



/ Finnish Metals and Engineering  
Competence Cluster

## Hybrid Materials (FIMECC HYBRIDS)

Public-private research programme

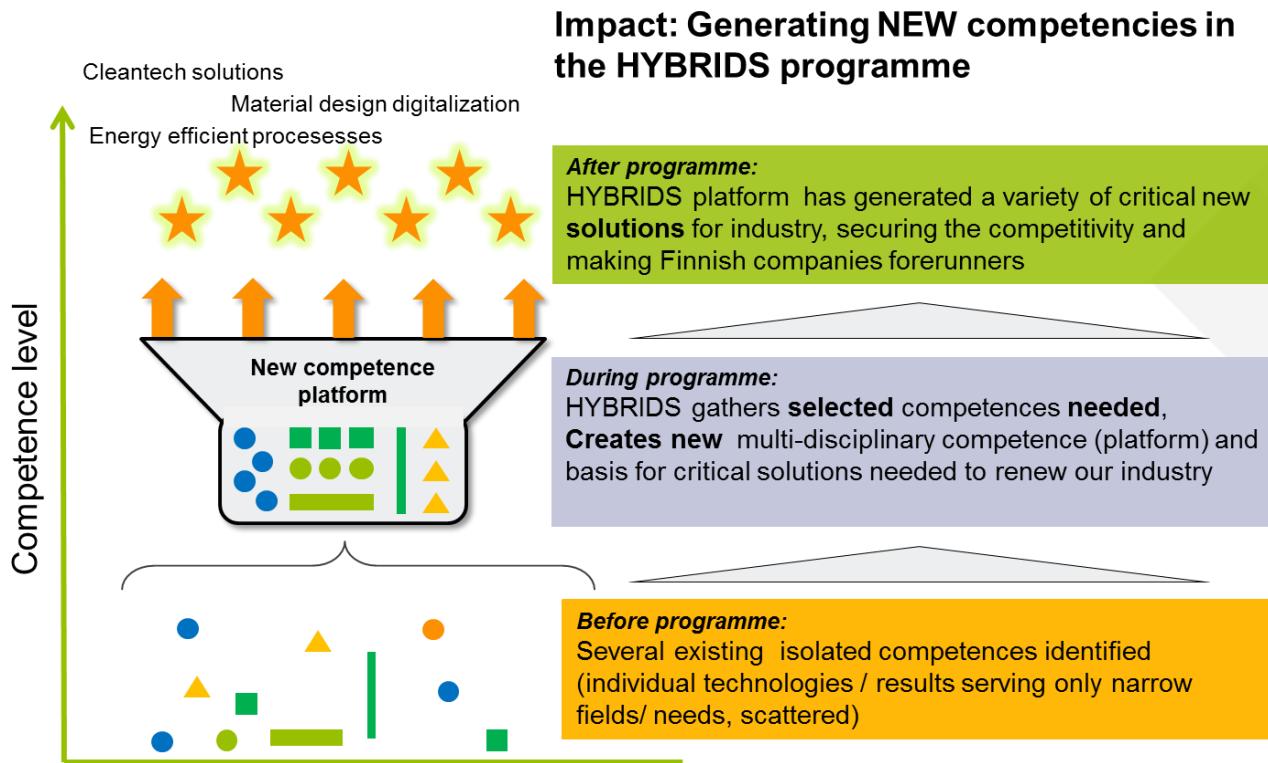
2014-2018

<http://www.fimecc.com/programs/hybrid>

# Executive summary

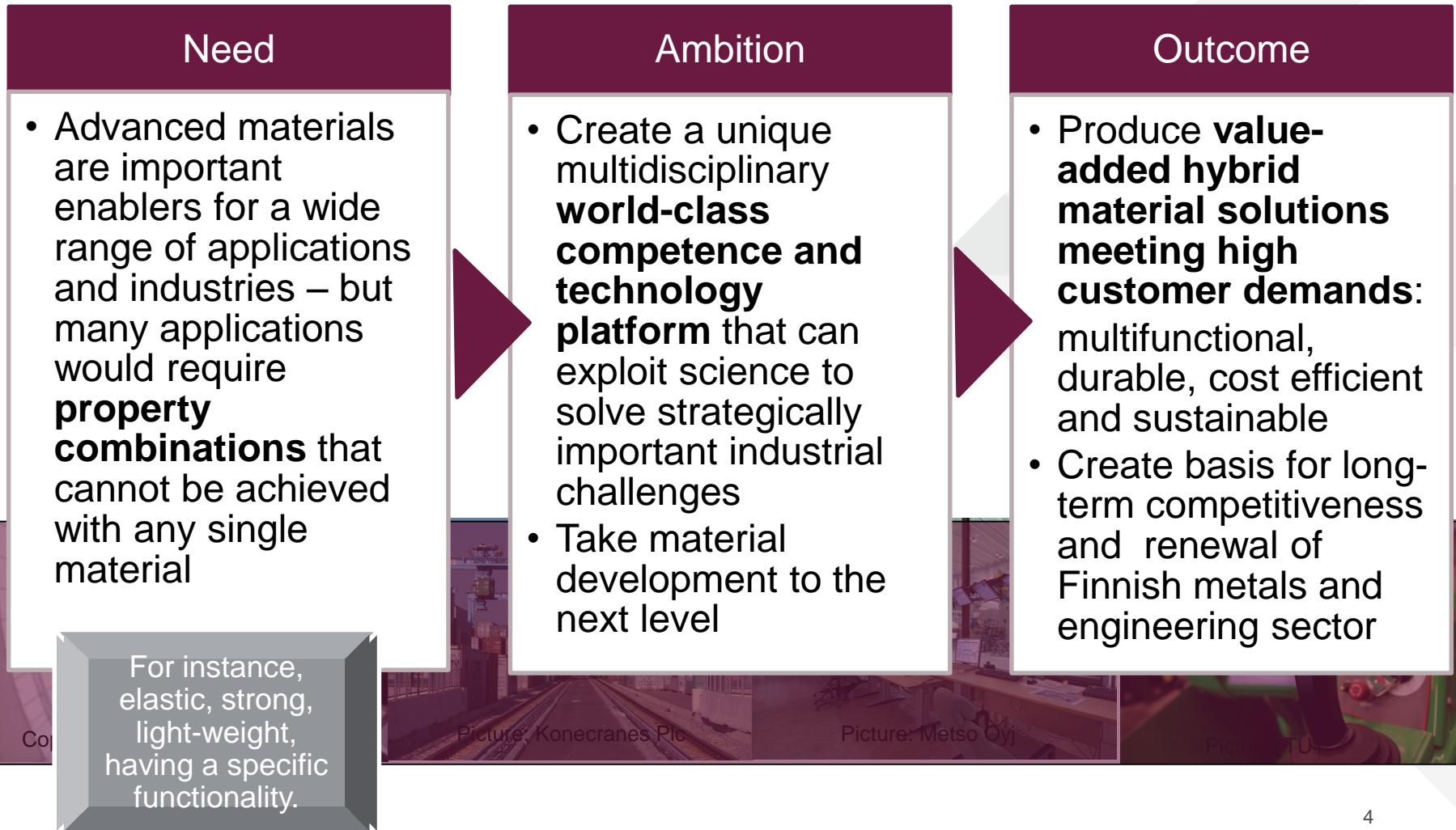
- ▶ HYBRIDS builds a unique multidisciplinary knowledge platform that will strengthen the manufacturing industry
  - The programme solves fundamental challenges in the R&D and application of multi-materials to create advanced property combinations that conventional materials do not possess
- ▶ Essential elements:
  - FIMECC Breakthrough Materials Doctoral school
  - Extensive collaboration both nationally (joint knowledge platform with Breakthrough Steels and Applications programme) and internationally
- ▶ **Impact:**
  - New value-added hybrid material solutions meeting high customer demands (multifunctional, durable, cost efficient and sustainable), creating a competitive advantage
  - Digitalization of manufacturing and material development will decrease the time to market
  - A strong manufacturing industry ecosystem and new industrial networks (in contrast to knowledge silos)
