Translators in action: Bridging from industrial problems to materials modelling solution

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Overview

- Motivation
- What is translation
- Process of translation
- Challenges that translators need to meet
- Examples from industrial practice
- Objectives for Translators, best practice and training

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Motivation

- Materials modelling has arrived in large companies and several SMEs
- It secures employment in high-wage countries
- It has proven economic impact
- In practice it means:

Translation → Demonstration → Application

Credit: Thomas Goehler, MTU Aero Engines, Presentation at 1st EMMC International Workshop, Vienna, 5-7 April 2017

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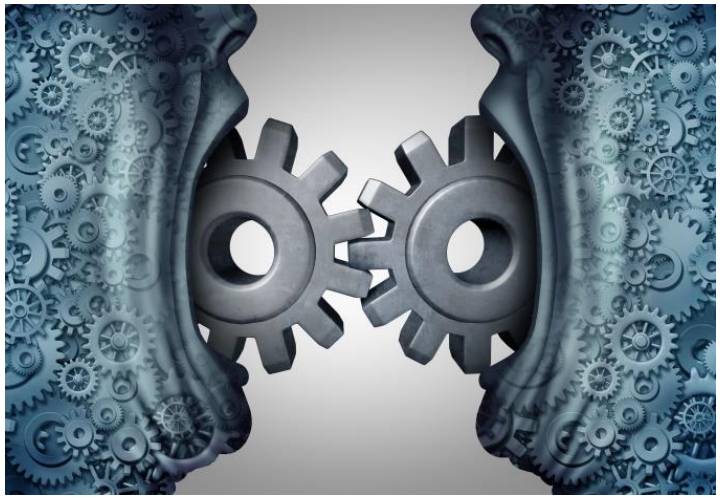
What is Translation?

Translation involves:

- Analysis of an industrial problem.
- Proposing materials modelling workflows to solve (parts of) the problem.



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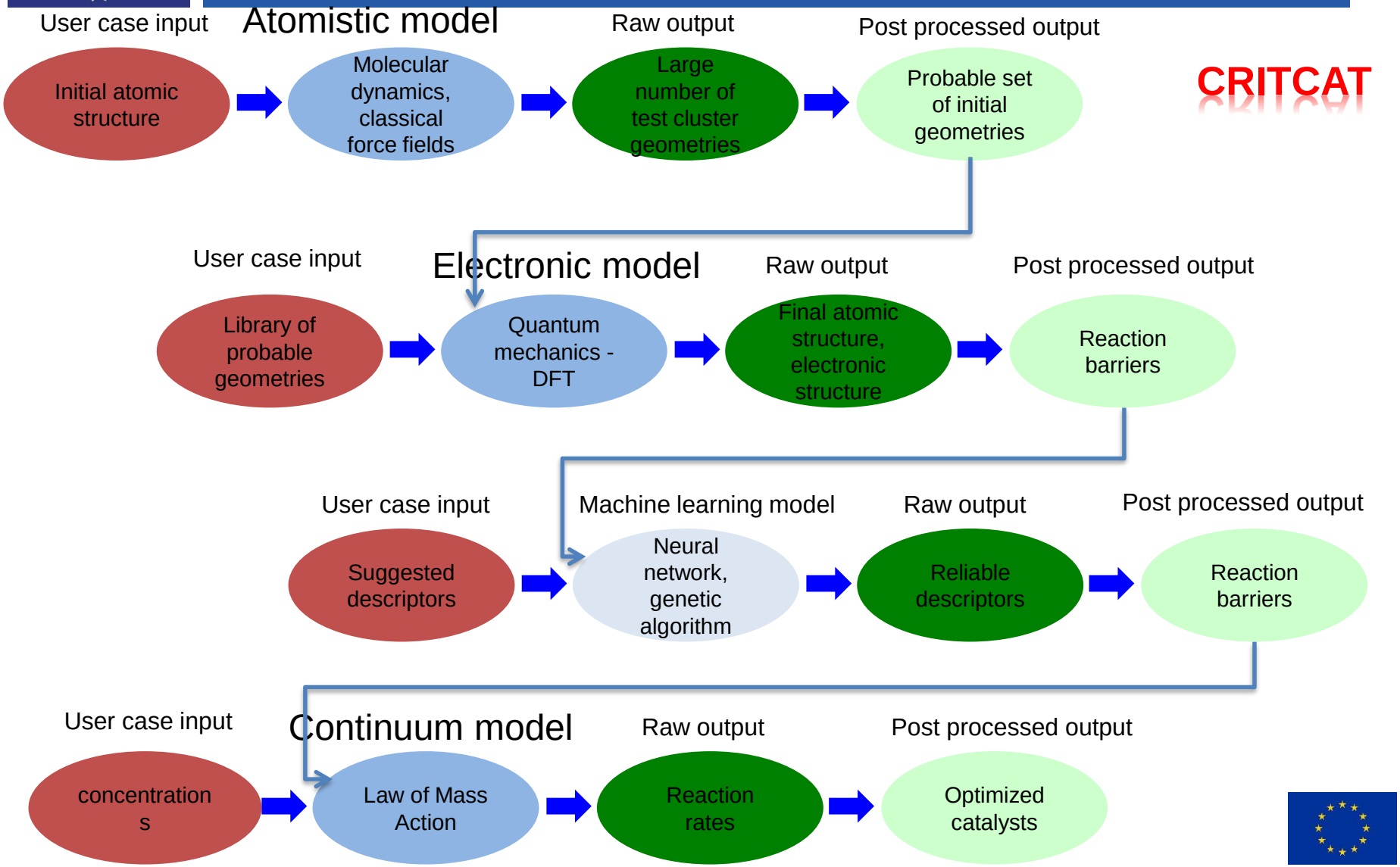
Models and workflows used for microkinetics



