INDustrial TECHnologies 2018
Innovative Industries for Smart Growth

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PILLAR 1

Session 1.4

Industrial Exploitation of Materials Modelling

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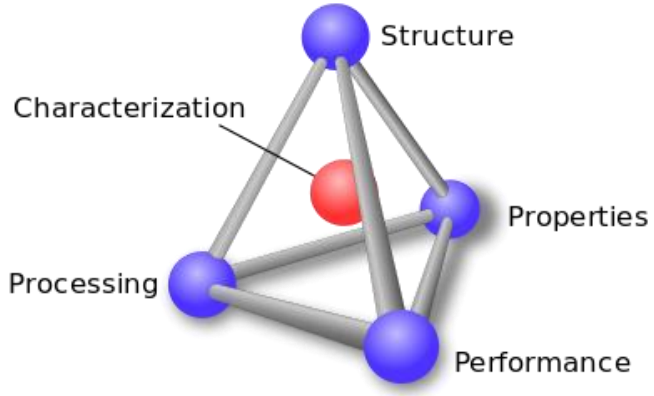
The European Materials Modelling Council

EMMC

Outline

- European Materials Modelling Council – EMMC www.emmc.info
- Why critical raw materials are important ?
- Industrial feedback on modelling use and benefits
- Stages of materials and product design
- Integration of materials modelling with engineering
- Current barriers for effective industrial exploitation
- Concluson



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European Materials Modelling Council (EMMC)

The overarching objective

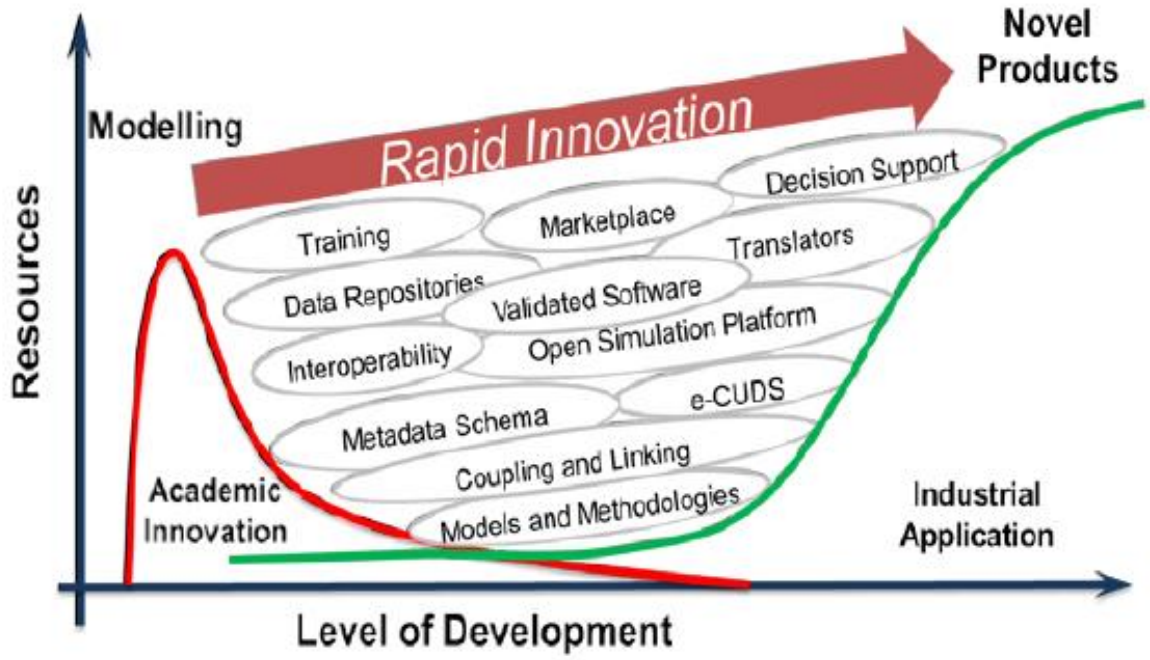
is to allow European Industry

to reap the benefits of materials modelling

more effectively and vigorously

www.emmc.info

Innovation valley of death



Substantial development efforts and time are needed to move from modelling to final products

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Why critical raw materials are important ?