- ▶ **Vision:** Growth and improved competitiveness by value-added, hard to copy solutions

# Motivation for the programme: Integration and development of individual key competences into an advanced knowledge platform to benefit the manufacturing industry



- ▶ Materials technology contributes to all sectors of the manufacturing industry, which currently covers a major part of Finnish exports
- ▶ The competitiveness of the manufacturing industry needs to be improved by creating value-added hard-to-copy solutions, advanced know-how and new value networks

# HYBRIDS – A unique multidisciplinary competence platform to create value-added and sustainable industrial solutions



# What are hybrid materials?

- ▶ Engineered combinations of two or more materials, complementing each other to create new functions or combinations of functions that the individual component materials did not possess

**Hybrid structures:**  
compound and  
layered structures

within the same class of  
materials

- typically metal-metal

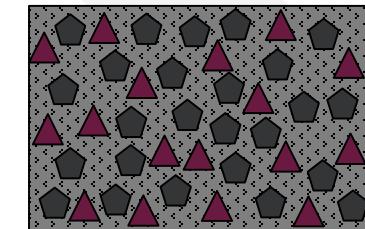
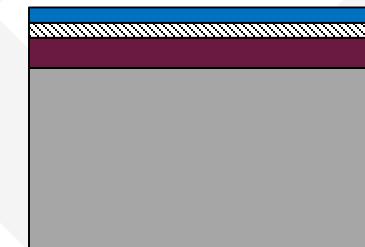
dissimilar materials

