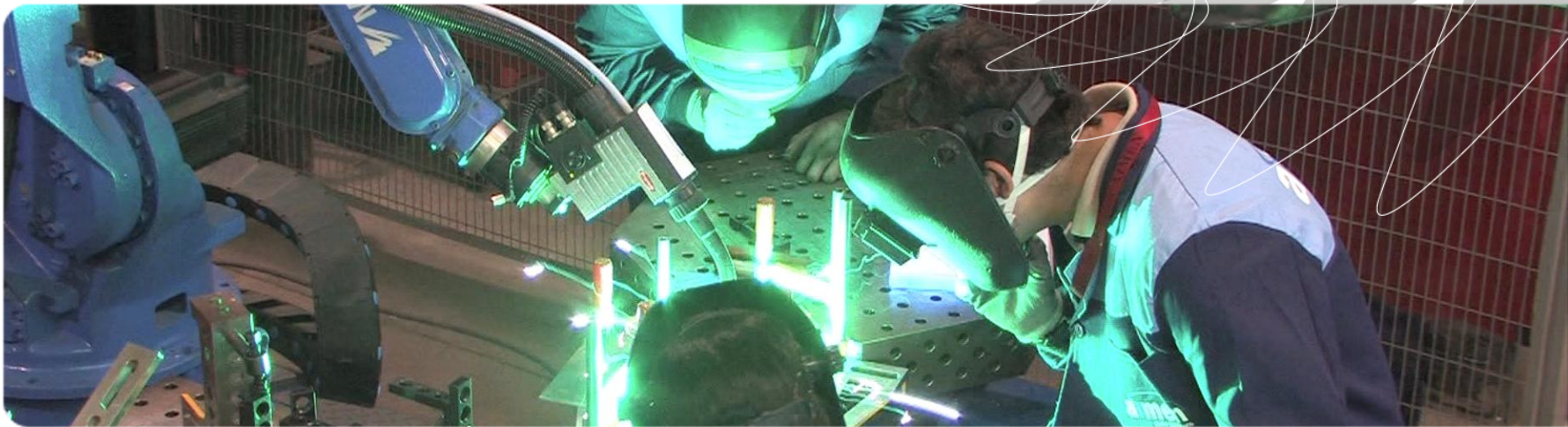


EFFRA Roadmap

Factories of the Future PPP Horizon 2020



2014 - 2020 Roadmap
June 2012 draft for consultation



EFFRA

EUROPEAN FACTORIES OF THE FUTURE
RESEARCH ASSOCIATION

a MANUFUTURE initiative

Next Framework Program: “Horizon 2020”

- Commission RD&I budget proposal: € 80 Billion
- 3 pillars:
 - industrial competitiveness
 - societal challenges
 - scientific excellence
- PPP as instrument for industrial innovation
- contractual partnership between private sector and the EC for the implementation of the PPPs



A vision for global competitiveness within the European context

- Shift the focus from a technology push to a market pull approach
- Manufacturing is the Key Economic area to create high added Value
- Towards:
 - more value created in Europe
 - efficiency and sustainability as distinctive, competitive factor
 - human-centered manufacturing
 - customizing for local and global competition



Maintaining European leadership

- future size of Europe's research PPPs should surpass competing initiatives (US, Japan, China)
- focus on demonstration and innovation requires additional financial investments
- Factories of the Future should be 3-4% of Horizon 2020 budget (~ € 500 M per year)
- industry ready to match EU investments with own RD&I resources
- measure the programme impact with market oriented and macro-economic indicators



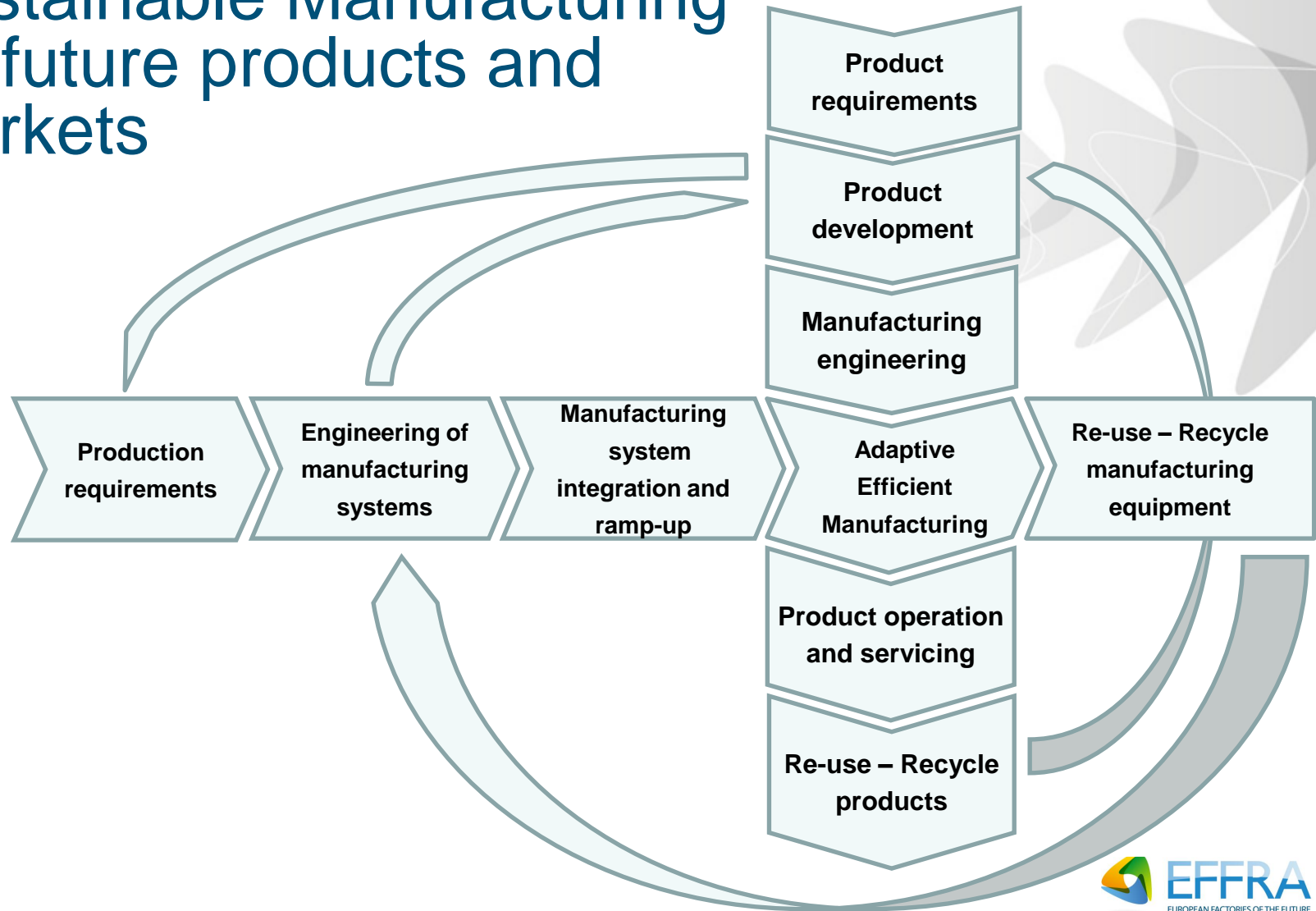
EFFRA Roadmap: 'Factories of the Future – Beyond 2013'