- **Link to industry** - non-energy raw materials are linked to all industries across all supply chain stages
- **Modern technology** - technological progress and quality of life rely on access to a growing number of raw materials. For example, a smartphone might contain up to 50 different kinds of metals, all of which contribute to its small size, light weight and functionality.
- **Environment** – raw materials are closely linked to clean technologies. They are irreplaceable in solar panels, wind turbines, electric vehicles, and energy-efficient lighting.

http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_de

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Industrial feedback on modelling use and benefits

Modelling offers unique insight into

- properties and in-service behaviour of materials,
- industrial manufacturing processes,
- provides understanding of the underlying physics of materials, devices and processes;

Modelling complements experiments by

- guiding experiments, replacing time and cost expensive trials,
- reducing cost and hardware for testing,
- interpreting the experiments;

THEORY → PRACTICE

Modelling helps design prototypes by enabling

- pre-screening, faster screening of alternative materials and designs,
- predicting final product properties and performance,
- determination if a design concept works without having to build it,
- optimisation of production processes;

Modelling reduce development time by

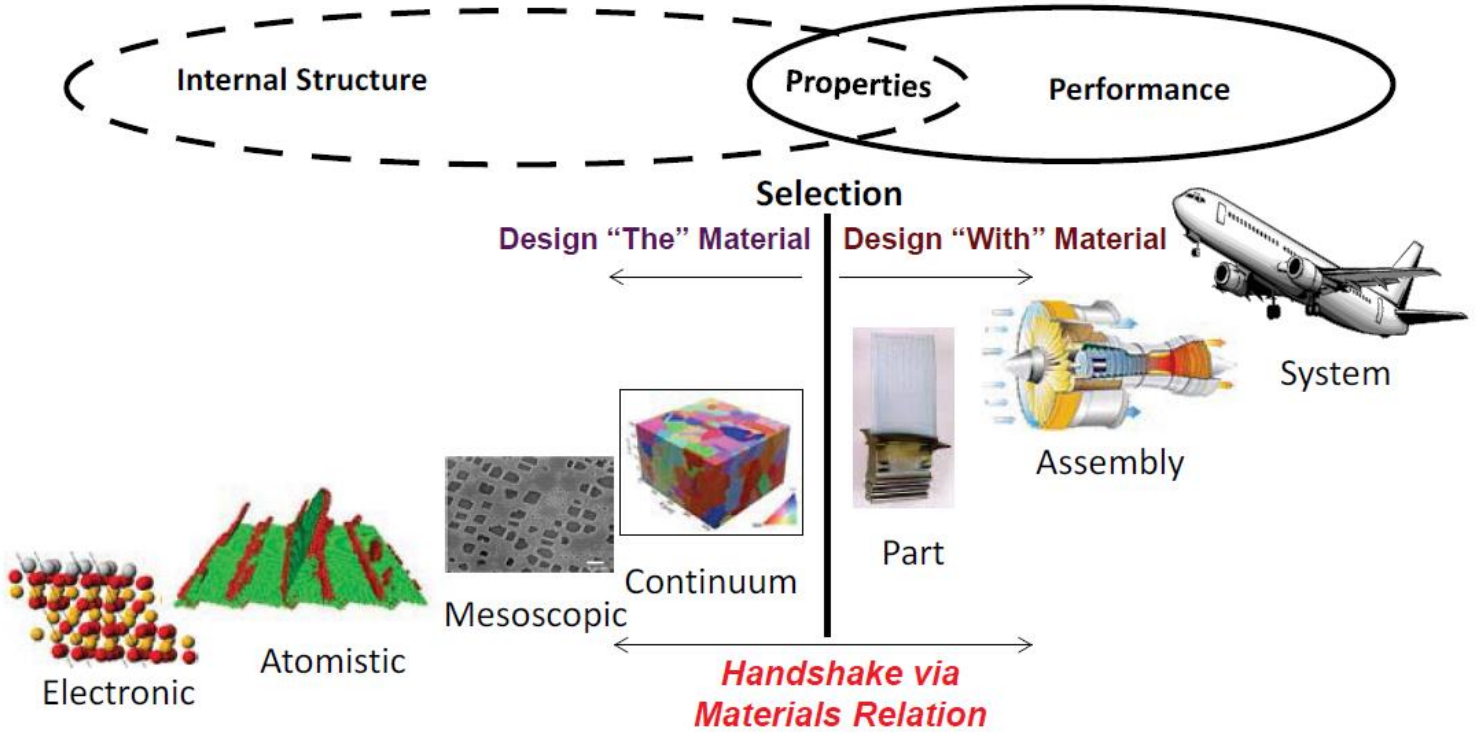
- shortening lead and qualification time,
- facilitating the debottlenecking,
- decreasing the time-to-market;