- for instance, metal-polymer,  
metal-ceramic

**Hybrid materials:**  
nano- and micro-  
composite materials

of dissimilar elements

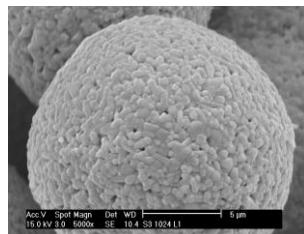
- for instance, metal-polymer,  
metal-ceramic, polymer-ceramic,  
polymer-polymer



# HYBRIDS solves fundamental challenges in the R&D and application of multi-materials

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## Goals



Source: Millidyne



Source: Oseir



Source: LM Instruments

Understanding the relationship between **microstructure, processing and material properties**

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Controlling the **interfaces of dissimilar materials**  
- formation, structure and long-term properties

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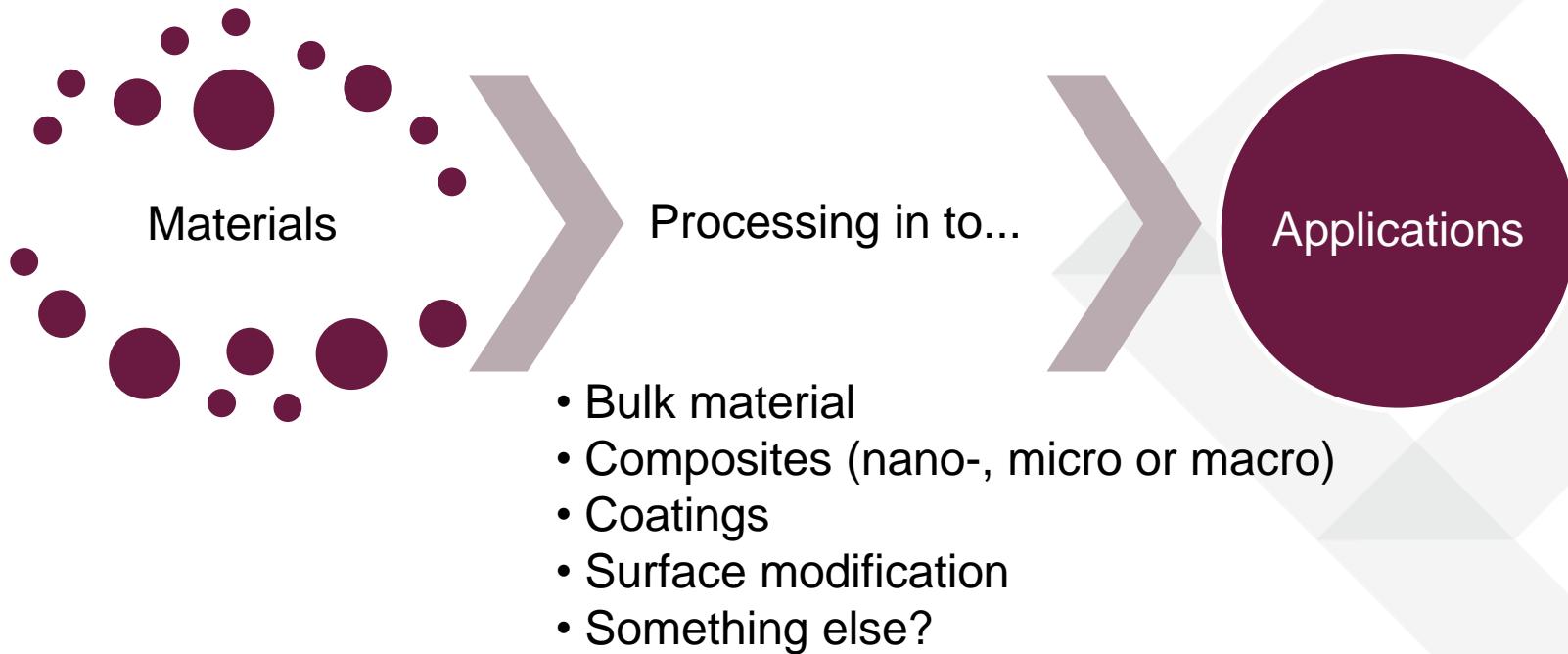
Development of **modeling and non-destructive testing; digitalisation** of material development

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**Development, production and application** of novel metal, ceramic or polymer-based and nanohybrid materials

