SIMP - System integrated metals processing

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Size: total 24,2 M€

SUMMARY
Resource efficiency is high on the EU political agenda (www.unep.org as well as http://ec.europa.eu/environment/resource_efficiency/re_platform/).
Digitalisation of processes, process chains, systems and especially linking them in a mathematically and process control systemic and coherent basis is arguably a key component in realizing sustainability through resource efficiency.

In ***"System Integrated Metals Processing – SIMP"*** a global unique grouping of leading Finnish companies exporting sought after quality metal and technology products, have come together to address sustainability in quantified manner. The objective of the project is to further improve the already low environmental footprint of the 7.8 billion € export "Metals and metal products" Finnish industrial sector employing around 28,000 people[1] (2011 data) and to further increase its global competitiveness by integrating Digitalisation and Sustainability in a system integrated manner. The focus is specifically also on digitalising complex process models and making them operable in real-time in a gate-to-gate systemic plant environment. Therefore this project relies heavily on software developments by project partners and trusted sub-contractors used by the companies in this project.

To this end the project will have the objective to deliver system integrated sustainable metal production predictive control systems for 3 key Finnish industry sectors i.e. copper, steel and stainless steel. These will further improve product quality by integrating systems that enable predictive quantified sustainability i.e. further drive processes and their metal products to their resource efficient limit as dictated by physics and economics of the technology. This depth will provide the basis to further innovate the production systems to higher resource efficiency and render the world class export metal products even more sustainable and CleanTech based. World Class CleanTech systems will therefore be an important product of this project.

As world class players involved in the project, we acknowledge that this is a rather ambitious programme. It is clearly a great challenge to link various existing process simulation models and data resolution/detail, sensors, measurement, data bases, control systems, advanced process control models, big data reduction and multivariate analysis tools, artificial intelligence, physics etc. to each other in order to predict product quality at least one challenging time step ahead. If required, new models will be developed, with the objective to further advance the science and technology of metal production and their control systems. It will therefore be a challenge with poorly measurable processes and sometimes non-existent measurement to calibrate dynamic simulation models to predict ahead in time – but this we know is the true creative part of this project.

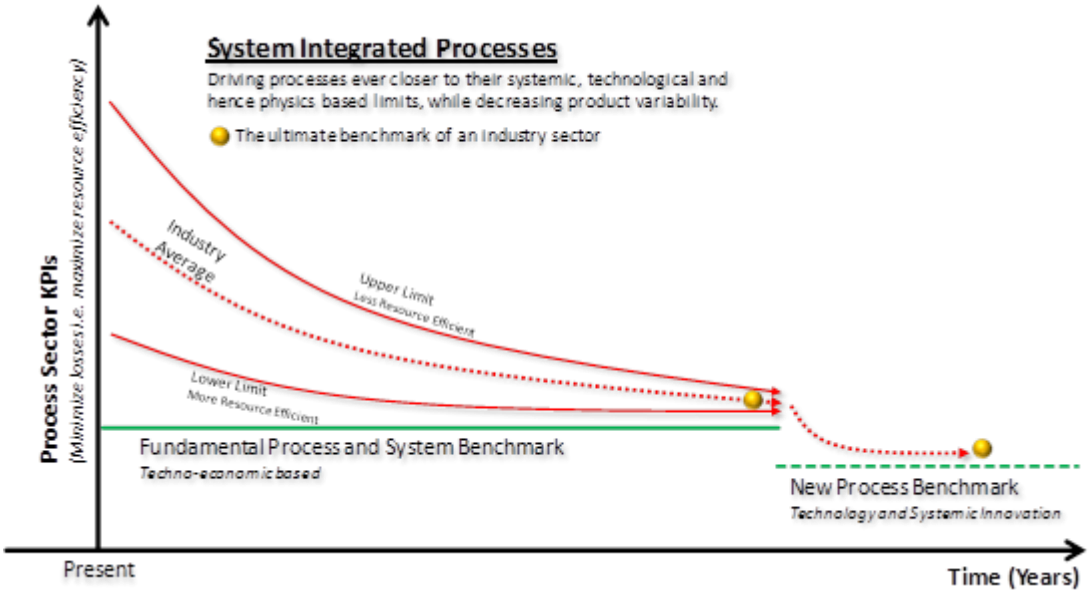
In summary: the focus of the project will be to make the sustainable systems work in an industrial setting of world class production facilities in a system integrated and in real-time manner to predict a time-step ahead. This is an enormously challenging task to take (some still academic) models and transform them to work as robust control models in larger resource-to-metal-product process control systems. This challenge will be demonstrated in four Show Case projects with various cross-cutting supporting sub-projects:

- **Show Case 1 (SC1):** Flexible copper plant operation with wide range of raw material quality. The challenge in this SC is to link mineral information (poorly measurable) via high temperature and

aqueous solutions to final refined copper while capturing the depth of hydro- and pyrometallurgical reactors with a mix of easy and poorly measurable data.