The modelling has generated improved control of materials development and an improved control of industrial products and processes, minimising the environmental impact, reducing risk of product failure and increasing service life-time.

Materials modelling-led product innovation can be a key differentiator for success in competitive markets.

Source*:*
https://publications.europa.eu/en/publication-detail/-/publication/ec1455c3-d7ca-11e6-ad7c-01aa75ed71a1

Stages of materials and product design



David Cebon, Granta Design, Presentation at EMMC International Workshop2017, Vienna, 5-7 April 2017

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Integration of materials modelling with engineering

There is strong evidence that the **integration of materials modelling with engineering workflows** (so-called Integrated Computational Materials Engineering- ICME) has been carried successfully with a large return on investment.

The prominent industrial demonstrations of the materials modelling potential are:

- **GE Aviation** utilised an ICME approach to achieve **a reduction of the rhenium** (a rare and expensive element) in superalloys for aircraft engine turbine airfoil components. The ICME approach taken resulted in the introduction of a new alloy **in two years rather than the typical six years** historically required for such a new alloy.
- **QuesTek Innovations** led a project that resulted in the development of the **corrosion-resistant Ferrium S53 advanced high-strength steel alloy** for landing gear and other applications. The ICME approach led to **significant reductions in alloy development time** and an **estimated development cost savings of nearly $50M**.
- A project led by **Ford Motor Company** is reported to have yielded a **7:1 ROI** and a corresponding **15%–25% reduction in development time** and led to a **lighter engine design**.

The Economic Impact of Materials Modelling, Indicators, Metrics and Industry Survey, G. Goldbeck, Ch. Court
https://zenodo.org/record/44780#.W786vflCS9I

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Current barriers for effective industrial exploitation of materials modelling

Modelling today is not always the essential tool in commercial materials development because

- modelling tools are often seen as **difficult to use**,
- **not accurate enough**, or
- unable to **get answers to very specific questions in a timely manner**.

There remain a number **of scientific and technical challenges to develop predictive models that are easy in use and affordable yet accurate enough.**

There are still **organisational and language barriers** that hinder the successful integration of materials modelling.

There is a **gap in awareness, knowledge and skills and the lack of information about new developments and best practices.**

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Concluson

- High potential of critical materials modelling as a driver for more efficient and effective product innovation
- A large part of materials modelling use relates to continuum modelling during the "Design WITH material" stage of product development
- Microstructural continuum modelling and discrete modelling is growing strongly in use in the "Design WITH material" stage due to ever increasing demands on product features and properties
- Materials modelling in the "Design THE material" stage has experienced slow but steady growth in the last 30 years. Success and industrial impacts are clearly demonstrated.
- Recent developments in digitalisation and big data are likely to influence the way in which materials modelling is regarded as a potential digital asset that captures in house knowledge and allows easy access of distributed datasets

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