Summary from the Surveys: Translator Case and Industrial Case

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Summary from the Translator Case Survey

Number of Participants: 35

5. Function/position in the organisation
6&7. Type of organisation

- Researcher: x9
- Senior Scientist: x3
- Project leader: x2
- Owner/sole trader: x2
- (Deputy) Director: x5
- Full professor: x3
- Assistant professor: x1
- Group Leader: x2
- General manager: x1
- Coordinator: x2
- Head of department: x6
- R&D Engineer: x2
- President: x1
- Head of Institute: 1

- Research and Technology Centres (RTC): x12
- University: x6
- Consultancy: x4
- SWO: x4
- Industry: x1

- Most of Translators are from RTC
- Input from more SWOs and independent (consultancy) translators is needed: action!
- Independent Translators are rare: Action: can we promote them?

8. What is your field of expertise (e.g. specify type of material, type of models, type of property /phenomenon, other)?

- Type of material:
  - Metals: x15
  - Polymers: x14
  - Chemicals: x7
  - Composites: x14
  - Ceramics: x3
  - Wood: x1
  - Concrete: x1

- Type of process:
  - Multi-objective optimisation
  - High dimensional optimization
  - Machine learning
  - Data analysis
  - Small scale testing
  - Validation through experimental mechanics

This information is useful for the Translators Data Base

8. What is your field of expertise (e.g. specify type of material, type of models, type of property /phenomenon, other)?

- Bulk and surface modification/engineering of materials and smart structures
- Surface corrosion processes
- Simulation/modelling of production and transformation processes
- Simulation of components and structures
- Modelling the chemical, physical, thermal, electrical and mechanical properties of materials and components
- Effect of manufacturing processes on material integrity and properties
- Thermodynamic and kinetic simulations
- Catalysis, chemistry and molecular design of materials
- Rheology of materials

This information is useful for the Translators Data Base

9. How was the contact with the client established? Did you know the company in advance? If not – how did they find you?

Company was known in advance, contact made trough:

- ❑ Existing academic/industrial collaborations (joined projects)
- ❑ Own client employee proposes modelling project (via internal translator!)
- ❑ Workshops/conferences participation

- ❑ Calls of European projects and information about local or international projects are the sources of finding new partners

Company was not known in advance, contact established:

- ❑ As a result of a common meeting and conferences
- ❑ Through our Industrial Partnership
- ❑ Worth of mouth", recommended by others, having a name/reputation
- ❑ Via internet presence
- ❑ Through personal contacts, networking
- ❑ Proactive attitude of the Translator (initiate the first contact)

Use this information for outreaching industrial users of modelling
Feedback is included in the Translators Guide

10. Is the client a large company or SME? In which application sector (e.g. automotive, energy) and in which value chain segment (e.g. material producer, convertor, end-user) is it positioned?

- **Size client company?**
  - Large: x22
  - SME: x13
  - Associations (between large companies and SMEs or between SMEs): x2
  - Academia: x1
  - Research institute: x1

- **Value chain segment?**
  - Material producer: x5
  - Convertor: x14
  - End-user: x5

Action: use this information in the Translators Data Base

Currently most of Translation is done for Large companies than for SMEs as discussed in the Translators Guide.

Are SMEs really more in need for Translators than Large companies ?

11. Was the client familiar with the use of modelling/simulation?

- **No:** x14
- **Yes:** x20
  - Several comment that the client modelling knowledge is limited

Client was familiar/experienced with the use of modelling

12. To what extend/how often did they use modelling/simulation?

- ❑Daily/regularly: x14
- ❑Rarely/limited: x3

13. Had the client a preferred software tool or preferred academic group to work with?

- ❑Preferred academic group: x3
- ❑Preferred software tool : x6
- ❑Both: x5
- ❑None: x4

The client was familiar/experienced with the use of modelling:
14. Why did the client need the translator's help/service to follow a modelling/simulation approach?

