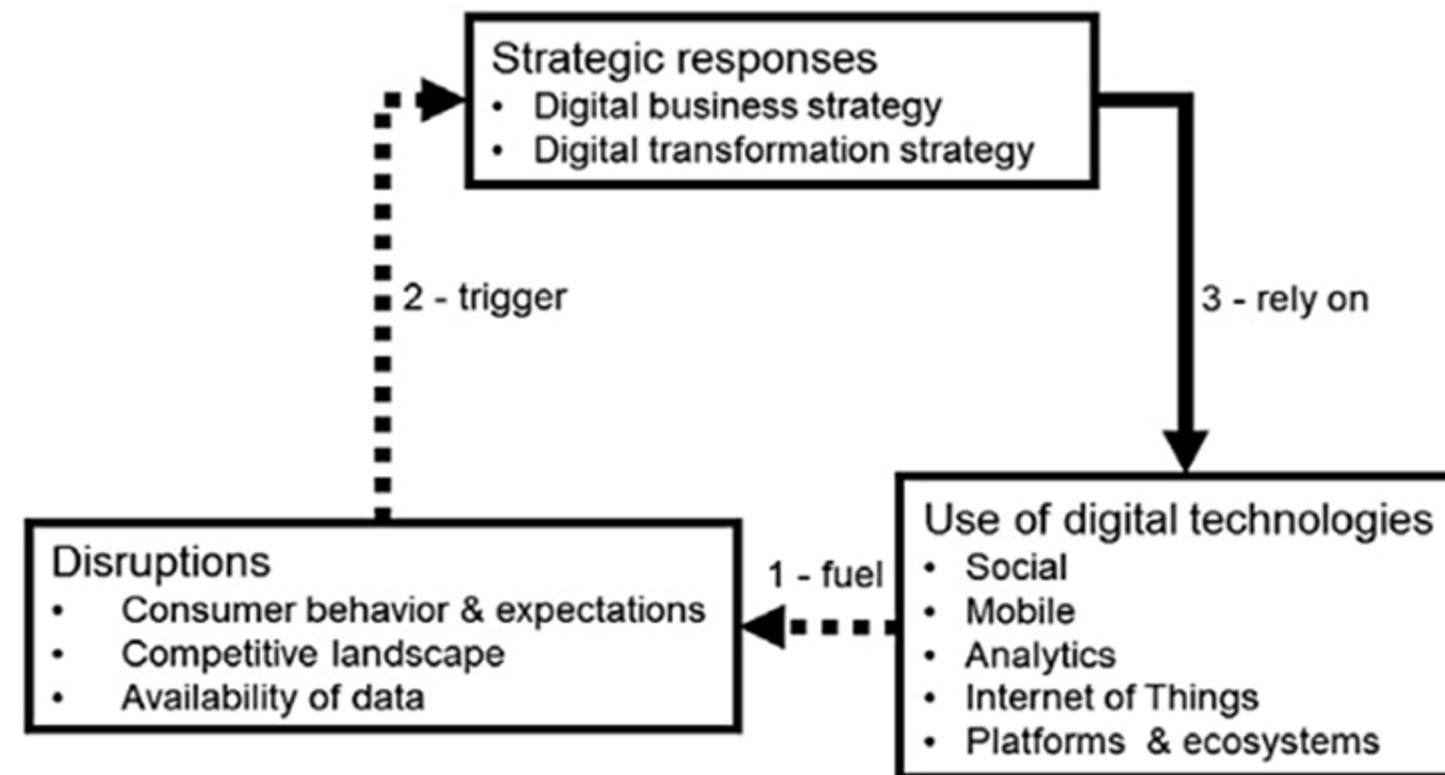
by Behnam Tabrizi, Ed Lam, Kirk Girard and Vernon Irvin

March 13, 2019



Colin Anderson Productions pty ltd/Getty Images

What triggered the digital transformation?



Key:

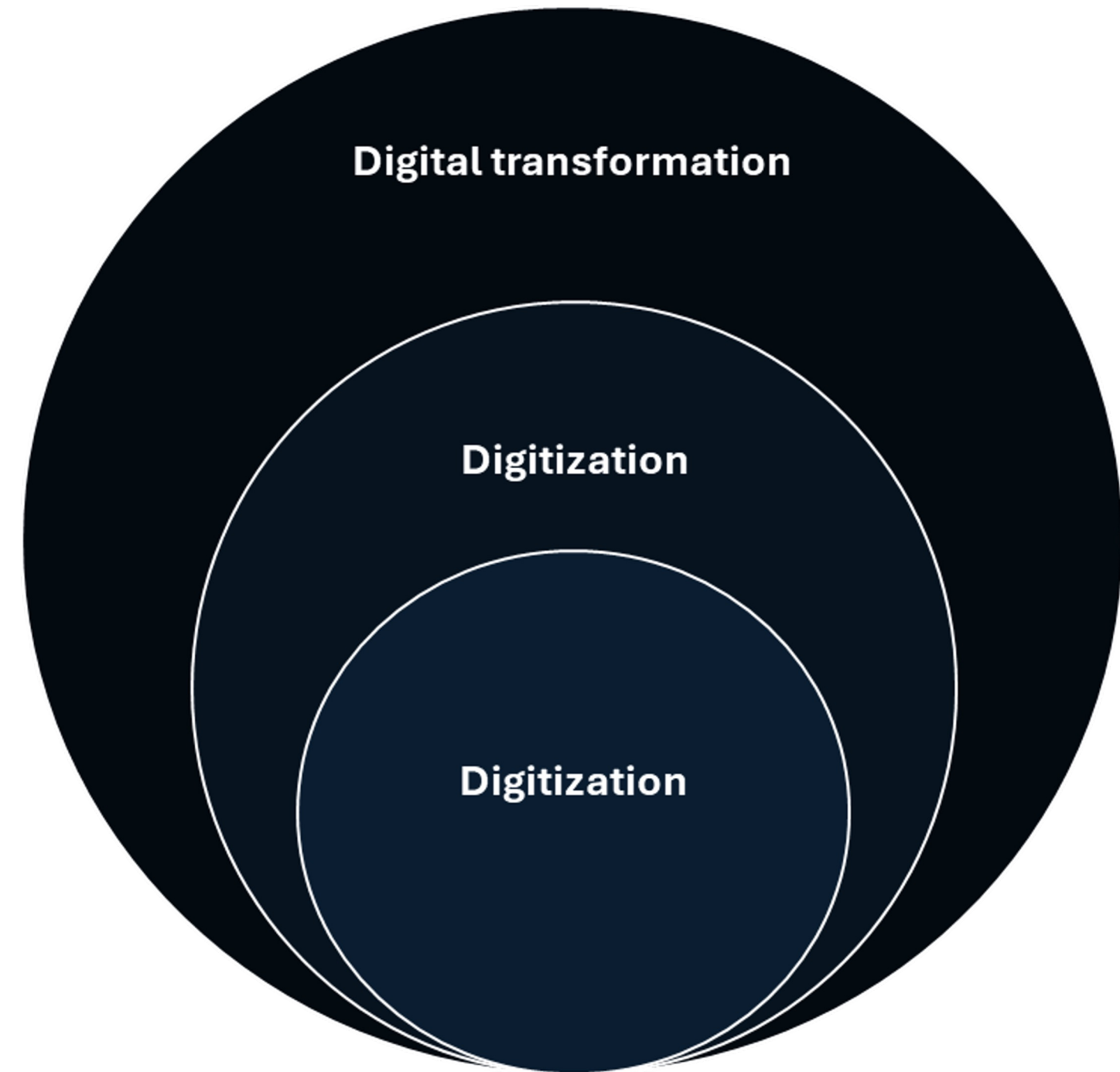
- The dotted arrows represent global trends (industry, society levels)
- The solid arrows represent phases of the DT process at the organizational level

(Vial 2019)

The 3 stages of Digital Transformation

Verhoef et al. (2021) concluded that the stages of digital transformation comprise digitisation, digitalisation, and digital transformation.

- *Digitization is the encoding of analog information in digital form so that computers can store, process and transmit this information.*
- *Digitalization describes how information technologies or digital technologies can be used to change existing business processes.*
- *Digital transformation is the most extensive phase and describes a change across the enterprise.*



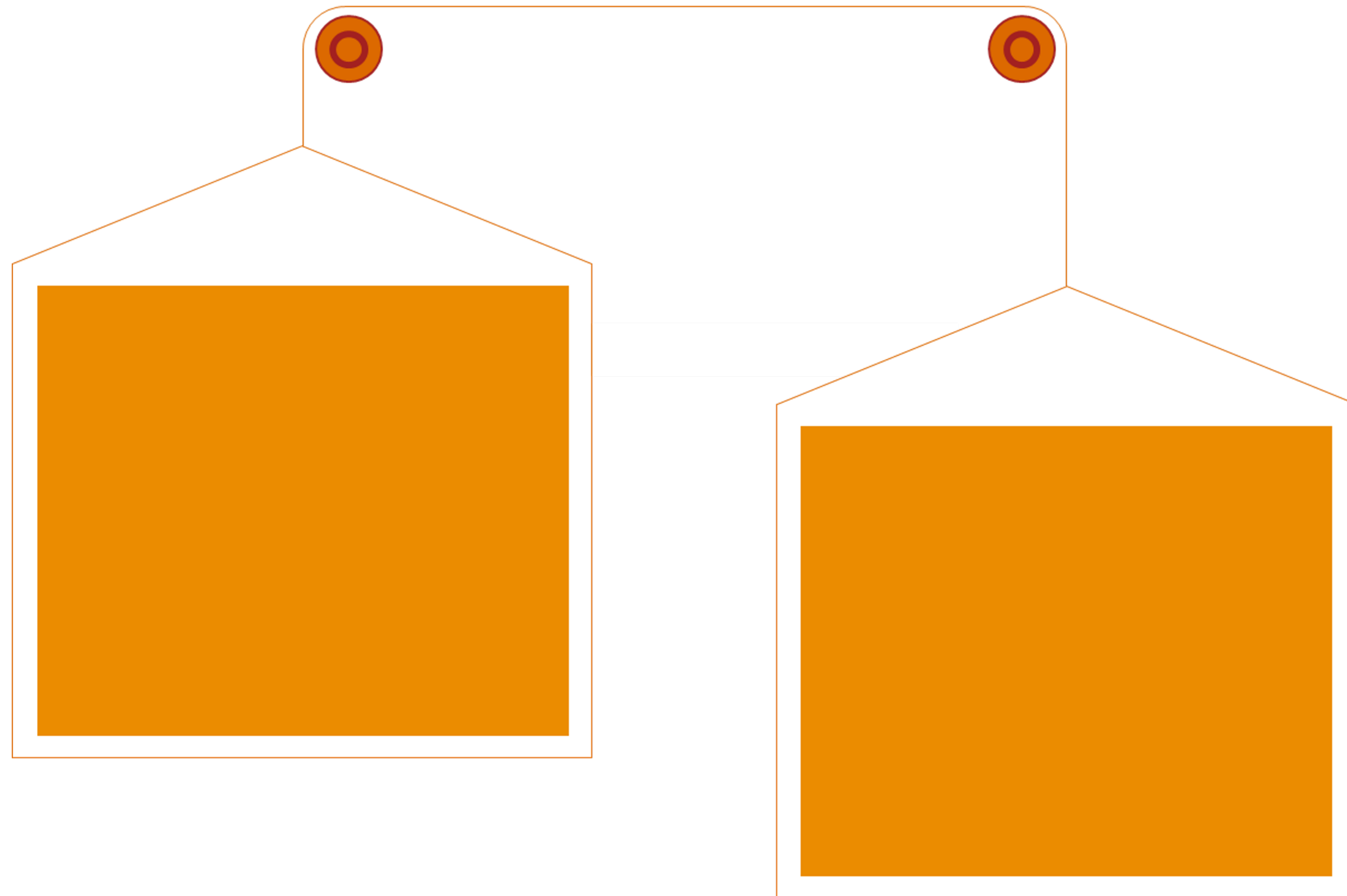
(Verhoef et al. 2021)