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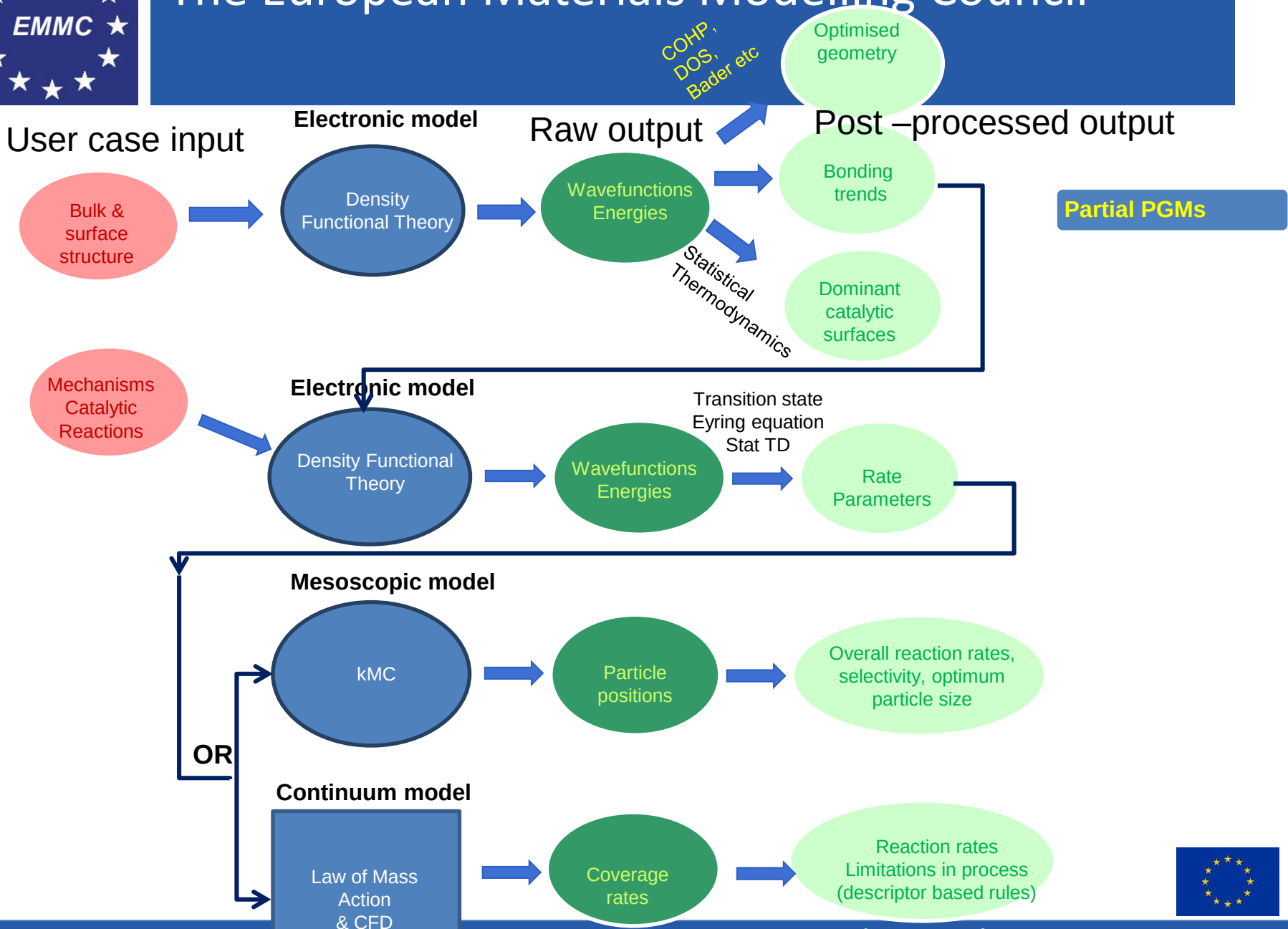