- To formulate the project: which problems to solve, identify the research focus of problems, which tools to use, what can be gained and what are the solution boundaries
- For new ideas how to solve problems
- Lack of time to probe all options
- Lack of internal expertise on specific simulations and/or on the use/development of new models or on the current state of art in modelling/software
- For validation methods or for combination of both – experiments and simulation
- To understand manufacturing process and how to control it
- To understand the physics including the correct physics behind their models
- For a deep and broad interpretation of the results
- For training or to use/improve certain functionalities of (own) simulation programs
- To improve their model knowledge and capabilities and to unravel the full potential and exploitation of modelling tools and approaches
- Needed access to databases they had no access to

The client was familiar/experienced with the use of modelling:
14. Why did the client need the translator's help/service to follow a modelling/simulation approach?

- To promote faster product design and more efficient products
- To bridge the gap between simulation scales
- For better/faster in-depth expert solutions
- As a sparring partner, a team of experts with overcritical size
- To increase the potential for success with state of the art modelling and simulation tools
- Limited time for prove all options
- For sensitivity analysis

These are all the tasks of the Translators and benefits of modelling:

Used in the Translators Guide and to be used to promote Translation!

The client was not experienced/familiar with the use of modelling:
15. The client propose themselves to use simulation tools for their problem

- Expectations of the client:
  - To establish process simulation as an additional tool in the part development stage
  - To understand underlying processes
  - Time reduction to final parts production (less trial and errors)
  - Validation
  - Concrete suggestions for new materials and quick material selection
  - To learn how to apply certain tools in new testing conditions
  - Better understanding and optimization of their application
  - To save handling and high quality polishing scenarios

- Did not know what to expect

- Clients are not aware of:
  - the limitations of simulations
  - the unavailability of experimental input parameters
  - the boundary conditions

Use this feedback in Translator Guide: convincing arguments for using modelling

The client was not experienced/familiar with the use of modelling:
15. The client propose themselves to use simulation tools for their problem

- **Additional arguments of the Translator:**
  - Check first whether verifications can be made so that the simulation fulfil their expectations: by performing some sample simulations for parts already produced
  - Check/discuss whether the approach was feasible
  - Help with materials screening
  - Define specific applications
  - Explain the modelling approaches and the benefits of using simulation/modelling
  - Flexibility in product development
  - Determine what would be the costs and ROI
  - Analysis of parameters which may influence the results
  - Give guidance on what was possible and could be delivered
  - Care to not overestimate the possibilities of modelling: develop realistic view and expectations from modelling

Used in the Translator Guide: tasks and skills of the Translator and benefits of modelling

The client was not experienced/familiar with modelling:
16. In case you proposed to use simulation tools for their problem

Arguments to convince clients of modelling benefits:

1) Avoiding numerous and unnecessary experiments
2) Understanding of phenomena
3) Only modelling can give answers to your specific problems
4) Economic impact
5) Other:
   - ❑ Exploration of new or unusual ideas
   - ❑ Demonstration of other successful cases
   - ❑ Verification of the modelling method by comparing with experimental data
   - ❑ All the others are doing it
   - ❑ Probing the accuracy of the currently used in the company approach
   - ❑ Performing preliminary feasibility studies

Used in Translators Guide: benefits of using modelling

17&18. For what type of problem did you suggest a modelling solution?

- ❑ Material development
- ❑ Product development
- ❑ Material processing
- ❑ Product manufacturing
- ❑ Application performance
- ❑ Other

Modelling is most used for material/product development

Processing/manufacturing industry: do they need stimulation?

19 & 20. What type of model(s) did you propose (according to the RoMM definition)?

- Continuum: x24
- Mesoscopic: x12
- Atomistic: x12
- Electronic: x10
- Combination of models: x16

Most used/proposed models are still the continuum: due to maturity, costs, application range, …?