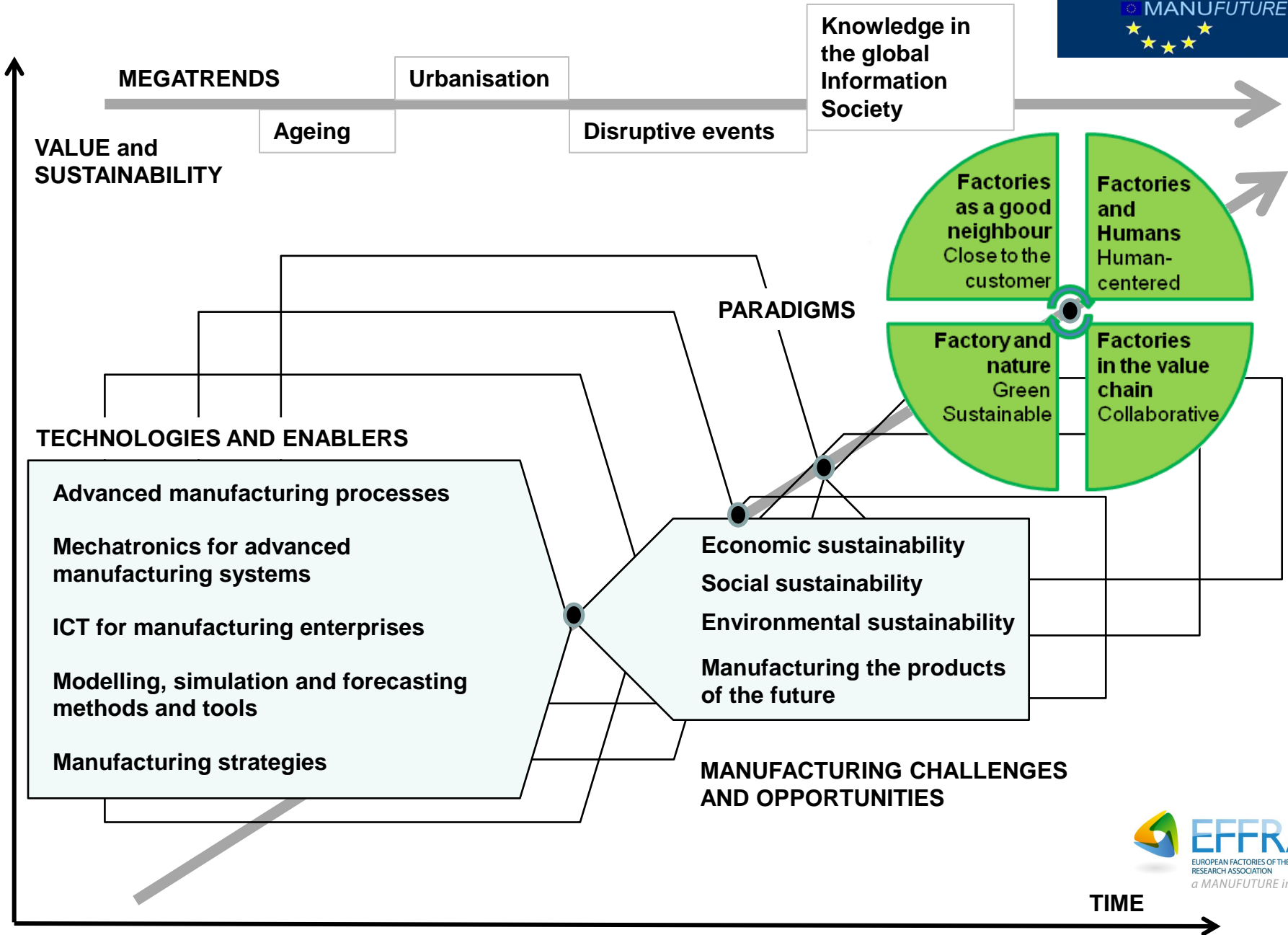
RD&I roadmap 2014-2020

- roadmap will cover R&D and Innovation activities
- guiding principles:
industry competitiveness,
from research to industrial
application and market uptake
- ambition: key impact on industrial
application fields
- ongoing comprehensive multi-
sector consultation process



