Modelling Factory and Virtual Upscaling - Project goals

- The idea of the Modelling Factory is to create a **virtual working space**, where individuals and organisations can test and share their ideas on how to **advance material efficiency and circular economy by creating different types of computational models** and solutions and to validate them against real provided scientific, industrial and environmental data.

- In the Virtual Upscaling project we will tackle real life upscaling challenges collected from the different KIC partners

- The methods, **tools (models) and interfaces will be made available** through Modelling Factory.

- Modelling Factory acts as both a dissemination channel of the results and a virtual **work room** where the results are produced

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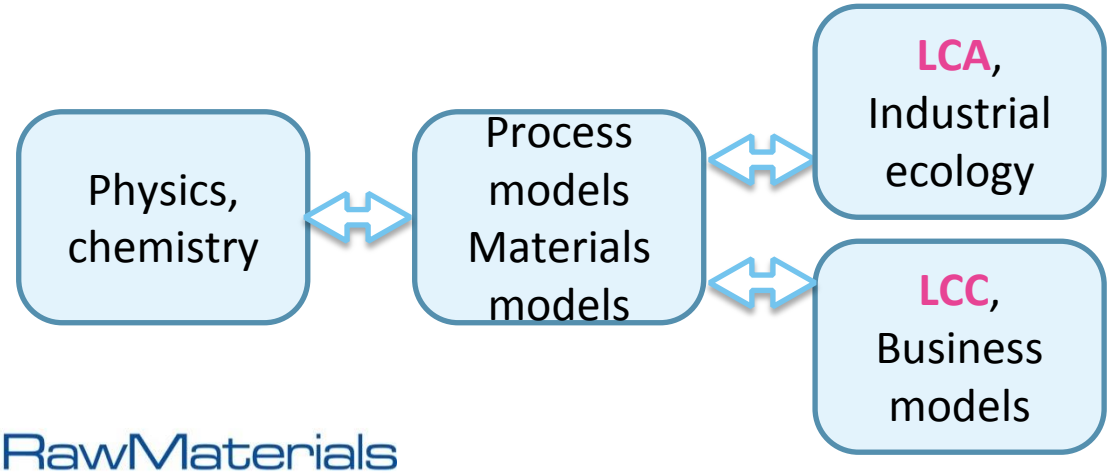
Virtual Upscaling: Multi-disciplinary collaboration and improved design/implementation decisions via Modelling Factory platform

- Improving collaboration between domain experts in different fields.
- Three types of users
- Developers (Information infrastructure coding)
- Modelers (domain experts, computational models)
- End-users/ Decision-makers (product designers, strategic designers, excecutives, teachers)
- Dissemination: data, models, GUIs (user interfaces of models)



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Main deliverables (M3)/outputs 2017 of Modelling Factory and Virtual Upscaling projects

- Modelling Factory
    - WP1/M3,M4: Development of Modelling Factory portal (iterative)
    - WP2/**M3**: Integrating the tools needed in the scenarios to the Modelling Factory: Milestone: M3: Deliverable: Working set of tools in the different Modelling Factory scenarios and related documentation (**main demo 2017: ValueChainLCA <= SULCA**)
- Virtual Upscaling
    - D1/M3,M4: Presentation and demo material describing the Modeling Factory
    - D2/M3 Report on the pilot equipment measurement data: Deals with partner case study
    - D3.1.1/M3 Material model, simulation results and documentation (iterative)
    - D3.1.2/M3 Report on linking the microstructure model to structural analyses (iterative)
    - D2/M3 Creation of CFD model for the EWT process development (iterative)
    - D5.1.1/**M3** Business case description and ecosystem analyses report: **Recognition of relevant business cases and actors (new angle: LCC+LCA services)**
    - D2.5.1/**M4** Description of the LCC tool developed: **LCC tool + documentation (Outotec)**

Business model possibilities

- Typical companies benefiting from the suggested ecosystem:
  - companies developing new processing concepts and equipment for the circular economy
  - small consultancy companies as well as ICT tool vendors providing computational solutions.
- Possible forms of business include:
  1. Participation fees paid by ecosystem members
     - for establishing private workrooms to the public Modelling Factory
     - for installing intranet versions of the Modelling Factory
     - for selling components and services via the marketplace
  2. **Modelling consultancy chain (SMEs, research institutes, large enterprises in the ecosystem) <= LCC to be assessed. LCC is but one possibility for a focused service model. Need easy-to-understand, possibly standardized, not too contested application.**
  3. Integration solutions (scripts/plug-ins) for connecting data of different tools together
  4. Indirect cost savings for the large enterprises