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What is Translation?

- Taking account of technical as well as business requirements
  - Accuracy, uncertainty, timescale, cost etc of the models and simulation
  - Economic impact achieved (type/quality and quantity)
- Taking account of human factors: skills, readiness, management of subcontractors etc

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Reasons cited for Translation

Lack of know-how about applicability and potential for success of simulations. **Lack of knowledge about software.** **Lack of human resource.**
Lack of expertise and experience.
Need to identify the research focus of problems, pick out the solution boundaries and explain the results of the investigation.
Lack of time
Lack of off the shelf software tool for specific case.
Need to develop or extend functionalities of simulation workflows for new problems or considering new aspects.

Source*: EMMC Translators Survey, Spring 2017*

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Process of translation

1. **Full understanding** of the problem and its industrial context is necessary: Listening, questioning and discussion until the real question is identified.
2. Identifying **all requirements**
   - Deadlines
   - Budgets and costs
   - Model accuracy, simulation uncertainty and validation
   - Human resources: training and management of subcontractor
3. Identifying **potential workflow(s)** and the (Pareto-) optimal solution.
4. Implementation **support**: software choices, implementation experts.
5. **Interpretation** of results in the industrial challenge context.

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Challenges that translators need to meet

- Find the best expert, suitable code, optimal solution.
- Balance between investments and expected return.
- Neutrality. Third parties might be involved in the implementation.
- Getting the required input of data from the industrial stakeholder..
- Managing data confidentiality.
- Managing change at the industrial stakeholder: e.g.
  - Readiness to learn to simulate.
  - Hiring and integrating new skills.
  - Learn to manage a subcontractor for simulation.

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Skills of a translator

- Ability to manage the technical, economic and human dimensions.
- Expectation management, neutrality and confidentiality.
- Translator should be knowledgeable in the use of the four different materials models (electronic, atomistic, mesoscopic and continuum) and on expected accuracy of modelling efforts.
- Translators also need a broad economic background to advise on costs and time to solution.
- Expertise for results interpretation in the industrial context.