Defining the term of Digital Transformation

- Gong and Ribiere (2021) developed a unified definition of “digital transformation” based on a vastly rigorous/scientific review and analysis of 134 well-received, published definitions of DT that significantly differentiates from other related terms in the literature.
- Based on the unified definition of Gong & Ribiere (2021), it is *"a fundamental change process, enabled by the innovative use of digital technologies accompanied by the strategic leverage of key resources and capabilities, aiming to radically improve an entity and redefine its value proposition for its stakeholders"*. An 'entity' in this context may refer to an organisation, business network, industry, or society.

Digital Readiness vs Digital Transformation



"Digital readiness" is the preparation for the disruption of "digital transformation" and is the measure of an organization's ability to create value through digital technology."

(Silva, Saraiva, and Mamede 2022; Trischler and Li-ying 2022))



The Challenges of Digital Transformation

- ❖ The Fear
- ❖ The Financial Constraints
- ❖ The Leadership Team
- ❖ The Employees' Status
- ❖ The Lack of Digital & Building Infrastructures
- ❖ The Previous Bad Experiences
- ❖ The Resistance to Change
- ❖ The Challenge of New Requests
- ❖ The Intangible Benefits

The Digital Leadership Gap

Exploitation

Utilization

Readiness

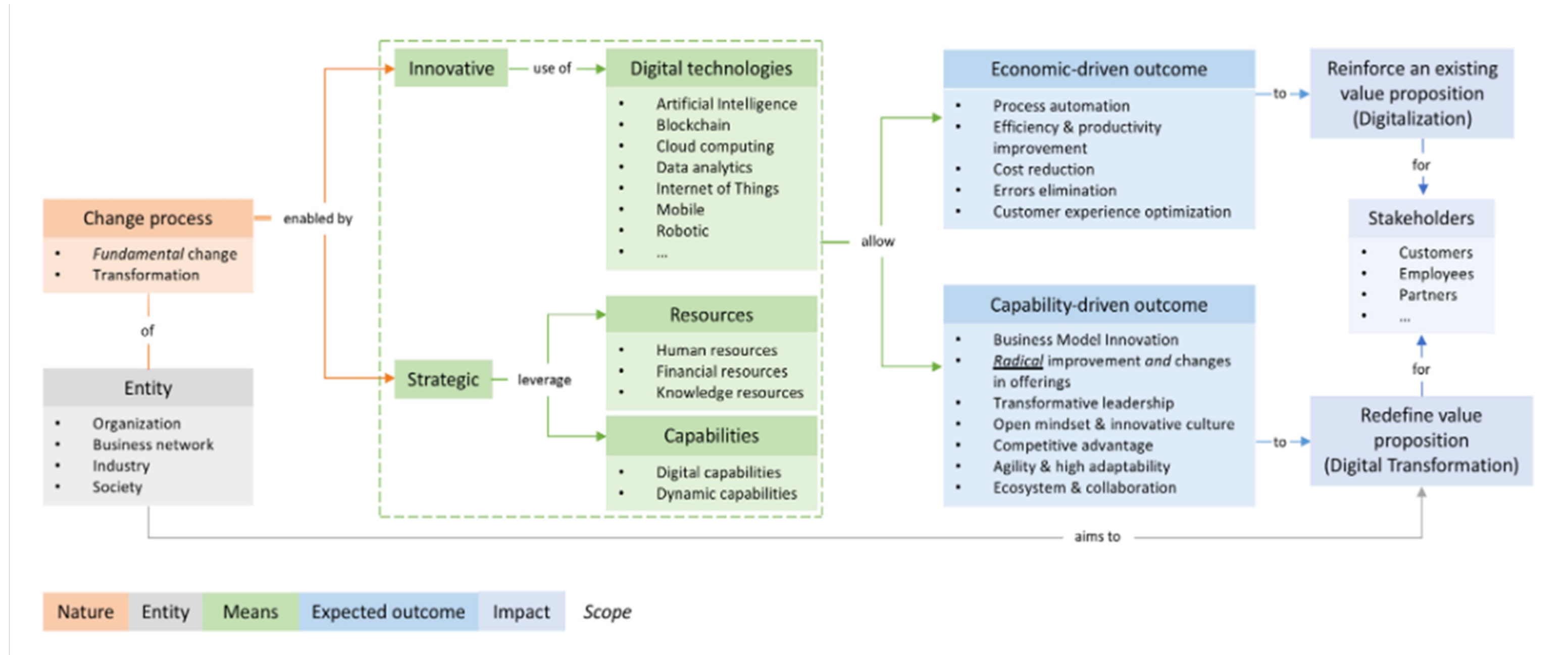
Transformation

Investments

PERCEPTION **Vs** REALITY



Digital Transformation Conceptualization



(Gong, C. and Ribiere, V., 2021)