Sustainable Manufacturing for future products and markets





Baselines

Challenges & opportunities

- Economical
 - Social
 - Environmental
 - New products markets
- } sustainability

Technologies & enablers

- Advanced manufacturing processes
- Mechatronics for advanced manufacturing systems
- ICT for manufacturing enterprises
- Modeling, simulation and forecasting
- Manufacturing strategies

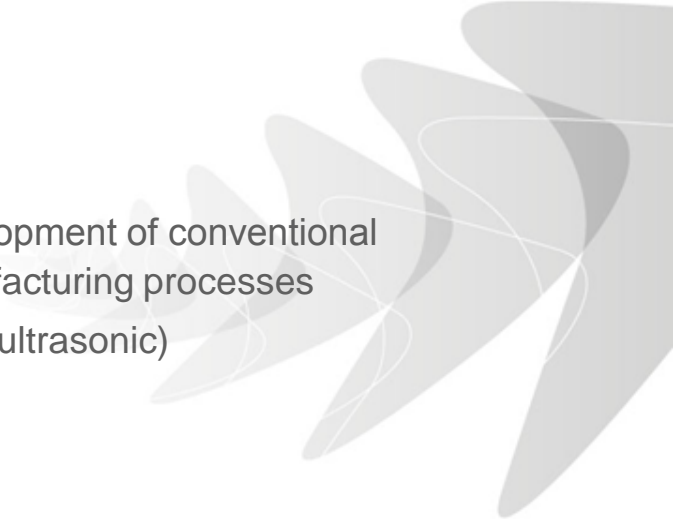
Manufacturing Challenges & Opportunities

- **Economic sustainability**
 - realising reconfigurable, adaptive and evolving factories capable of small scale production in an economically viable way
 - high performance production, combining flexibility, productivity, precision and zero-defect while remaining energy-efficient
 - economic impact of resource efficiency in manufacturing, including the end-of-life of products
- **Social sustainability**
 - increasing human achievements in manufacturing systems
 - safe and attractive workplaces
 - care and responsibility for employees and citizens along global supply chains
- **Environmental sustainability**
 - reducing the consumption of energy, while increasing the usage of renewable energy
 - reducing the consumption of water and other process resources
 - near to zero emissions in manufacturing processes
 - optimising the exploitation of materials in manufacturing processes
 - co-evolution of products-processes-production systems or 'industrial symbiosis' with minimum need of new resources
 - enabling resource efficient, sustainable products

Manufacturing Challenges & Opportunities (2)

- Manufacturing the products of the future
 - creation of value through design and production of the products of the future
 - which satisfy ever changing needs of society
 - offer the potential of opening and creating new markets in Europe and abroad
 - driving force for new products will be at the same time
 - global (consumer electronics, connectivity, telecommunications, mobility, solid state lighting...)
 - local, where local regulations and local market needs will push for products with specific requirements in a specific geographic area
 - service provisioning and enhanced functionalities in future products
 - increased product smartness, such as the increased use of embedded mechatronics in components, requiring the design and production methodologies to evolve as a consequence

Technologies and enablers

- **Advanced manufacturing processes**
 - high productivity and “self assembly” technologies development of conventional (joining, forming, machining) and new micro/nano-manufacturing processes
 - integration of non-conventional technologies (e.g. laser, ultrasonic)
 - shaping technology such as forming and machining
 - methods for handling of parts, metrology and inspection
 - photonics-based materials processing technologies
 - flexible Sheet-to-Sheet (S2S) and Roll-to-Roll (R2R)
 - **Mechatronic technologies for advanced manufacturing systems**
 - control technologies will be further exploiting the increasing computational power and intelligence in order to come forward to the demands of increased speed and precision in manufacturing
 - continuous monitoring of the condition and performance of the manufacturing system on component and machine level, also introducing autonomous diagnosis capabilities and context-awareness
 - intelligent machinery components will enable the deployment of safe, energy-efficient, accurate and flexible or reconfigurable production systems
- 

Technologies and enablers (2)

- ICT for manufacturing enterprises

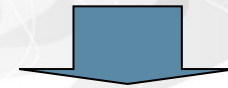
Considering ICT trends:

Collaborative Manufacturing – Connectivity – Mobility – Manufacturing intelligence