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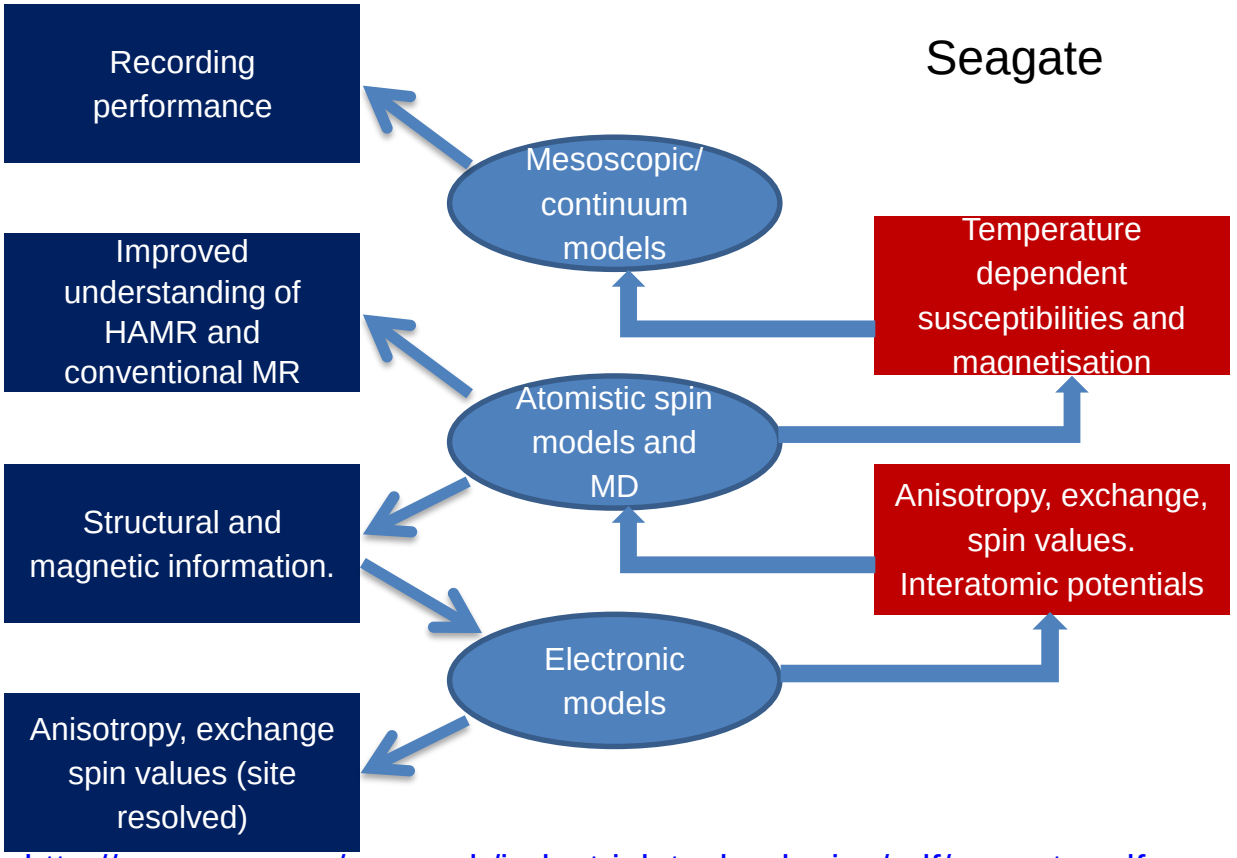
Example: Heat Assisted Magnetic Recording

- **Complexity**: High T heating, sub-50nm, magnetically dynamic environment.
- **Material + Process**: Accurate prediction of structure, temperature and recording reliability.



http://ec.europa.eu/research/industrial_technologies/pdf/seagate.pdf

Coordination/management: Several software tools, validation experiments, partners.
Saved 6 months in development time and tens of millions of Euro in costs

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Translation example by Dr. Ronan Le Goff

- MOPLA and IPC approve the public use of all the project and impact information we provided including the organisation name.

https://www.poleplasturgie.net/ipc.html

http://www.mopla.it/

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Project description and general outcome

- **Client Objective**: improve manufacturing performance of a body actuator plastic product!
  - Re-design the production tool
  - Improve quality
  - Increase productivity

CAD ?