Digital technologies

SMACIT acronym

- Social media
- Mobile
- Analytics
- Cloud
- IoT

Platforms

Artificial intelligence

Software

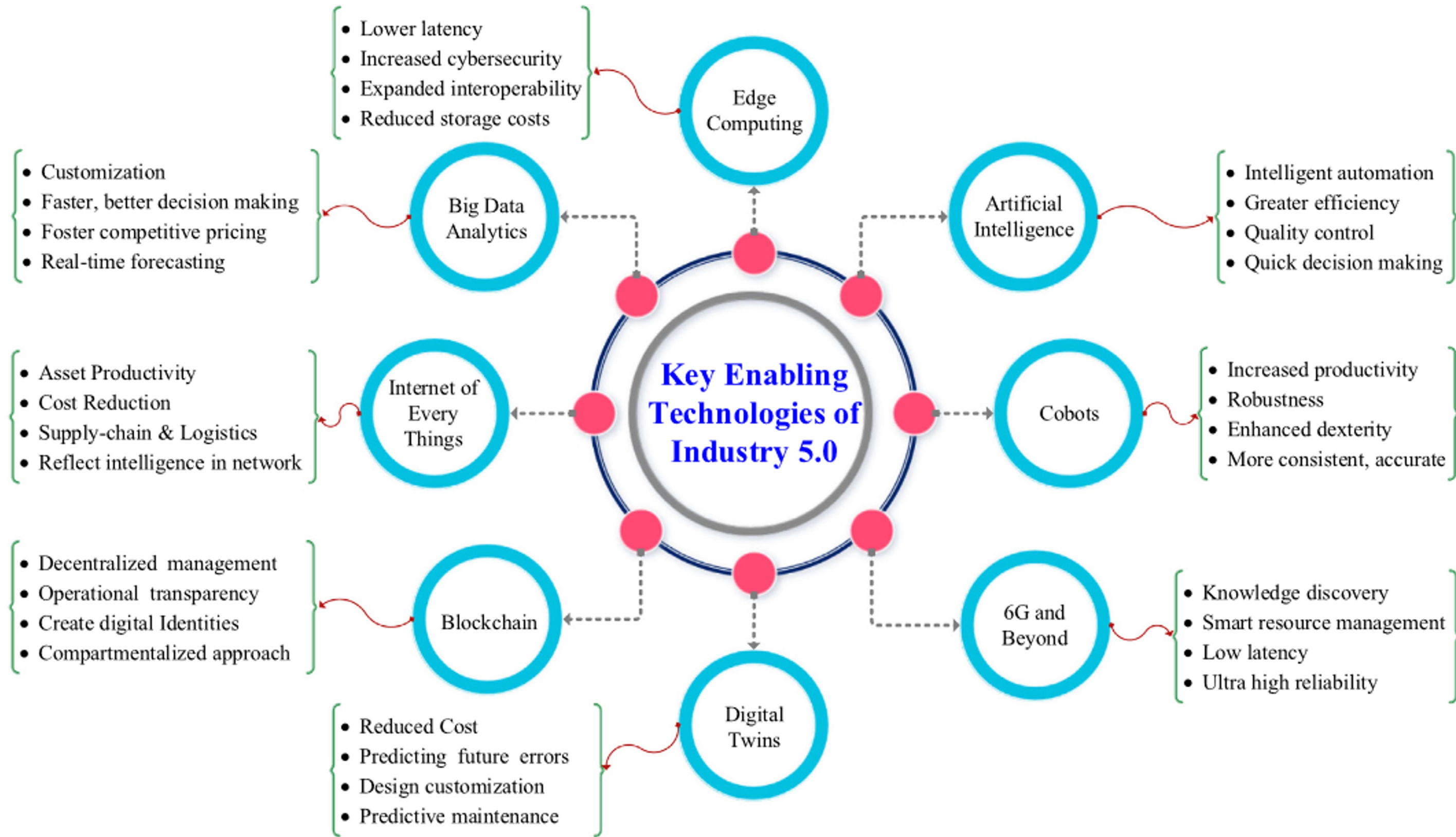
Digital twins

Robotics

Blockchain



* The combination of technologies is particularly important in the context of digital transformation
(Vial 2019)



(Maddikunta et al. 2022)



Business benefits from digital technologies



(Doukidis, Farmakis & Fraidaki., 2024)