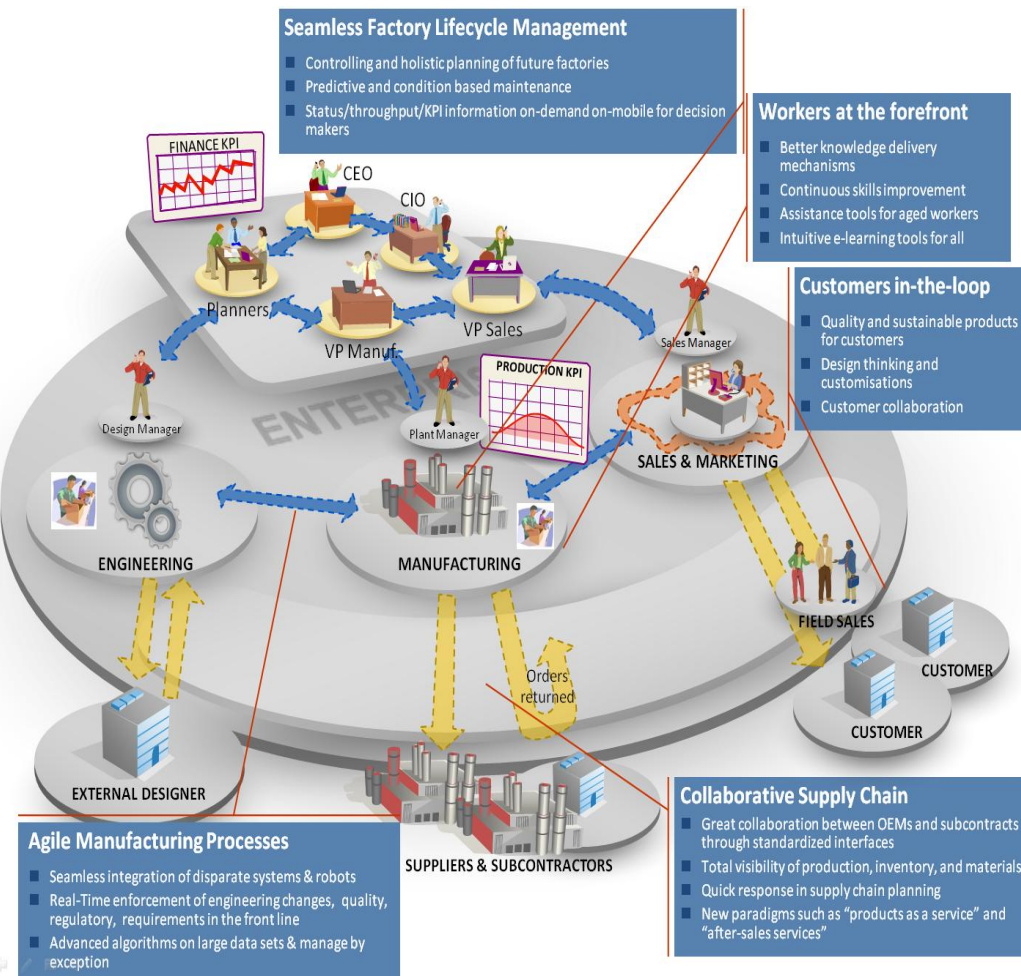
- ICT solutions for factory floor and physical world inclusion
 - all need to be connected to each other and to back-end systems and at the same time to be self-aware of the surrounding environment.
 - ICT solutions for next generation data storage and information mining
 - ICT solutions for implementing secure, high performance and open manufacturing services platforms
 - collaborative and decentralized application architectures and development tools
- Modelling, simulation and forecasting
 - for integrated product-process-production system
 - strategically support the manufacturing-related activities during all the phases of the real factory life-cycle
 - Manufacturing strategies

Considering the ActionPlanT roadmap

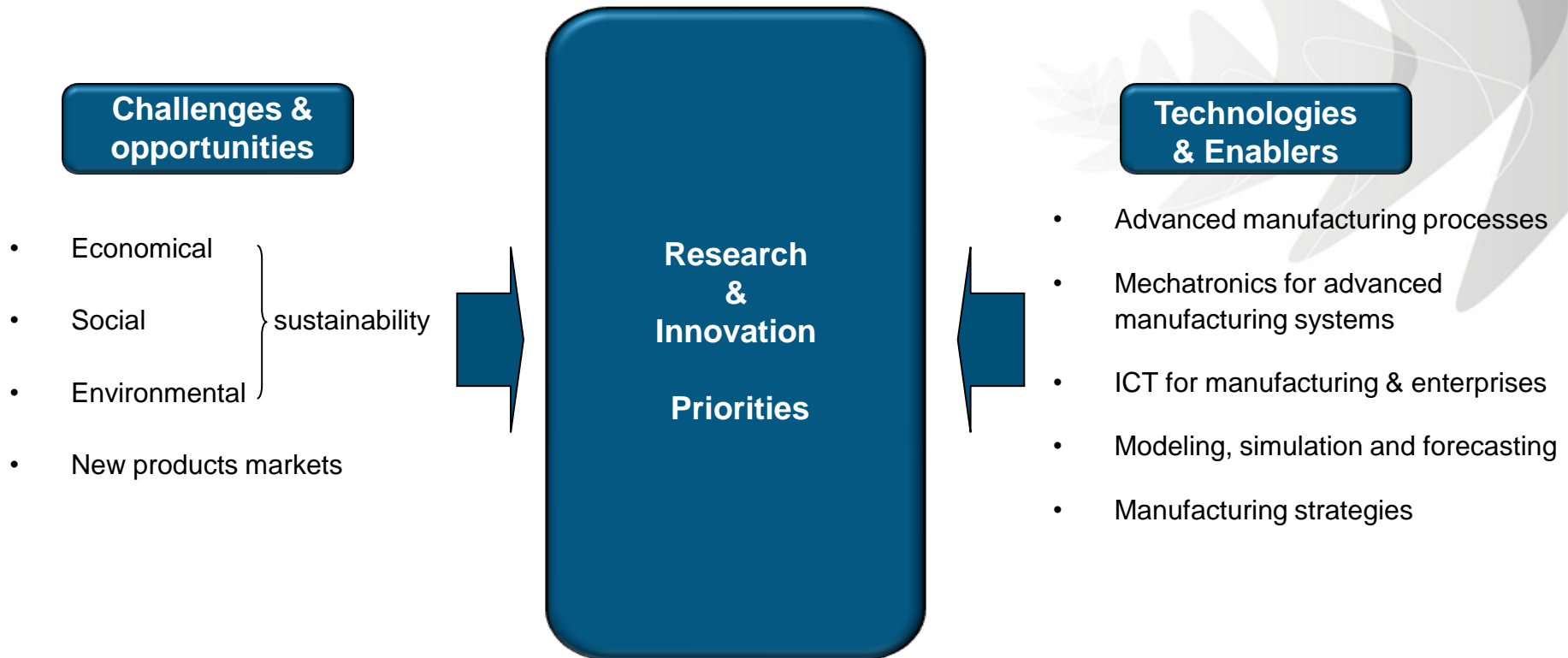
Information and Communication Technologies