Action for modellers: promote discrete models for industrial use

Multi-modelling approaches are becoming more popular

21. What are your arguments to relate the specific industrial problem to the specific modelling approach you proposed?

Specific arguments:

- Evaluate the **suitability, availability and reliability** of different modelling approach/software tools to study the specific physical phenomenon.
- Map the most suitable models onto the whole industrial problem, and not other way around (which can often be the case)
- Consider linking/coupling of models when analysis on different length and time scales of key phenomena is required
- Perform analysis of the available input data and the desired output data
- Consider the preference of the client for specific/familiar software tools and procedures
- Chose mature models when there is need to produce reliable results in short time
- Consider a “robust" cost-effect ratio: use applied models that are exact enough to solve particular problem, with acceptable costs

Included in the Translators Guide

21. What are your arguments to relate the specific industrial problem to the specific modelling approach you proposed?

General arguments on the use/benefits of modelling:

- Accelerate the development time
- Reduce materials and manufacturing costs and time
- Improve materials performance, reliability and safety
- Increase the variability
- Modelling is used to understand the nature of the specific problem in its complexity which avoids trial-and-errors
- Commercial software is not always able to provide desired solutions: need for flexible, tailor-made/in-house build modelling tools
- Experimental data is unavailable so modelling (e.g. ab initio) techniques are required
- The optimization work through modelling can be much cheaper than the experimental one.
- Literature data /previous modelling cased on for similar phenomena
- Modelling is a cost efficient wat to probe new/different ideas and solutions or to give directions
- We are giving a solution to the client, not a simulation result

Included in the Translators Guide

22. Did you propose to the client only one or a number of potential software tools? (If so, specify for what type of problem which model did you propose). What were the differential arguments?

Proposed multiple tools to solve the problem: x9

Arguments:

- ❑ Industry preferences and needs
- ❑ Availability and experience in using the tools by the client and the executor
- ❑ Allow for multiscale approach
- ❑ To accommodate different applications
- ❑ A combination of in-house or open source codes and commercial software (also for models linking)

Multiple tools proposed usually for linking/coupling

Benefits and drawbacks of proposing multiple modelling tools?

Should translators propose *always* more than one modelling flow?

22. Did you propose to the client only one or a number of potential software tools? (If so, specify for what type of problem which model did you propose). What were the differential arguments?

Proposed only one tool to solve the problem: x14

Arguments:

- Most suitable to reproduce experimental results
- Clients 'preference to use only one tool (that they are familiar with)
- An existing tool needed further development
- In-house model and software tool, easy to be further optimised /adapted / tailored to the industrial needs/specifications
- Translator/modeller very familiar with this tool
- Efficiency
- Costs
- Parameters data for this tool were available
- Other solutions were not competitive

The proposed tool is usually own/in-house developed tool
Included in Translators Guide

22. Did you propose to the client only one or a number of potential software tools? (If so, specify for what type of problem which model did you propose). What were the differential arguments?

Some considerations/questions

- Not clear answer/depends on the case/client not interested to know: x14
- Involve the client in selecting the most suitable tool(s) – in which cases?
- Is the client interested/intend to use the modelling tools after the project? Should translators stimulate this as well?
- Should we keep the number of different software tools low, in order the client to be able to become an expert in these tools?
- For some translators, the software tools are explicitly not part of the translation process. The decision on which tool to use is left to the modelling executor(s). Does the translator first choose the modelling tool or first choose the modelling executor?
- "Translators do not offer the use of specific methods, but rather the solution of a problem". How generic is this – is using the tools by the client not essential for making them familiar/interested in modelling?

23. Did you propose to the client only one or several places/groups where modelling/simulation can be executed?

- More than one group proposed: x6
  - X3: own group+ external group (for experiments or for modelling)
- One group proposed: x25
  - x3 are not own group
- Not applicable: the client did the modelling: x1
- The client or the TR did the modelling: x1

A common practice is to propose only one modelling executor, usually the translators own group. What about Neutrality…?