Digital skills - DigComp Framework

Data analysis

Digital
communication
and
collaboration

Digital Security

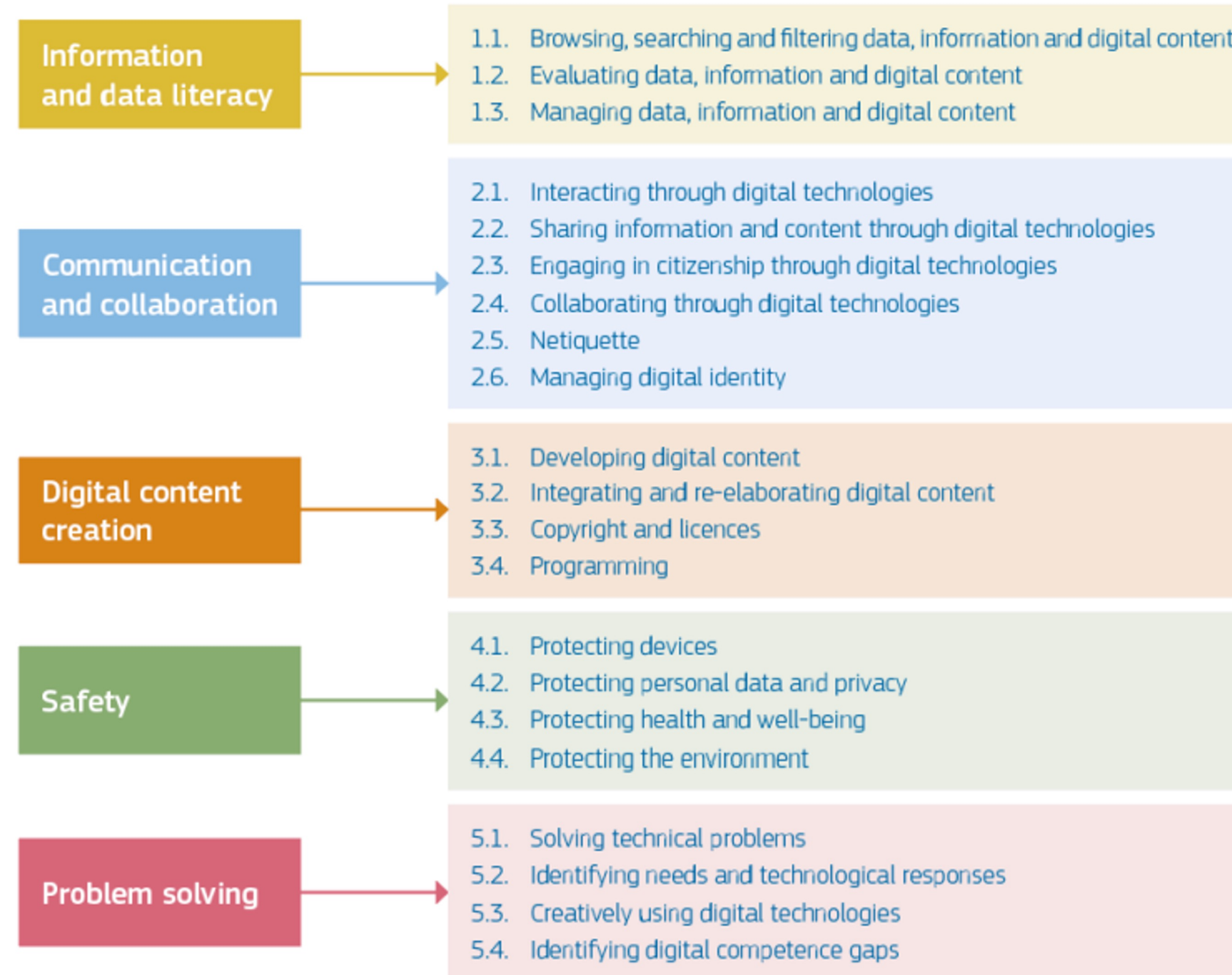
Digital content
creation

'In DigComp, digital competence involves the 'confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society. It is defined as a combination of knowledge, skills and attitudes'

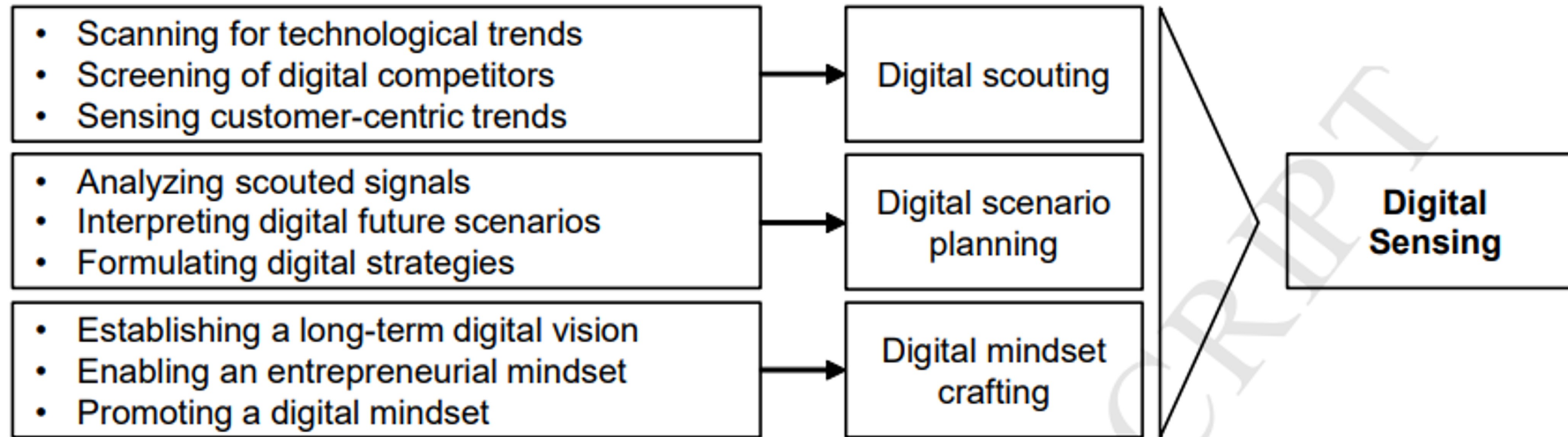
Problem solving

(*'DigComp Framework - European Commission', 2024*)