- towards agile manufacturing systems and processes
- the new seamless factory life cycle management
- people at the forefront
- fostering collaborative supply networks
- aiming at customer centric design and manufacturing



The right research priorities



the right technologies for the right challenges/opportunities,
measuring the (potential) impact of technologies

Research & Innovation Priorities

Domain 1: Advanced Manufacturing processes

innovative processing for both current and new materials or products

Domain 2: Adaptive and smart manufacturing systems

innovative manufacturing equipment at component and system level, including mechatronics, control and monitoring systems

Domain 3: Digital, virtual and resource-efficient factories

factory design, data collection and management, operation and planning, from real-time to long term optimization approaches

Domain 4: Collaborative and mobile enterprises

networked factories and dynamic supply chains

Domain 5: Human-centric manufacturing

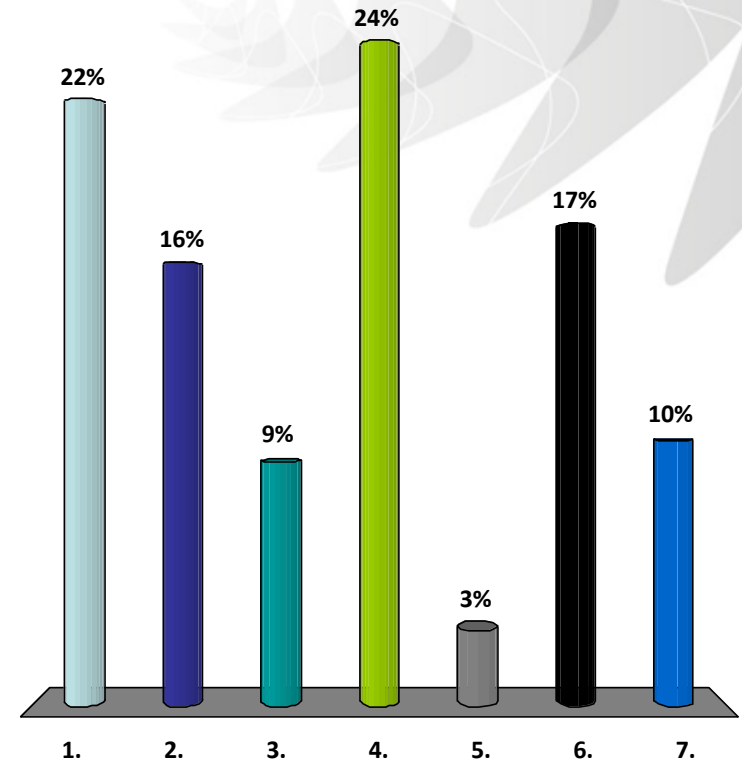
enhancing the role of people in factories

Domain 6: Customer-focused manufacturing

involving customers in manufacturing value chain, from product-process design to manufacturing associated innovative services