24. Only one modelling executor proposed: criteria?

Own Translator's group proposed because of:

- The intended longer support
- Ability to determine the model parameters (available advanced experimental methods)
- Translation and model execution go most of the times together
- Confidentiality issues are more difficult to manage for more than one executor
- Previous collaboration
- Expertise in problem analysis and modelling-experiments correlation
- Modelling expertise in the area of interest for the client
- A unique combination of skills, currently not available elsewhere
- Own code which was ready to be used in a commercial setting
- No other model and no other modelling group were available for the specific problem
- Knowledge of the solver technique (FE) and the software tools

Considered in the Translators Guide: profile of translators

24. Only one modelling executor proposed: criteria?

External group proposed because of:

- Best fit or one-stop-shop
- Expertise
- Particular skills

25. Several modelling executors proposed: who made the choice for the selected executor and on the basis of which criteria?

- Choice is made by the industrial partner, considering:
  - experience
  - expertise
  - availability of resources
  - price
  - speed (also of the simulation)
  - criteria not clear

- Choice is made together with the manufacturing company
  - discussion with each of the proposed modelling/software providers

The criteria are considered in the Translators Guide (estimation of investments)

26. Were you personally or as organisation involved also in the execution of the modelling task? If yes – was it your choice or it was requested by the client?

- No: x2
- Yes: x32
  - Choice of the client: x27
  - Self proposed: x5

A common practice is to Translators to be involved also as modelling executors.
If this is preferred by the client → no conflict with neutrality!?

Should translators act also as modelling executors only upon request of the client?

27. Did you also propose validation or other experimental analysis complementary to the modelling? Was it requested by the client?

- Validation proposed and performed: all x34
  - Requested by the client: x7
  - Proposed by the Translator: x9
  - Not indicated by whom: 16
  - Together: x3

- Performed by the client: x2
- Not clear who performed validation:x18
- Performed by the Translator: x 10
  - with literature data: x1
  - with client's data: x1;
  - with own tests: x6;
  - with collaboration: x2

Validation is an established step in the translation process!
Included in the Translators Guide.

28. For the translation action: did you have all needed information to decide which model and which modelling executor to choose? If not please specify the additional search you needed to do.

- Had all needed information: x24
  (own expertise and experience, info from the client)

- Missed information: x7
  - obtained via literature x5
  - obtained via collaboration x2

- Not clear: x3

- It is useful and important for the Translators to have a database with the profiles and simulation competence of European software companies, model developers and academic groups!

29. Was the client satisfied with the results from the simulation of their problem?

- Satisfied: x26

- Partly satisfied: x6
  - Limited applicability of the model
  - Involvement of additional external groups that are not adhering to client's expectations
  - Need for additional funding
  - Need for follow-up
  - Not matured models

Not clear: x2

Models maturity, robustness and limitation are important criteria for selection of the most suitable tool!
Action: Survey on this topic coming soon.

30. If the client was not satisfied, please specify whether the reason was related to:

- ❑ The choice of modelling/software: x2
- ❑ The choice of modelling executor: x1
- ❑ The origin of the industrial problem: x1
- ❑ Other: x10

31. Please explain (also for the cases when client was in general satisfied)

- ❑ Communication
- ❑ Time
- ❑ Expenses
- ❑ Model accuracy
- ❑ Automation for more user friendly tool
- ❑ Delay due to model complexity
- ❑ Initial development time too long
- ❑ Need for model improvement for real large shapes
- ❑ Need for support/maintenance of the tool after the project

32. What else do you think could have helped?

Modelling/validation issues:

- More accurate and realistic simulation tools
- More robust and well validated pre-processing and post-processing tools
- Better and easier access to Materials Relations parameters
- More versatility of the commercial software platform, including "easy to handle" discrete models in combination to continuum models.
- More mature automated and validated software tools
- Improvement of both – the simulation tool and the experimental technique to analyse complex shapes
- More materials to be tested
- More extensive validation for different types of components
- A stronger commitment of experimentalists (involved in characterisation/validation) in exploiting the potential of modelling. Closer interaction between modelling and experimental experts.