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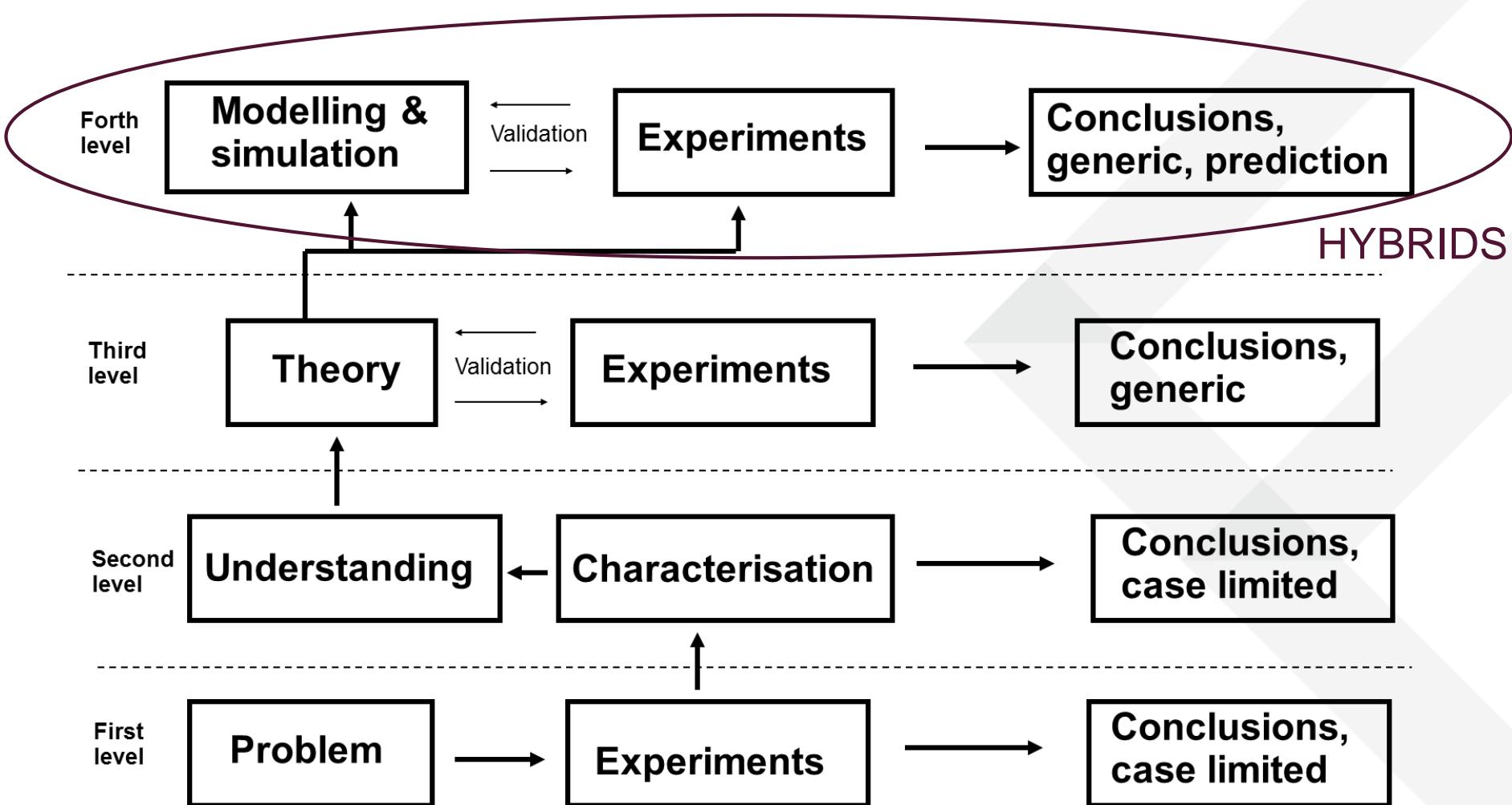
# Key issue: Understanding the relationship between materials, processing and properties