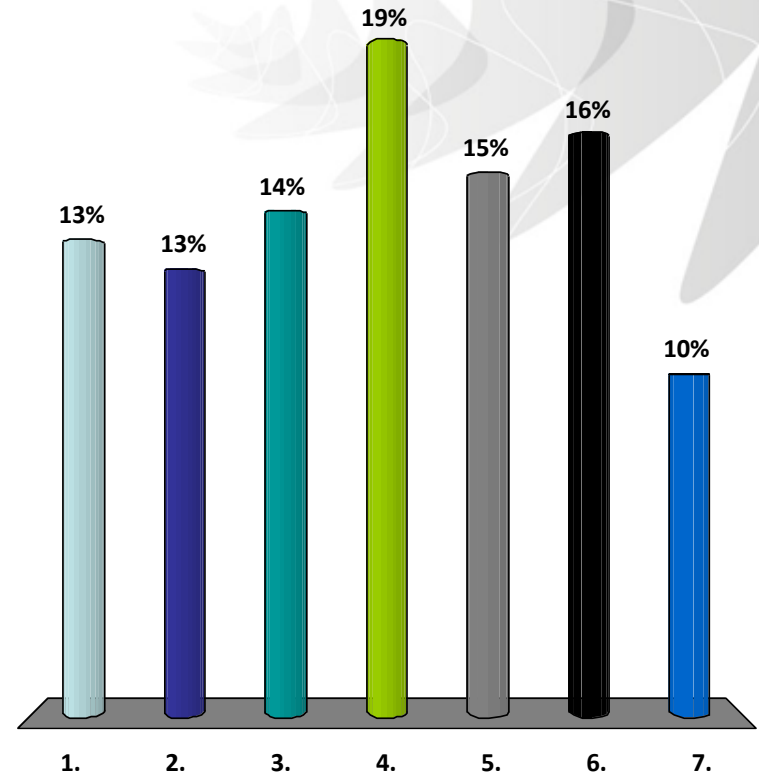
Domain 1: Advanced Manufacturing

- 1.1 manufacturing for custom made parts
- 1.2 automated production of composite structures/products
- 1.3 manufacturing processes for renewable raw materials, biomaterials and cell based products
- 1.4 material efficient manufacturing processes
- 1.5 characterization as a key enabler for robust micro-nano-enabled production
- 1.6 joining technologies for advanced and multi-materials
- 1.7 high volume manufacturing at the micro- and nano-scale



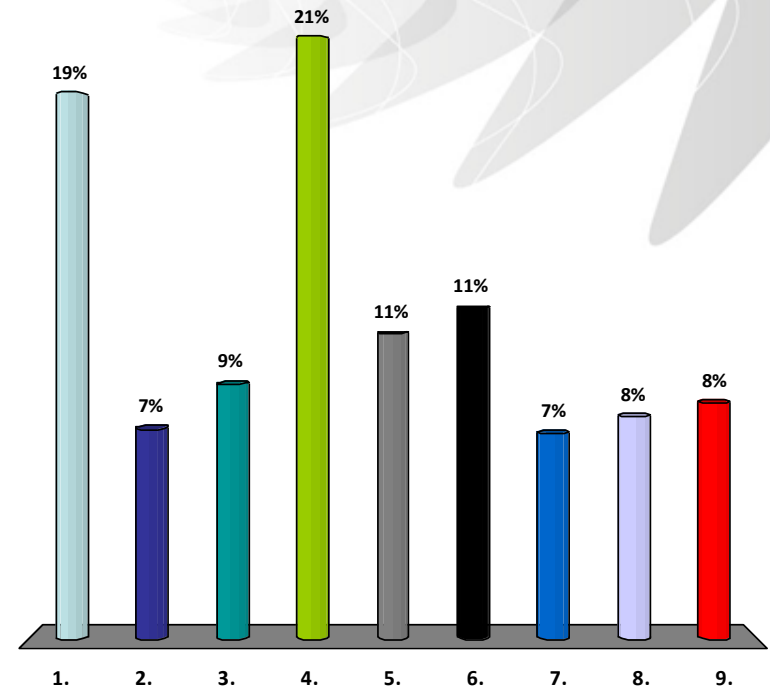
Domain 1: Advanced Manufacturing (2)

- 1.8 delivery of new functionalities through (mass production) surface manufacturing processes
- 1.9 manufacturing of flexible structures
- 1.10 product life cycle management for advanced materials
- 1.11 multifunctional manufacturing processes
- 1.12 novel supply chain approaches for innovative products
- 1.13 integration and automation of the industrial heterogeneous processes
- 1.14 factories for mini-micro production



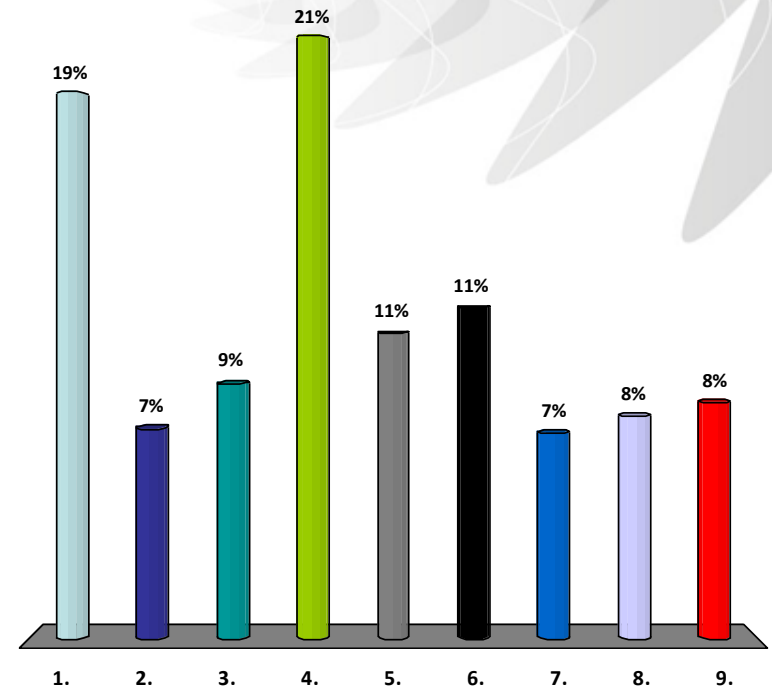
Domain 2: Adaptive & Smart Manufacturing

- 2.1 flexible and reconfigurable machinery and robots
- 2.2 embedded cognitive functions for supporting the use of machinery and robot systems in changing shop floor environments
- 2.3 symbiotic safe and productive human robot interaction, professional service robots and multimodal human-machine-robot collaboration
- 2.4 adaptive process automation and control