32. What else do you think could have helped?

Client-related issues:

- Better way to deal with confidentiality which is still a great problem especially with large companies (even with NDA signature and personal trust)
- More extensive/general knowledge about modelling/simulation on the client side
- More funding to continue to do more
- To have employee from the client who is actively involved and manage the project
- A close interaction between the modelling executor and the process expert on the client side to speed up the model validation phase
- Proper post-contract services for the client or planning of long-term maintenance

Included in the Translators Guide

32. What else do you think could have helped?

Translation process and translators :

- Translator network and training
- A close collaboration among translators specifically when dealing with limitation, applicability and simplifying of certain models for industrial problems
- A formal translation exercise and a formal translation qualification and certification, to separate the translation role from that of software owners and modellers
- A materials modelling market place, like the one proposed by the EMMC. Successful translation cases might be a source of inspiration and can lead to potential collaborations
- Partnership with academic/ or software developers to provide a database of parameters for real industrially relevant materials and processes and for better clarification (in advance) of the software IP
- More "industry-friendly" approach from the University side
- More resources

Included in the Translators Guide

33. Did you need to translate/present the outcome from the simulation in an understandable form for the client? If yes – what was the role of the modelling executor?

- Translation/presentation of results to the client: x22

- Not always: x5
  - Depends on the communication skills of the executor: x2
  - Not needed if the client is an expert: x2
  - Jointly translated the result with the client: x1

- No translation/presentation of results: x6
  - Client was an experts: x1
  - No reasons were given: x5

No clear answer: x1

Translation/interpretation of results is included in the Translators Guide

34. Please name the most important characteristics/ competences which a translator should have.

Industrial/business skills:

- Wide range of knowledge on industrial problems and industry trends – where do things go
- Understanding of the importance of economy, the technological issues and limitations.
- Understand the real problem and define the limitations of the simulation
- Understand the objective of the company and make a plan where simulation can help the company to understand their process and improve it, even if the simulation tool may not be ready for the real production timeline
- Know if modelling can have an impact: no need to model something you can measure fast and cheap
- Give the client what they need and not make a scientific project out of everything
- Let the user do the work – only that leads to adoption of a translation
- Knowledge of the industrial sector and in-depth process knowledge: ask the right questions!
- Knowledge of the issues related to the in-service performance of a material/component
- Ability to scrutinize all information provided by the client for data that is usable
- Ability to understand the essence of the industrial problems and situation in hand
- Keep in mind that the goal is to help solving real problems, not modelling problems
- Ability to inspect and envision a real experiment and production line

34. Please name the most important characteristics/ competences which a translator should have.

Technical skills

- Combination of subject matter knowledge in the relevant field of materials science and wide enough knowledge of modelling and simulation and software choices
- Modelling experience and knowledge of what general modelling strategies are available and on their evolvement/update
- Profound knowledge of, and experience in applying, at least one class of applied modelling, accompanied by at least some knowledge about a number of others. Shallow expertise may lead to directing a client to the wrong solution or executer.
- Knowledge in the use of the different materials models (electronic, atomistic, mesoscopic and continuum)
- Experience on the use of different software, know how to teach software
- Expert in simulations
- Domain experience, not necessarily in the same application, but in similar ones
- Experience or at least a good understanding of the experimental side (characterization, verification, validation) in order to balance which modelling/experimental combination
- Interdisciplinary background/experience
- Applications oriented
- Creativity to explore a virtual simulation space

34. Please name the most important characteristics/ competences which a translator should have.

Analytical and organizational skills:

- Ideally, 50% analytic thinking and 50% creative thinking
- Ability to describe a complex problem in simple terms
- Problem interpretation and simplification skills
- Thinking from most simple simulation solution to more complex to give a solution compatible to client objectives
- Open minded for new approaches and (unusual) solutions
- Ability to handle several projects at the same time and to manage complex projects
- Strong analytical and problem solving skills
- Flexibility and understanding the importance of time pressure: sometimes a fast trend provided can bring to the customer more than a precise value that takes to long to be calculated.
- Quick in learning. Ability to pick the essential things from information overflow.
- Capable to translate/present the outcome from the simulation in an understandable form
- Ability to understand complicated phenomena.
- Ability to concisely summarize results and recommendations