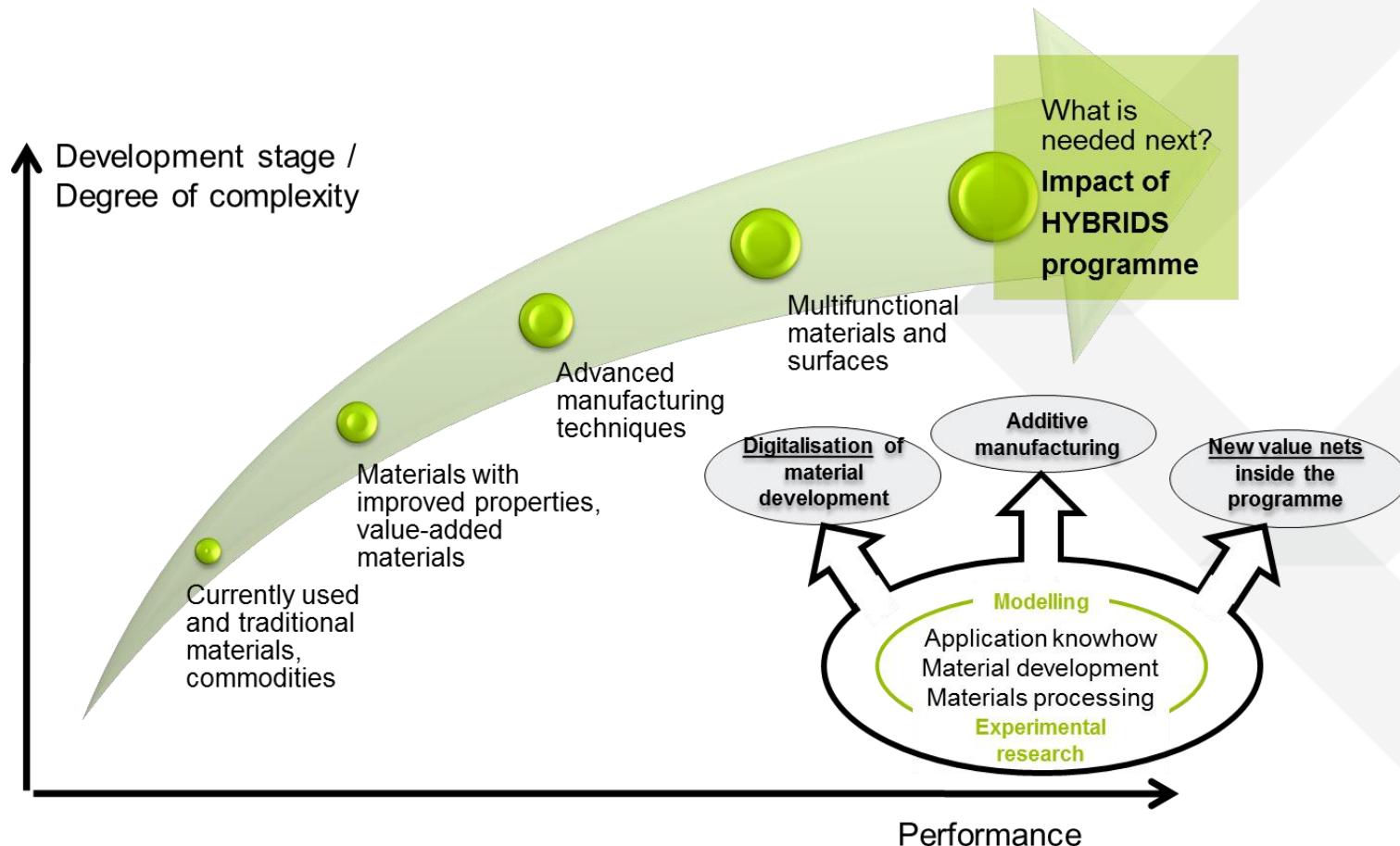
# Expected result: New property combinations to enable competitive and sustainable solutions



# HYBRIDS brings materials research and design to a new level



# HYBRIDS builds on the latest advances in materials development - and takes them further



# Applications of hybrid materials will benefit various fields of industry

Heat resistant components

Power plant equipment, metallurgy, etc.



Source: Neste Oil

Corrosion resistant components

Pulp and paper, oil and gas



Wear resistant components

Mining machinery, rock crushing, etc.

Functional material solutions

Renewable energy, smart surfaces etc.



Source: Abloy

Vibration control

Mobile machinery, rotating machines, etc.



Source: Oras

Light structures

Moving machinery, lifting and handling etc.



Source: Nokian Tyres

# HYBRIDS vision – Growth and improved competitiveness by value-added, hard to copy solutions, technologies and networks

## Global markets and cost competition

- Improvement of **competitiveness** by value-added, hard to copy hybrid material solutions
- **Agile** and **cost-efficient** manufacturing technologies for advanced hybrid materials

## Renewal of Finnish manufacturing industry

- **Growth in new business areas:** new jobs are being created by developing value-added hybrid material solutions combining different technologies
- **Digitalization** of manufacturing and material development will decrease the time to market