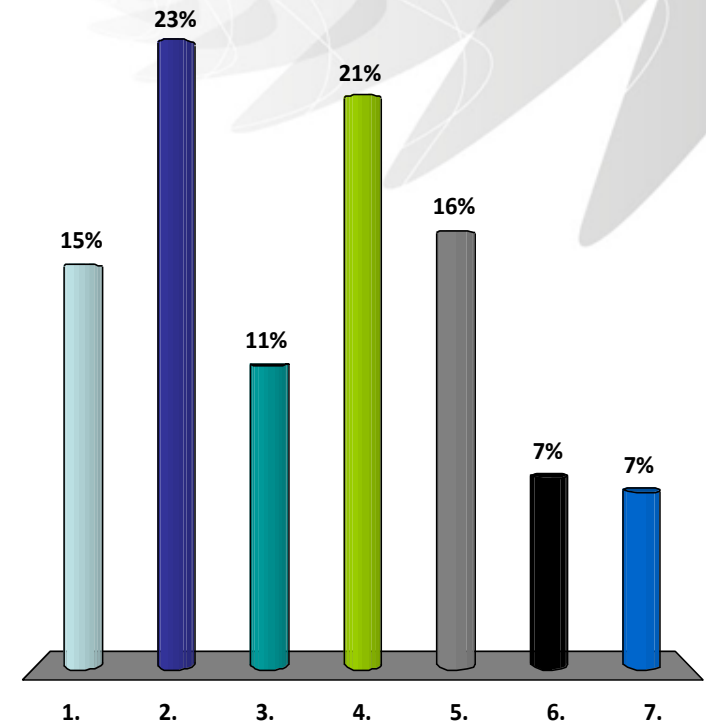
Domain 2: Adaptive & Smart Manufacturing (2)

- 2.5 manufacturing execution environment for smart factory
- 2.6 monitoring, perception & awareness on manufacturing
- 2.7 applying advanced materials in high performance and resource-efficient manufacturing equipment
- 2.8 mechatronics for high performance and resource-efficient manufacturing equipment
- 2.9 multi-disciplinary engineering tools for mechatronics engineering



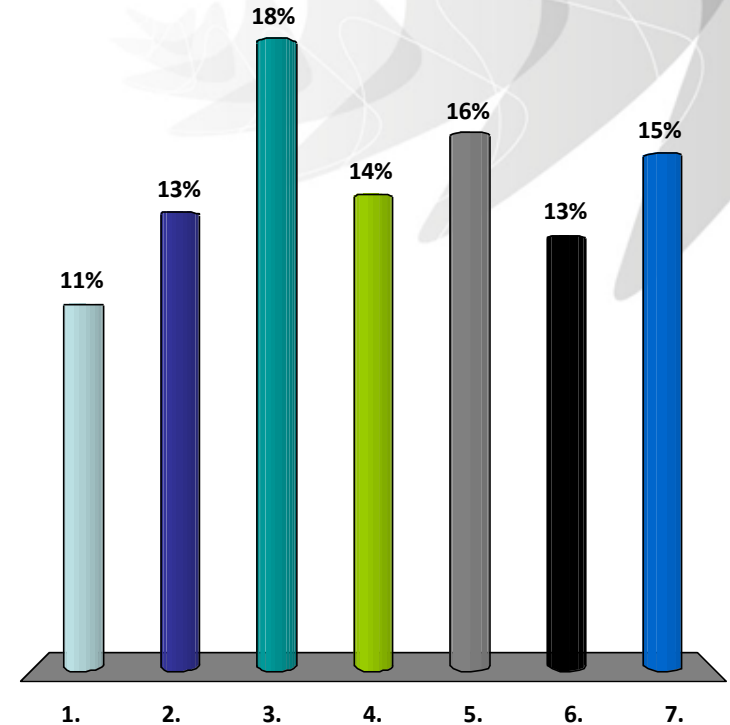
Domain 3: Digital, Virtual & Resource-Efficient Factories

- 3.1 integrated factory models for evolvable manufacturing systems
- 3.2 intelligent maintenance systems for increased reliability of production systems
- 3.3 integrated high-performance computing in factory life-cycle management
- 3.4 energy monitoring and management in future manufacturing enterprises
- 3.5 multi-level simulation and analytics for improving production quality and throughput
- 3.6 services for continuous evaluation and mitigation of manufacturing risks
- 3.7 on-demand modular and replicative models for faster factory initialization



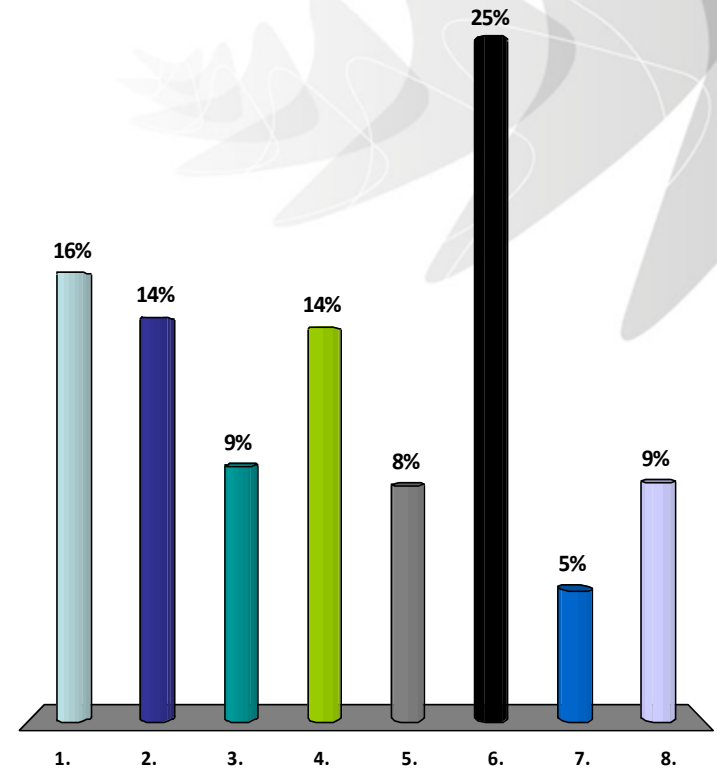
Domain 3: Digital, Virtual & Resource-Efficient Factories (2)