34. Please name the most important characteristics/ competences which a translator should have.

Soft skills:

- Excellent communication, explanation, listening, reporting, presentation and public speaking skills
- Convincing
- Patient
- A customer facing skill-set and background
- Courage to ask even ‘stupid’ questions and show if one does not understand the answer. No fear of losing face
- Use (translation into) client's language
- Understand the 'language' of all sides and the ability to see things from all/both points of view
- Work effectively with experimental partners(to shorten the iterative R&D manufacturing transfer process)

34. Please name the most important characteristics/ competences which a translator should have.

Generic skills:

- Wide network in the area of software owners, model developers, translators and events (EU)
- Collaborative attitude with other translators
- Independent from a software company
- Separate software tool from translation. The execution should be done by any available tool
- Separate the Translator role from that of either SWO or Modeller, since these are the executors
- The translator should not “oversell” the simulation/modelling activities. The offered results should be realistic

The feedback related to Translators characteristics is included in the Translators Guide: Translator profile

Industrial User Case Survey

Number of Participants: 8

Type of organization/ Country

Commercial Research Organisations: x2
Academic Organisation: x2
SWOs: x4

Belgium x1
Germany x1
Ireland x1
Italy x1
Spain x3
United Kingdom x1

2.1. Objectives as the industrial user of modelling

Material modelling was used to:

- Study chemical reactions
- Predict metals performances in various conditions
- Optimize the components design
- Shorten the time to market
- Minimize the number of tests
- Create more options for innovation
- Support our client companies on the material selection, optimization of product performance and manufacturing processes.
- Support the new materials development.
- Improve predictions with regards to product quality 5-days in advance

Action: Use the objectives as qualitative/quantitative measures for the benefit of modelling!

2.2 Open (i.e., not confidential) description of the industrial problem

Type of the industrial problem:

- ❑ Find new/alternative material solutions with improved/defined functionality
- ❑ Study the correlation material characteristics –material performance
- ❑ Predict material composition and processing parameters for optimum performance
- ❑ Develop simulation tool for material behaviour predictions, coupled with experiments

2.3 Describe weakness of former approach

- Not sufficient accuracy of the existing models for industrial application
- Laborious determination of the model parameters
- Severe simplifying assumptions
- Simplification of models for simulation of complete processing chain
- Low R^2 value previously / Linking of several models
- The phenomena happening over the relevant wide ranges of length- and time-scales cannot be described with a single global chemistry model
- Expensive materials and experiments used for model validation

Actions for modellers:

- *Improve the accuracy of existing models*
- *Linking/widening of material models required for complex phenomena*

Action for Translators:

- *Consider the available experimental data and the costs for model validation!*

2.4 Materials
2.5 Applications

- **Type of material:**
  - Metals
  - Polymers
  - Chemicals
  - Composites
  - Ceramics

- **Application sector:**
  - Automotive: 3
  - Aeronautics/aerospace: 2
  - Railway: 1
  - Energy: 2
  - Catalysis:1
  - Chemical: 1
  - Manufacturing systems engineering: 1
  - Pharmaceutics: 1