Digital skills - DigComp Framework

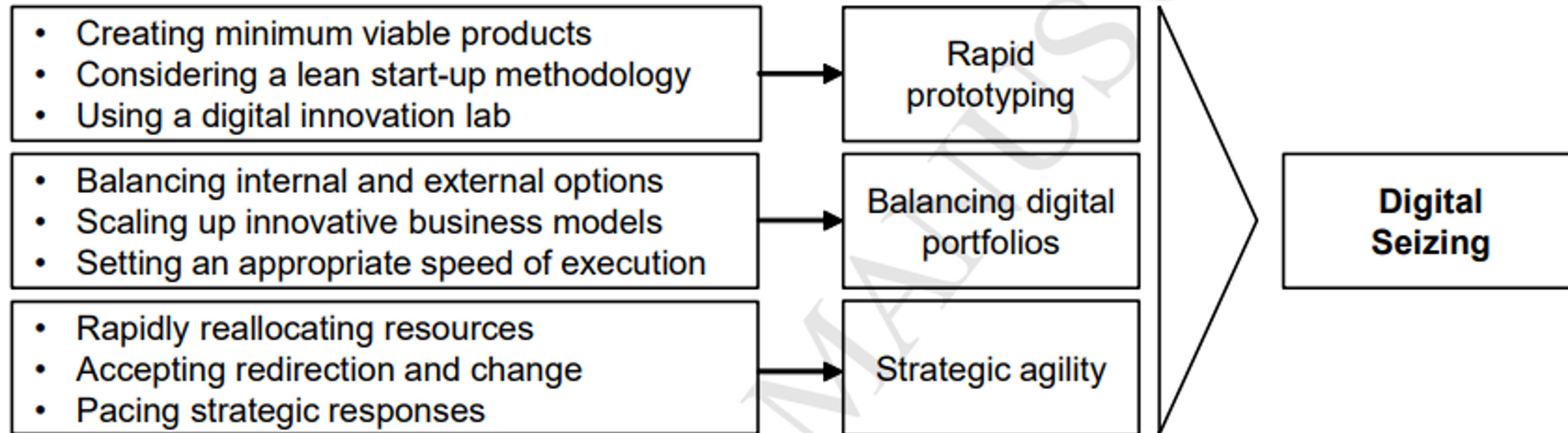


Dynamic Capabilities for Digital Transformation



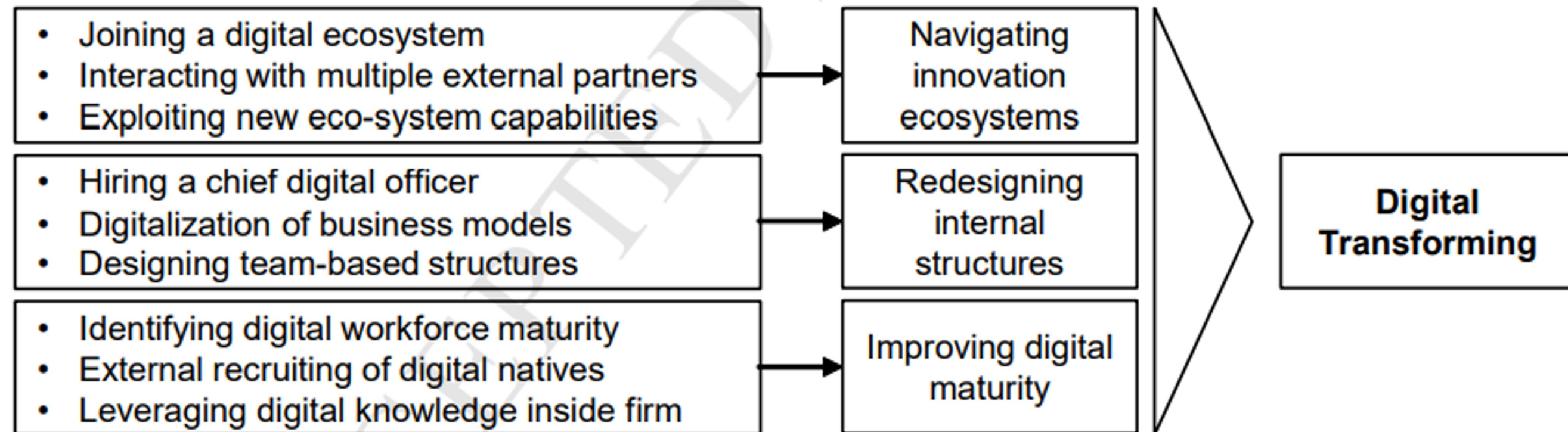
(Warner and Wäger 2019)

Dynamic Capabilities for Digital Transformation



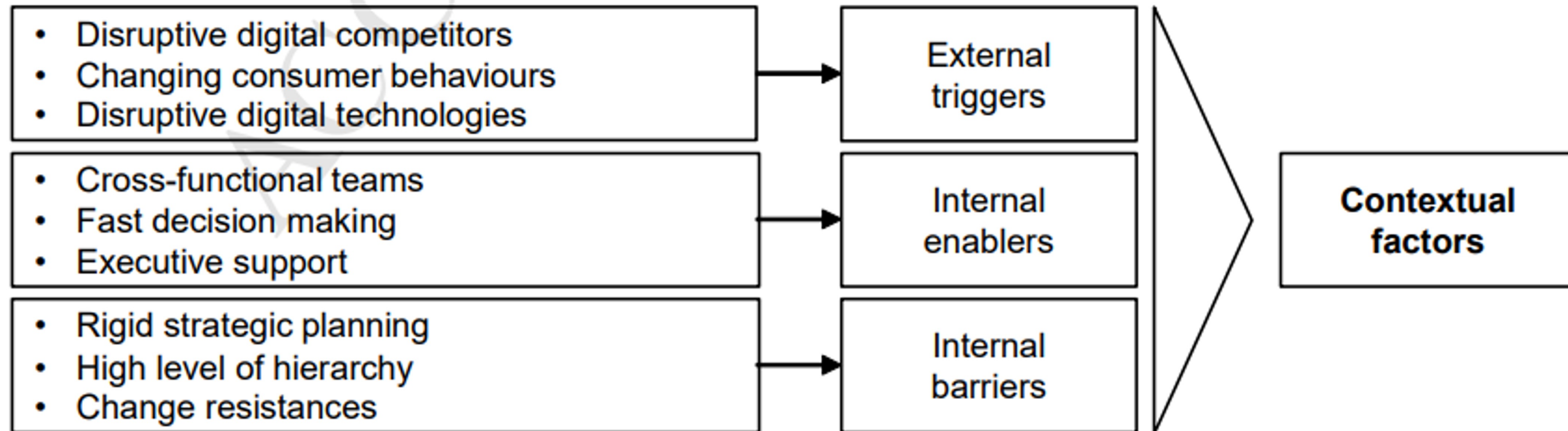
(Warner and Wäger 2019)