- **Modelling Translation**:
  - Designing a new cooling system in injection molding mold
  - Identifying the best location for cooling channel Providing
  - Understanding heat transfer in metal during in-service behaviour

CAD + Materials Modelling

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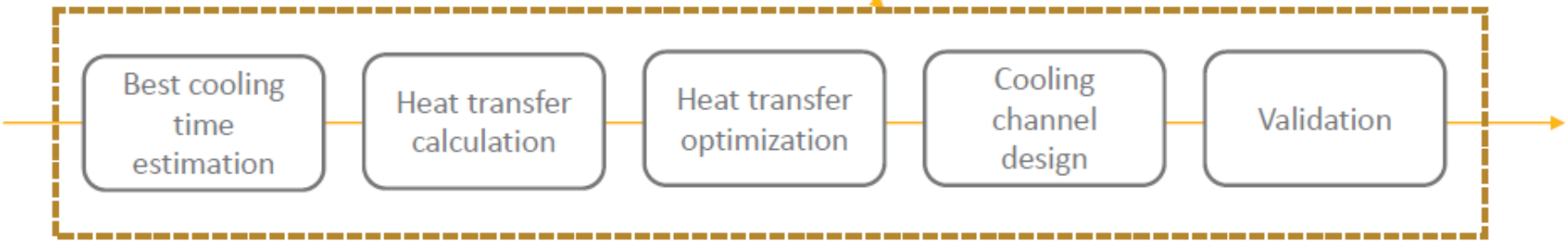
Modelling workflow

Global Development workflow

Modelling worflow



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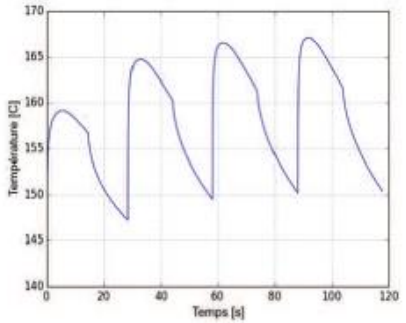
Modelling results

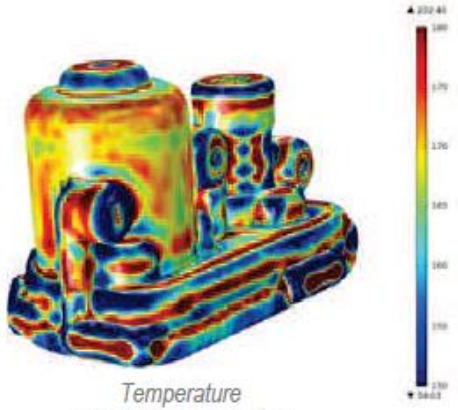
- Modelling results
  - Model 1 : 1D energy equation

Heat transfer calculation App for cooling time estimation in injection molding



- Model 2 : 3D heat transfer + optimization engine

Heat and mass transfer modeling

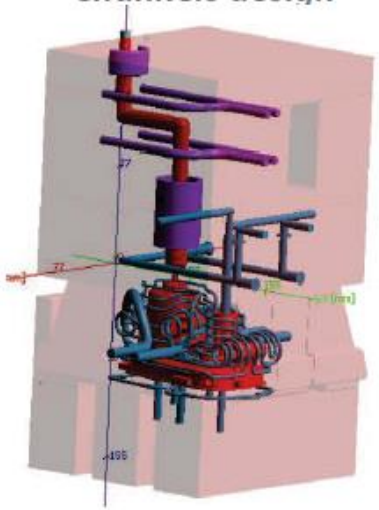


Temperature distribution on cooling surface

Isotherms for cooling channel design

Isotherm and heat flux

Conformal Cooling Channels design



www.ct-ipc.com

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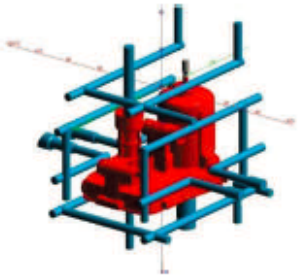
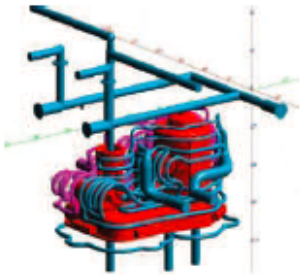
Technical impact