2.6 Scale of the material
2.7 Type product

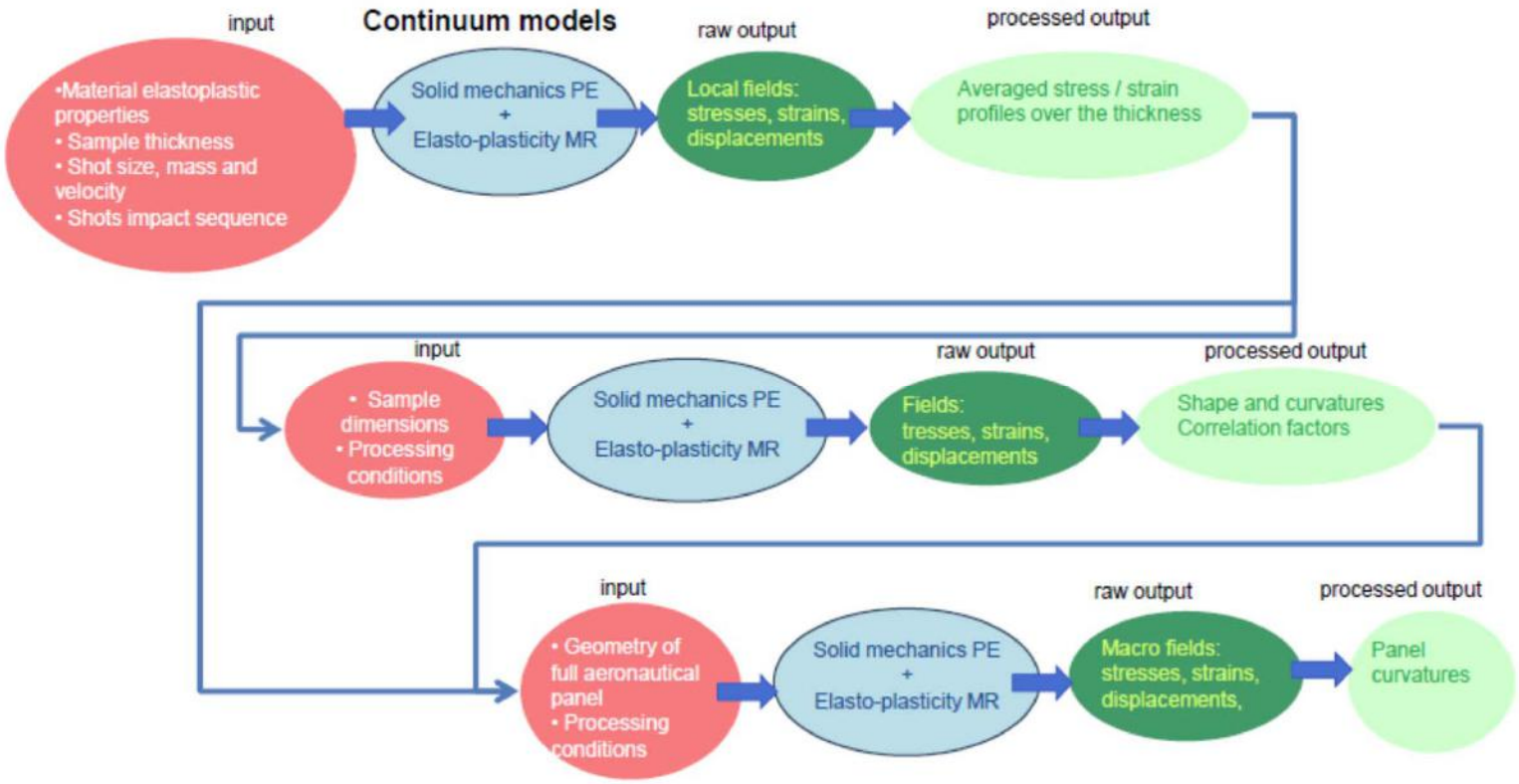
Scale

- Atomistic: x3
- Mesoscopic: x2
- Continuum: x4
- Multiscale: x2

Product:

- System: x1
- Sub-system: x1
- Components: x3
- Gas state: x1
- Fluid state: x1

2.8 Please upload your Model workflow (see template on www.emmc.info)



Example of workflow (from ITAINNOVA)

- ❑ Only 3 workflows followed the proposed template

Action: facilitate/help the wider use of common modelling workflow analysis

2.9 Resources spent with clear indication on the investment risk/reward considerations which were made

- Average total project budget ~ x100.000 Euro
- Medium to long term R&D projects

What is listed:

- Costs for experiments and materials
- Costs for software license
- Costs for Personnel: dominating costs!
- Number of computing hours

- In some cases no data was provided: difficulties to estimate?