## Industrial ecosystem

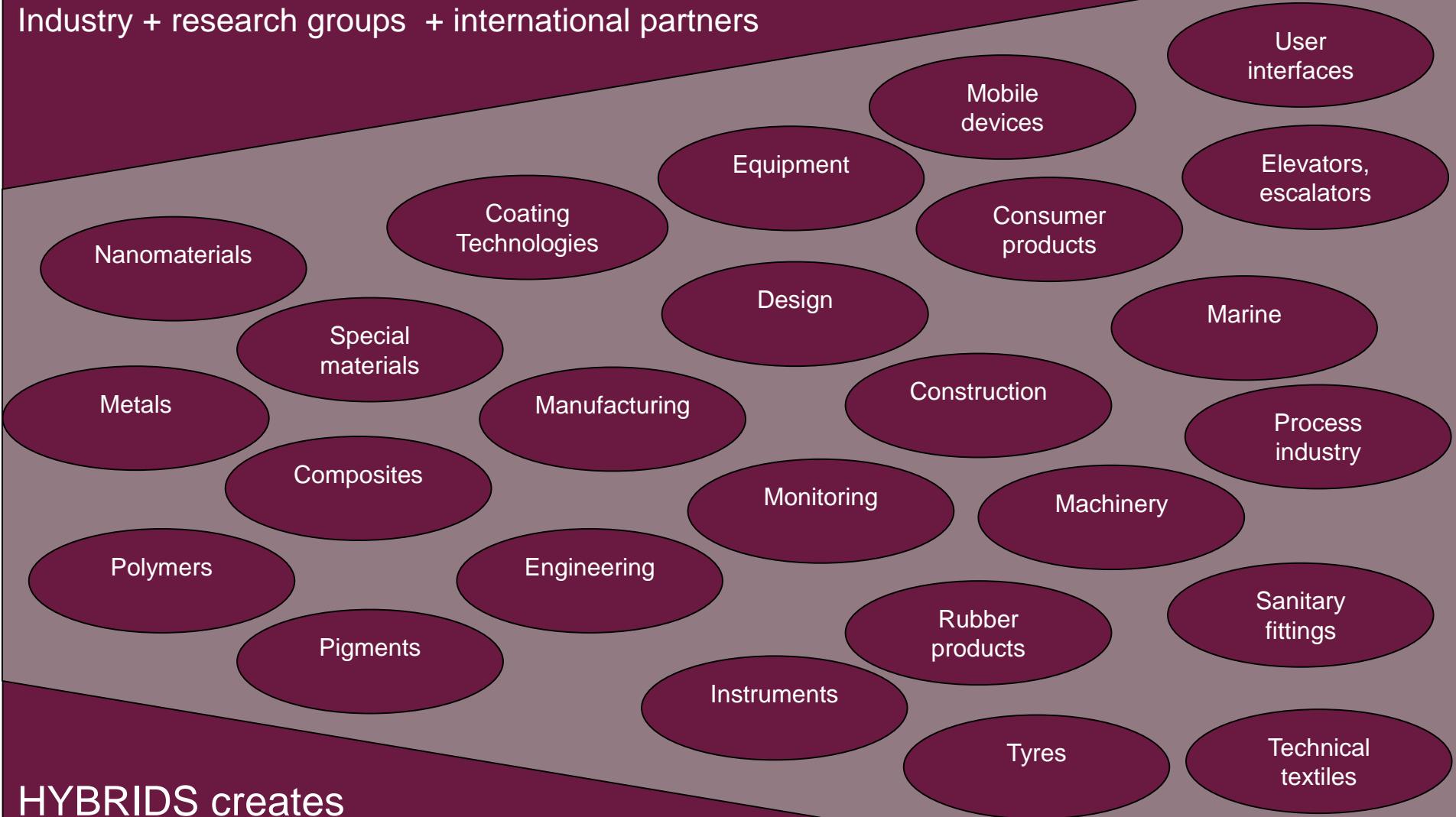
- Development of manufacturing industry ecosystem and new industrial **networks** (in contrast to knowledge silos)
- Comprehensive value chains for fast up-scaling and commercialisation
- Creating new breakthrough material innovations by open innovation

# Factsheet: HYBRIDS

- ▶ Timetable: 5 years, started 1.1.2014
- ▶ Volume: 34 M€ total (7 M€ first year)
- ▶ Participants:
  - **38 companies** including many branches of industry, e.g. metals, plastics, composites, special materials, designing, manufacturing, mechanical engineering, coating technologies, measuring, monitoring, instrumentation and several end products/applications.
  - **7 research organisations** including several multidisciplinary research groups with high level international partners

# COMPETENCE VALUE NETWORKS

Industry + research groups + international partners



HYBRIDS creates  
a unique multidisciplinary competence platform

# Hybrid Materials brings together 38 companies and 7 research organisations



# HYBRIDS combines cross-cutting scientific basis with industry-driven projects

## P1. Multifunctional thin coatings

*Create innovative and sustainable solutions with multifunctional properties*

## P2. Multifunctional thick coatings and composites

*Create high-performance, cost-effective hybrid coatings for severe environments*