Experimental Validation





		Drilled cooling channels		Conformal cooling channels		Outcome
		Production	Numerical	Production	Numerical	Production
Productivity	Cycle time[s]	66	64	42	42	-36%
	Cooling time [s] (Packing included)	50	50	32	32	-35%
Quality	▱ [mm]	0.48	0.13	0.25	0.13	- 48%
	⊥ [mm]	0.30	0.32	0.18	0.29	- 40%

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Technical impact

- Key materials modelling tasks
  - Gain insight into in-service behaviour of product
  - Product design
- Range of benefits for the R&D process
  - Broader exploration
  - Deeper understanding
- Types of impact created by materials modelling
  - Innovative product
  - Designing the mold
  - Improve productivity by 35%
  - Improve quality by 40%

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Economic impact assessment

- Investment:
  - Client technical investment cost (mold +staff): €10,000
  - IPC Modelling cost of invest:
    - Staff cost : €1,500 (for project)
    - Software cost : €25,000 (cost of licence)
    - Computing cost : €2,000
- Client ROI
  - Total value of financial returns: €60,000
  - ROI = (60,000-10,000)/10,000 = 500 %

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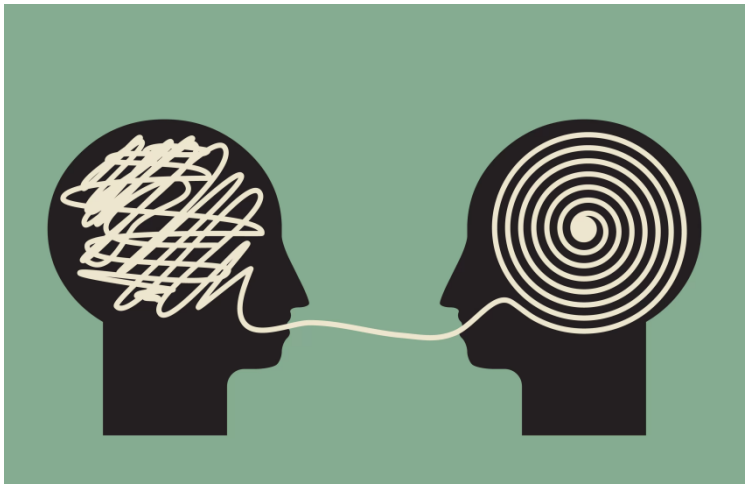
Translation Process

- Convince client to use materials modelling on top of CAD: More than technical + cost!
  - Explain the approach in the “client’s language”
  - Use success stories as explanation support
  - “Client had to free up some time to listen to us which is not always easy”



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EMMC Objectives for Translators

- **Code of conduct** which reflects what industry can expect from a Translator.
- **Show cases** from various translators performing translation for big companies and for SMEs.
- **User guide** for Translators.
- **Database of Translators** which will in due course be available in the Modelling Market Place (MMP) under development.
- **Stimulate Translators function**:
  - Training workshops for translators and provision of policy input to funding schemes (EU, national, international,…).
  - Work with and help **coordinate** Member States **actions** supporting Translators.

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Conclusions

- Translators are **key stakeholders** to promote the use of materials modelling in industry.
- Translators already exist (e.g. in large companies, software houses, consulting firms, etc): The point is to provide them further **support at European and national level**.
- Translators **fill the gaps** between industrial needs and model development: an **opportunity** for both industrial stakeholders (speeding up problem solving) and model developers (increasing the industrial impact).

http://emmc.info/translators/

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Acknowledgements

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