For the SWOs:

- Budget for licences (~60%) and budget for consultancy (including Translation) 40%
- Distinguish between application and translation services of SWOs?
- Can we estimate budget dedicated to translation and/or budget gained from translation?

2.10 Requirements and expected results to understand the material behavior

- Requirements are related validation, improved accuracy and coupling/linking between different simulation tools, analysis of tests results
- Expected results are related to improved knowledge and detailed description of the material behaviour and compositions

- Model accuracy and available/needed experimental data to be defined in advance!
- Can we use expected results as estimation of the qualitative/quantitative benefit?

3.1 Role of Materials Modelling/ How materials modelling played a key role in problem solving

- Prediction/estimation of material parameters, compositions and performance, in various conditions
- Scanning of a large number of materials and components for optimum material performance
- Increased knowledge of the processes and physical mechanisms across the length scales (from molecular to a component level)
- Feasibility analysis
- Optimization of industrial processes
- Shortening the development time

These are all benefits of modelling – to be used in business cases and evaluation of ROI

4.1 Description of the tool(s) and methodology(ies) that have been applied

- DFT methods (for catalyst activity)
- Mesoscopic models (particles kinetics)
- Continuum models (solid mechanics, thermal conductivity, plasticity)
- Data-driven models (for connecting different parts in one macroscopic model)

- The methodologies for each modelling problem are outlined: solvers, software, numerical codes and algorithms

5.1 Expected improvement of the material behavior simulation

- Tune given material system properties for manufacturing.
- Better defined and encoded material performance
- Creation and development of a simulation tool to link a microstructure with the expected mechanical behavior.
- Better grasp on ageing behavior in end-use applications + limits on design options to guide product development.
- Detailed prediction of material structures formation and composition in a single-step
- Additional projects generated with new innovative approaches to solve existing problems.
- Increase competitiveness on the client company.

Action: extract measurable benefits from using modelling!

6.1 Technical and technological benefits

- Release of products with novel materials with better performance: compare the price vs. properties
- Optimized processing parameters: leads to more, reliable and higher quality products
- Full characterization and virtual testing: no or less experiments needed and less scrap
- Faster delivery of new products to the market (faster industrialization)
- Gain in customer loyalty due to provided better understanding and customization
- More efficient use of energy (for high temperature processes)
- Less gaseous emissions to the environment (reduce CO2, NOx emissions)
- Prediction and control of particulate emissions

Action: Implement these (if not yet) in KPIs and measurable benefits

6.2 Return on investments (ROI) achieved

- Majority didn't provide data: reasons?
- SWO: provided estimation on the annual revenue from consulting services (translation?) and from licensing sales
- Qualitative return on investment:
  - Faster design cycle (3x)
  - Early pruning of less promising projects
  - Better portfolio management

Action: training of Translators (together with Industrial Users) to estimate ROI!

6.3 Annual cost savings compared to situation before, reduced development costs, higher product quality/performance, accelerated time-to-market, faster scale-up, better development…

- Annual cost savings can be determined based on:

  - Higher product quality and performance
  - Reduced experimental tests
  - Shorter time to market and time from quotation to production
  - Increased accuracy of prediction of product quality
  - Enhanced overall efficiency of the plant
  - Prediction beforehand if a new product will be possible to be produced or if the new product will be flawless.

  - Difficult to estimate

Action:
Use this information in Translators Guide and specifically for ROI analysis

7.1 Describe if competitive situation and/or innovative image could be improved

- Improving the developed modeling tools
- Extension of the technology to industrial materials
- Better use of experimental data and more targeted generation of new data
- Full integration of experimental and modelling results through empirical model layer

- The suggested improvements are considered in the Translators Guide
- Action for modellers: work on improving the modelling tools (accuracy) and their application towards industrial systems
- Action for Translators: seek synergy with the experimentalists (EMCC)

8.1 Describe whether new type of higher qualified jobs was generated

- In most of the cases there were higher qualified jobs generated

- The types of jobs were:
  - Engineers
  - Simulation experts and trainers
  - R&D staff
  - PostDocs

Use this information also as a measurable benefit