Dynamic Capabilities for Digital Transformation



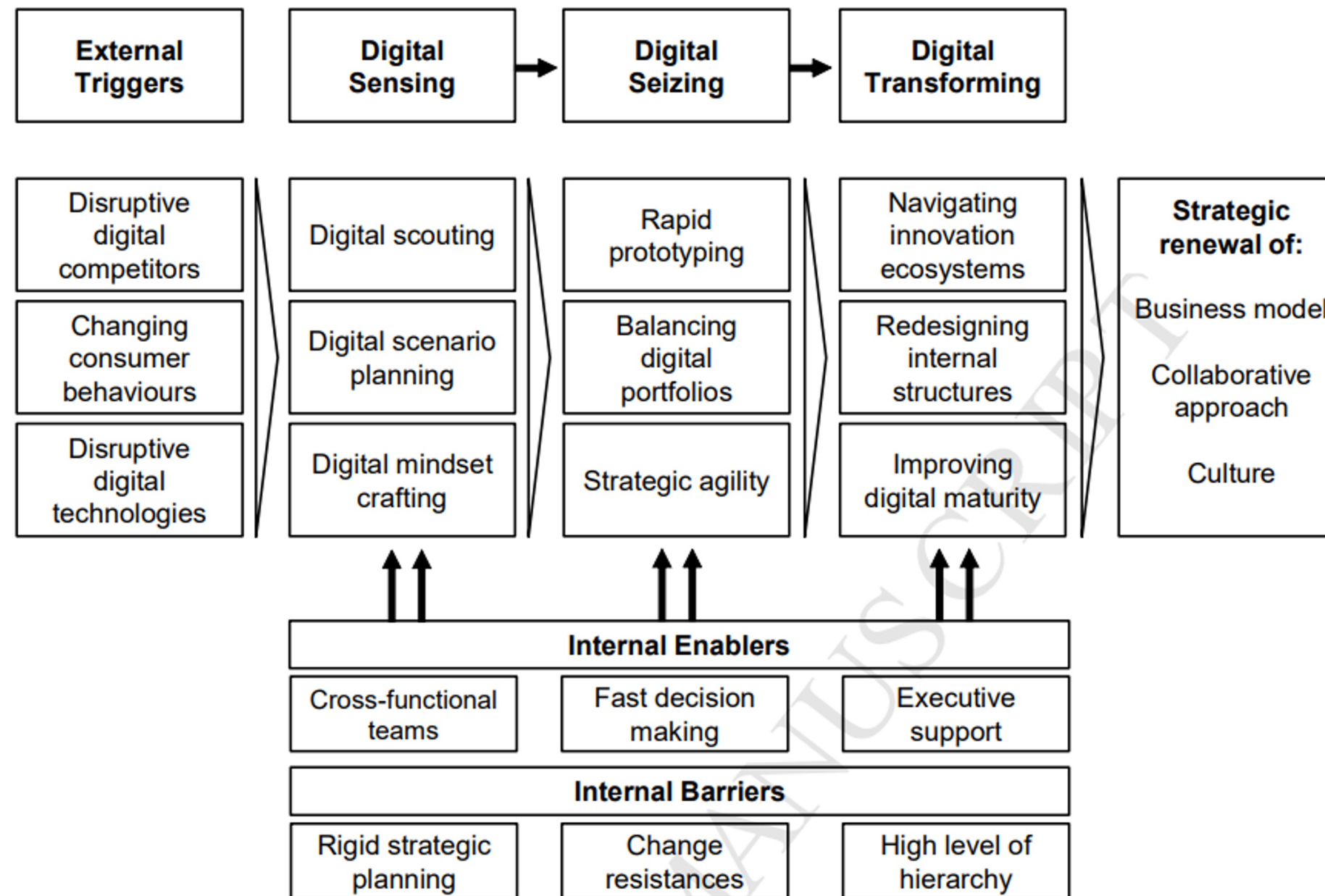
(Warner and Wäger 2019)

Dynamic Capabilities for Digital Transformation



(Warner and Wäger 2019)

Dynamic Capabilities for Digital Transformation



(Warner and Wäger 2019)