## P3. Light multifunctional hybrid structures

*Develop critical understanding of energy efficiency and long-term durability*

## P4. Polymeric multifunctional sliding materials

*Establish scientific basis and generate high-performance sustainable solutions for process efficiency*

## P5. Fundamentals and modelling

*Cross-cutting element ensuring sharing and integration of tools and knowledge developed*

# The HYBRIDS projects emphasise various types of hybrid materials and structures

P5

Fundamentals and modelling *Cross-cutting element ensuring sharing and integration of tools and knowledge developed*

P1

Multifunctional thin coatings

*Create innovative and sustainable solutions with multifunctional properties*

P3

Light multifunctional hybrid structures

*Develop critical understanding of energy efficiency and long-term durability of hybrid materials*

P4

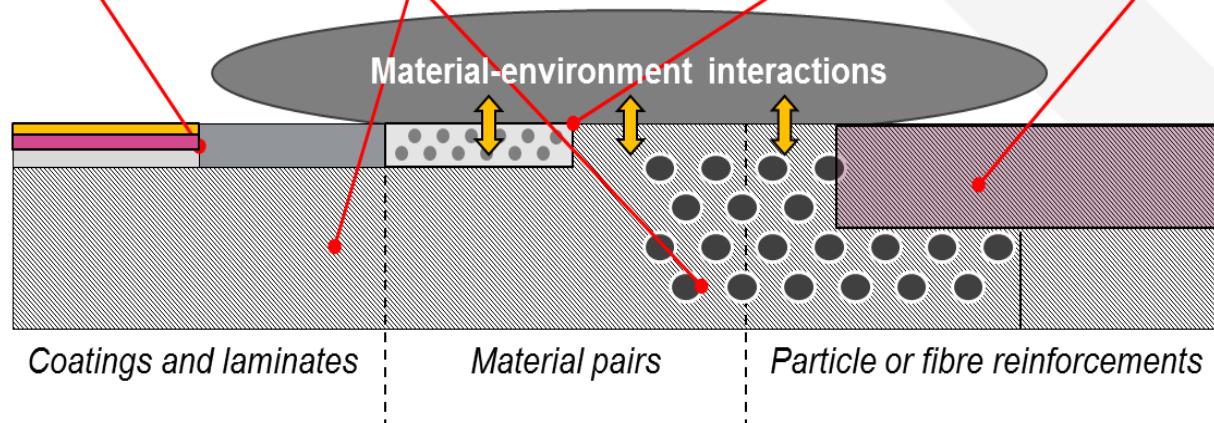
Polymeric multifunctional sliding materials

*Establish scientific basis and generate high-performance sustainable solutions for process efficiency*