What is LCC and why is it useful? (1)

- **Life-cycle cost analysis (LCCA) is a tool to determine the most cost-effective option among different competing alternatives to purchase, own, operate, maintain and, finally, dispose of an object or process**, when each is equally appropriate to be implemented on technical grounds. Life cycle cost can be conducted in two approaches: deterministic and probabilistic method.
- **Whole-life cost, or Life-cycle cost (LCC), refers to the total cost of ownership over the life of an asset: Financial + Environmental + Social costs must be evaluated!**
- The predicted LCC is useful information for decision making in purchasing a product, in optimizing design, evaluation and comparison of alternative design, in scheduling maintenance, or in planning revamping.
- LCC analysis in the early program phase has significant opportunities for minimizing the LCC, because the cost profile of commitment rapidly increases in the early program phase. **It is generally believed that 80 % of the LCC is allocated by decisions that are made within the first 20 % of the life of the project.**

What is LCC and why is it useful? (2)

- **Resource Efficiency** covers efficient use of monetary as well as physical resources. Industrial actors have formalized the related requirements through LCC (Life Cycle Cost) analysis [0] .
- **LCC is widely accepted, especially among OEMs (**Original Equipment (product) Manufacturer **), as a way to provide reliability measures to customers (i.e. total cost of ownership).**
- In the metals and mining sector, the **question of economic efficiency is becoming increasingly important, as ore grades are declining and the production processes are becoming costlier, especially in terms of energy, chemicals and water costs or land use**. However, LCC is seldom truly linked with the same system boundaries and same background assumptions as LCA, when and if such a method is used within the organisation. **Setting up this common platform for life cycle based methods, and allowing the life cycle costing method to become a natural part of modelling, will make the approach much more attractive for companies to implement**.

What can Modelling Factory Platform offer for LCC in extractive industries?

- **ORGANIZE CONSULTANCY CHAIN to bring about more accurate LCC + LCA cost estimates faster in the analysis process phases**: (1) Problems definition; (2) Cost elements definition; (3) **System modeling;** (4) **Data collection**; (5) Cost profile development; (6) Evaluation
- … and in the reporting phases: Uncertainity analysis, optimization, LCC model description, sensitivity analysis
- **System level modeling of impact assessment** of LCC: conventional methodologies:reliability block diagram (RBD), fault tree analysis (FTA), Markov modeling, Petri net, etc. The international standard IEC60300-3-1(10) tabulates characteristics of analysis techniques.
- Modern process plants are usually controlled by distributed control systems (DSC) (programmable logic controller (PLC)). Methodologies of availability (reliability) assessment for software have therefore become more important in order to quantify the availability of total production systems. **Some part of new business model could also revolve around direct data input from the plants control systems**.

How to make better use of LCA

- LCA and footprinting methods have been used for decades. However, LCA is still far from being standard practice, the application of LCA is often limited to singular efforts
- Need simple-to-use methods giving reliable results that are relevant for businesses, which operationalise the principles of sustainability.
- LCA does **not include** an evaluation of **depletion of the resources** (scarcity of non-renewable resources), only their consumption.
- LCA reveals differences between products and processes but it **says nothing on the efficiency of the process**.
- Generally the **LCA programs use average data**
- **eco-design tools are not well integrated and are usually used separately from classical design tools** (CAD, CAE).
- **Manufacturers often use LCA tools, but their suppliers are not skilled enough or cannot support this kind of tools <= consultancy/ValueChainLCA**

What can Modelling Factory platform offer for LCA in extractive industries?

- **The use of LCA can be promoted by providing a systematic approach, reliable data gathering and a results format relevant for the metals and mining sector to ease the implementation of LCA in their decision-making.**
- **Urban mine point of view** in LCC + LCA analysis (in addition to geological mine view point), in particular a **better inclusion of waste streams, recyclate quality changes** etc.
- Automatic parametrization Gabi/Sulca LCA models using process models (e.g. HSC Sim), automated model transformations between proprietatry LCA tools
- Better integration with strategic and product design software
- Improved collaboration and secure data sharing (ValueChainLCA). **LCC analysis is a collective study comprising many kinds of analysis. Some partial processes of LCC analysis have been standardized, yet there is a lot of room to improve the practices and improve the quality of the assessments**.