A primer for Digital Transformation

CE: Customer Experience Transformation	BP: Business Processes Transformation	BM: Business Model Transformation	OT: Organizational Transformation
<p>1) Comprehension of Customer's Needs and Behavior</p> <p>1.1) CRM and Loyalty Scheme 1.2) Business Analytics 1.3) Personalization</p>	<p>1) Business Processes Digitalization and Redesign</p> <p>1.1) Automation and Redesign 1.2) Agile Development, Collaboration, and Integration 1.3) New Supporting Services</p>	<p>1) Digital Organizational Modifications</p> <p>1.1) Supplementary Digital Channel 1.2) Digital Modifications 1.3) Digital Innovations</p>	<p>1) Integrated Business Strategy</p> <p>1.1) Compliance 1.2) High Investments 1.3) Integrated Strategy</p>
<p>2) Upgrading Customer's Experience</p> <p>2.1) Customer Journey 2.2) Multichannel 2.3) Omnichannel</p>	<p>2) Support and Improvement of Employees' Daily Tasks</p> <p>2.1) Info Reporting and Support 2.2) Personalized Services 2.3) DSS and Artificial Intelligence</p>	<p>2) Establish New Digital Activity/Service and Business Model</p> <p>2.1) Customer-Centric Targeting 2.2) New Digital Services 2.3) New Business Models</p>	<p>2) New Organizational Structures/Functions/Alliances</p> <p>2.1) New Structure 2.2) Supervision Process 2.3) Alliances</p>
<p>3) Automation and Digitization of Sales Processes</p> <p>3.1) Information Reporting and Support 3.2) Upgrade Salesperson's Role 3.3) Customer Self-Service</p>	<p>3) Business Performance Management</p> <p>3.1) KPIs and Balanced Scorecard 3.2) Real-Time Reporting and Analytics; Continuous Integration 3.3) Precision Management</p>	<p>3) Digital International Expansion</p> <p>3.1) Consolidation of Subsidiaries 3.2) International Service/Support 3.3) Think Global and Act Local</p>	<p>3) Human Resources Development, Talent Acquisition, and Exploitation</p> <p>3.1) Training and Talent Acquisition 3.2) New Methods 3.3) Innovation Structures</p>

(Doukidis, Spinellis, and Ebert 2020)

This primer can serve as a framework for evaluating technology implementations, such as digital twins, through the lens of digital transformation. Examples can be seen in technologies like digital twins, ERP, and RPA (Farmakis et al., 2024; 2025A; 2025 B). (Farmakis et al, 2024; 2025A; 2025B; 20225C)



CE: Customer Experience Transformation -Examples

1. Comprehension of Customer's Needs and Behaviour

- **CRM and Loyalty Scheme** → **Bosch** (Customer loyalty programs for B2B clients using IoT data)
- **Business Analytics** → **Michelin** (Uses predictive analytics to optimize tire performance)
- **Personalization** → **Caterpillar** (Custom maintenance plans based on IoT-driven performance data)

2. Upgrading Customer's Experience

- **Customer Journey** → **Tesla** (Direct-to-customer model with personalized interactions)
- **Multichannel** → **John Deere** (Combines dealer networks with online services and mobile apps)
- **Omnichannel** → **Siemens** (Seamless integration of digital sales and service channels)

3. Automation and Digitization of Sales Processes

- **Information Reporting and Support** → **ABB** (AI-powered predictive maintenance insights for customers)
- **Upgrade Salesperson's Role** → **Schneider Electric** (Empowers sales teams with real-time IoT data from products)
- **Customer Self-Service** → **BMW** (Online car customization and purchasing tools)



BP: Business Processes Transformation - Examples

1. Business Processes Digitalization and Redesign

- **Automation and Redesign** → **General Electric (GE)** (Digital twin technology for industrial process optimization)
- **Agile Development, Collaboration, and Integration** → **Airbus** (Uses cloud-based collaboration tools for supply chain optimization)
- **New Supporting Services** → **Honeywell** (Industrial IoT-based automation services)

2. Support and Improvement of Employees' Daily Tasks

- **Info Reporting and Support** → **Volkswagen** (AI-driven production floor monitoring)
- **Personalized Services** → **Boeing** (Digital workforce planning tools)
- **DSS and Artificial Intelligence** → **Bosch** (AI-powered decision support for smart factories)

3. Business Performance Management

- **KPIs and Balanced Scorecard** → **Daimler** (Data-driven performance metrics for manufacturing processes)
- **Real-Time Reporting and Analytics; Continuous Integration** → **Tesla** (AI-based supply chain forecasting)



BM: Business Model Transformation - Examples

1. Digital Organizational Modifications

- **Supplementary Digital Channel** → **Philips** (Shifted from hardware to digital healthcare solutions)
- **Digital Modifications** → **BASF** (Integrated digital tools into chemical manufacturing)
- **Digital Innovations** → **Siemens** (Developed MindSphere, an industrial IoT platform)

2. Establish New Digital Activity/Service and Business Model

- **Customer-Centric Targeting** → **Michelin** (Offers tire-as-a-service subscription model)
- **New Digital Services** → **Bosch** (AI-based predictive maintenance solutions)
- **New Business Models** → **Airbus** (Developed Skywise, a data-sharing platform for airlines)

3. Digital International Expansion

- **Consolidation of Subsidiaries** → **ABB** (Unified digital strategy across automation subsidiaries)
- **International Service/Support** → **Caterpillar** (IoT-enabled global equipment monitoring)
- **Think Global and Act Local** → **Siemens** (Localized digital manufacturing hubs)



OT: Organizational Transformation - Examples

1. Integrated Business Strategy

- **Compliance** → **Bosch** (Ensuring AI compliance in industrial applications)
- **High Investments** → **Tesla** (Massive investment in Gigafactories for digital-driven production)
- **Integrated Strategy** → **GE** (Combines digital and industrial operations)

2. New Organizational Structures/Functions/Alliances

- **New Structure** → **Volkswagen** (Restructured to focus on EV and software-driven production)
- **Supervision Process** → **Boeing** (AI-powered quality control in aircraft production)
- **Alliances** → **Daimler & Nvidia** (Partnership for AI-driven vehicle manufacturing)

3. Human Resources Development, Talent Acquisition, and Exploitation

- **Training and Talent Acquisition** → **ABB** (Industrial AI training for employees)
- **New Methods** → **Airbus** (Digital twin-driven skills training)
- **Innovation Structures** → **Siemens** (Dedicated AI research labs for manufacturing innovation)

From Perception to Reality