P2

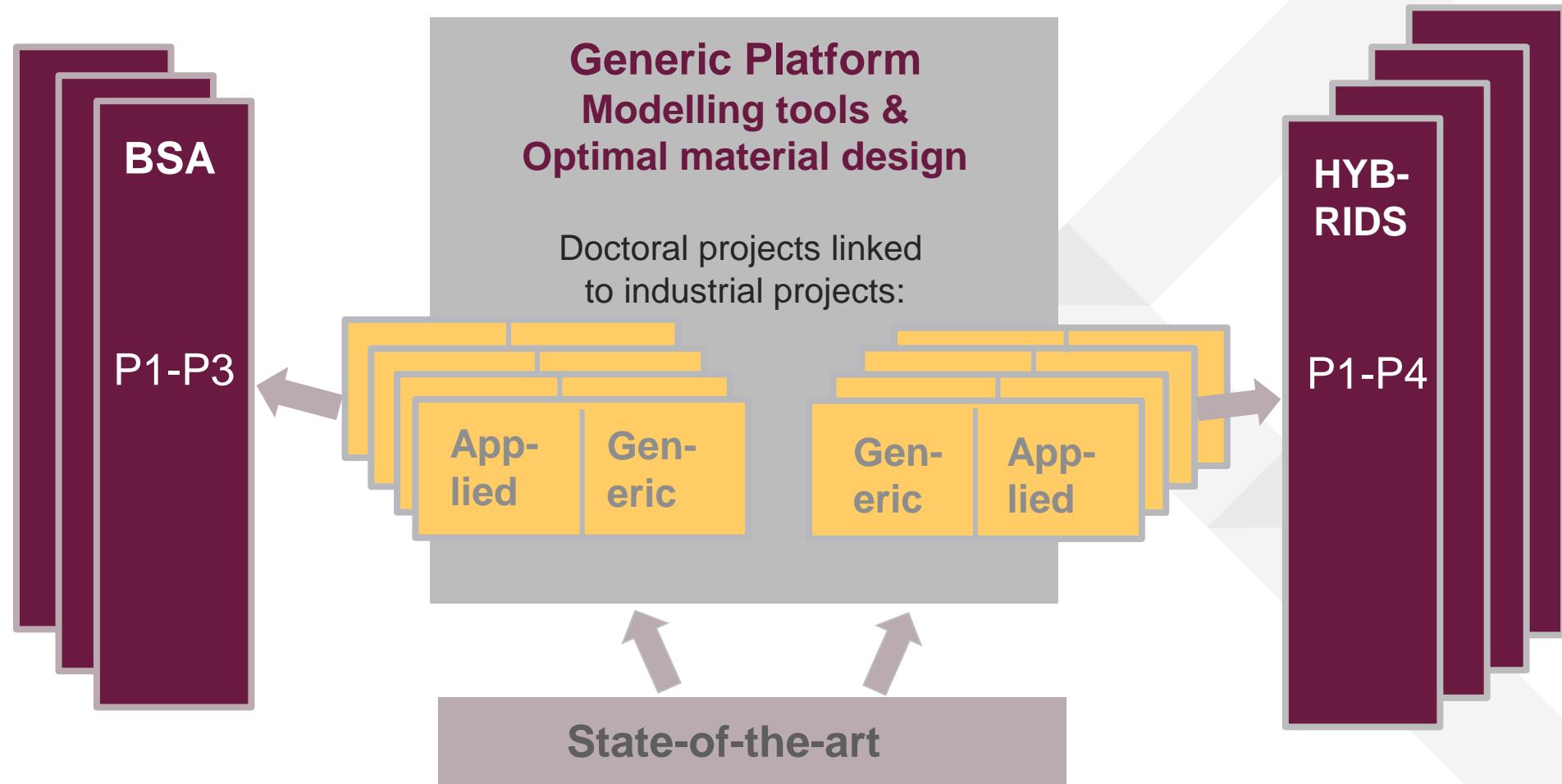
Multifunctional thick coatings and composites

*Create high-performance, cost-effective hybrid coatings for severe environments*



Schematic presentation of different types of hybrid structures and main emphasis of various projects

# A joint fundamentals and modelling project will create a solid knowledge platform



# FIMECC Breakthrough Materials Doctoral School solves industrial challenges with deep science

- ▶ **Industry-led Doctoral School which has been built within FIMECC BSA & HYBRIDS programmes**
- ▶ Launched in the beginning of 2014
- ▶ Involves 22 doctoral students in its first phase (*extended already to 30; all working within BSA&HYBRIDS*)
- ▶ Focusing on fundamental scientific challenges and modelling, a multi-disciplinary group of young scientists with their senior advisors and international partners will tackle critical research questions set by the involved companies to build new solutions and relevant competence for the industry
- ▶ Doctoral studies are carried out according to the principles of each university
- ▶ More information and Doctoral school in the media: [FIMECC's industry driven doctoral school brings materials research to new era](#)



# FIMECC HYBRIDS&BSA together are a major boost to the materials & engineering sector

- ▶ The programmes run in parallel and are linked via the Fundamentals and Modelling projects
- ▶ Strong co-operative R&D effort
  - 30 + 38 companies, all key universities + top-notch international partners; a total volume of 80 MEUR (46 + 34)
- ▶ Extensive expert networks
  - Gathering together wide, multi-disciplinary expert groups from different industries and academic branches
- ▶ Ambitious plans & crew to make it happen
  - Combining deep science and real industrial needs
  - New critical solutions and relevant competence for the industry
  - “FIMECC Breakthrough Materials Doctoral School” (see previous slide)

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# FIMECC and its programmes in brief

- ▶ FIMECC Ltd. (Finnish Metals and Engineering Competence Cluster) is an open innovation R&D company. The aim of FIMECC is to increase and deepen the cooperation between companies, universities and research institutes in R&D. FIMECC is the right cooperation partner for any organization willing to co-create knowledge through strategic pre-competitive research. All those who are willing to contribute significantly to our focus areas, are welcomed. Current list of shareholders can be widened through new shares issued for those willing to buy.
- ▶ FIMECC manages research in five strategic research themes through research programs that address specific issues and research questions mentioned in the [Strategic Research Agenda](#)

More information  
about FIMECC Ltd.:

[www.fimecc.com](http://www.fimecc.com)

# fimecc

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Competence Cluster

## We boost strategic research - together

**[www.fimecc.com](http://www.fimecc.com)**