- 3.8 mobility suite for comprehensive factory performance management
- 3.9 system-oriented quality control strategies in multi-stage manufacturing
- 3.10 design and management of production machinery and processes
- 3.11 design and management of production systems in evolution
- 3.12 design and management of manufacturing strategies
- 3.13 integration of design methods and tools
- 3.14 de-manufacturing factories



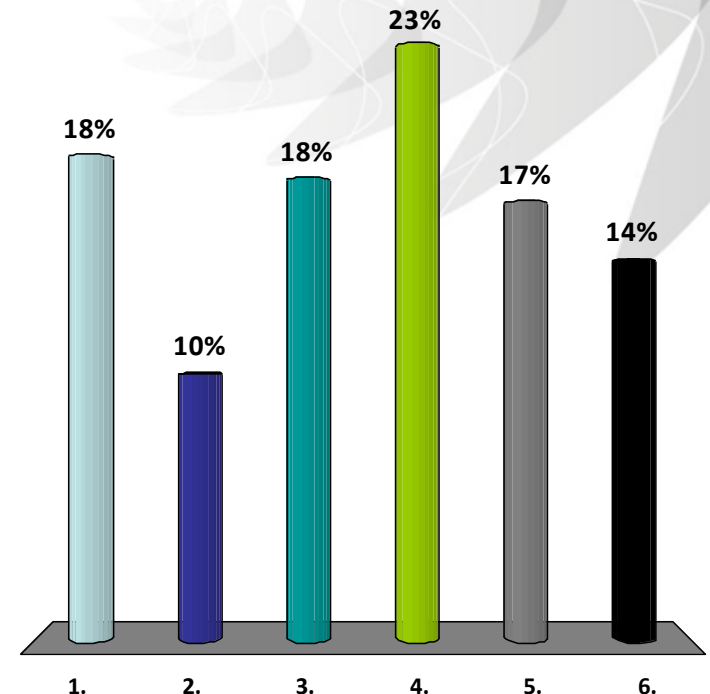
Domain 4: Collaborative & Mobile Enterprises

- 4.1 cloud-based manufacturing business-web for supply network collaboration
- 4.2 end-of-life (EOL) applications in a network of re-manufacturing stakeholders
- 4.3 mobile store and applications for an agile and open supply network
- 4.4 connected objects for assets and enterprises in the supply networks
- 4.5 complex event processing (CEP) for state detection and analytics in supply networks
- 4.6 collaborative demand and supply planning, traceability, and execution
- 4.7 digital rights management (DRM) of products and code in enterprise supply networks
- 4.8 multi-enterprise role-based access control (MRBAC) in manufacturing enterprises



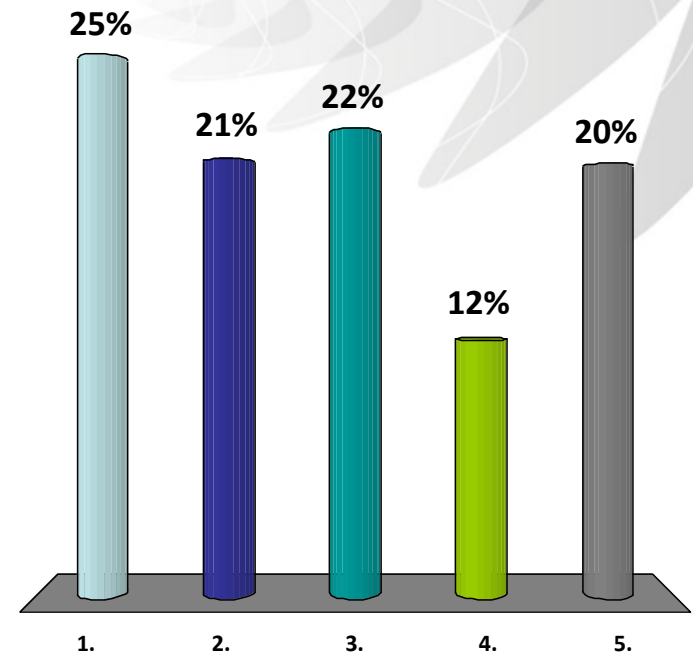
Domain 5: Human-Centric Manufacturing

- 5.1 enhanced visualization of complex manufacturing data
- 5.2 teenage-awareness for manufacturing and new manufacturing education systems
- 5.3 advanced information models for knowledge creation and learning
- 5.4 ICT support to the worker-process interaction and collaborative competence development
- 5.5 integrate e-learning tools with real life manufacturing
- 5.6 methods and tools for a continuous adaptation of workplaces



Domain 6: Customer-Focused Manufacturing

- 6.1 manufacturing intelligence for informed product design
- 6.2 ICT for energy-efficient product life-cycles
- 6.3 collaborative design for global manufacturing of product-service systems
- 6.4 crowd sourcing for highly personalized human-centric innovative product
- 6.5 product value and impact simulation



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