- **Show Case 2 (SC2):** Predictive plant wide production and quality control ((i) Dynamic multiphysics modelling as guidance in progressing steel making and (ii) Dynamic modelling and control of microstructure and properties from continuous casting to final product) touching on similar issues as SC1, but then applied to steel and stainless steel.
- **Show Case 3 (SC3):** Decision support of metallurgical processes ((i) Plant-wide operation control system for hot metal production, (ii) Improved blast furnace control, (iii) Optimisation of coking blend and coke oven leakage detection, and (iv) Intelligent Ferroalloy production process), extending SC1 and SC2 issues to ironmaking, while capturing the rather complex processes and phenomena in the blast furnace.
- **Show Case 4 (SC4):** System modelling to optimise low-carbon footprint fuel usage in Finnish metallurgical industry ((i) Production and pre-treatment of alternative reducing agents, (ii) Development of a raw material selection applications, (iii) Modelling of alternative reductants in metallurgical process units, and (iv) Integration of energy, reductants and metal production), which will integrate the methods developed in SC1-SC3 to lower the footprint of the industry by the application of lower footprint reductants.

It is clear from these show cases that the intent is to predict from a feed being either, a concentrate, hot metal, mineral, etc., the product quality of copper, pig iron, ferrochrome steel and stainless steel. This will bring to life the true meaning of system integrated metal processing and will realise Quantified Sustainability, bringing much needed physics and technology basis to environmental footprinting[2]. The figure below summarises this objective.



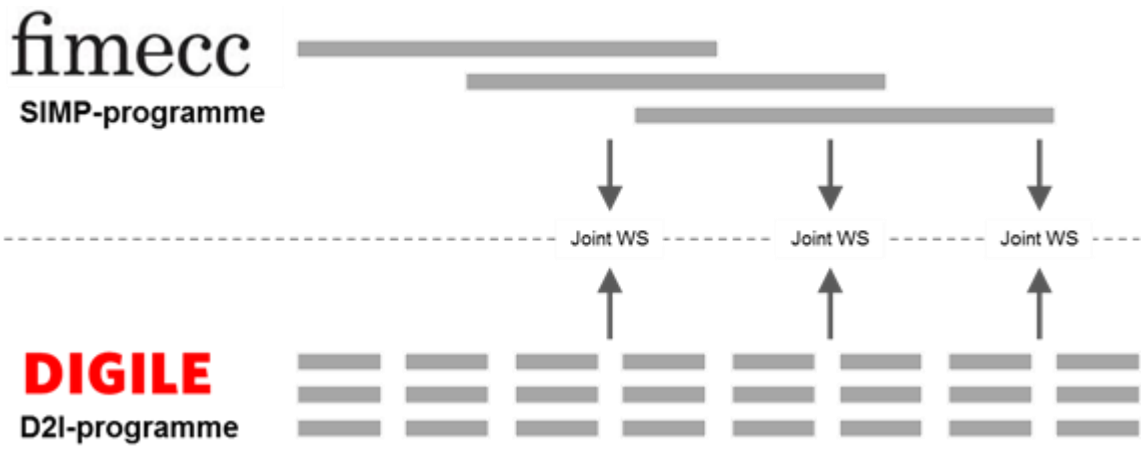
The programme size is 43.8 M€ and duration 5 years from 01.01.2014 onwards. There are 20 Companies and SMEs participating, 7 Finnish Academic and Research Institutions and 31 International participants and will improve the profitability of the industry well in excess of the invested money as shown in chapter 7.

It is self-evident that if these objectives are achieved, not only will the Finnish metallurgical industry improve its resource footprint but it will provide techniques and technology that places it in a leading global position with regard to enabling increased resource efficient metal production while maximizing export B€ of the involved companies and hence contributing innovatively to enabling a sustainable local and global society.

With this objective this project clearly covers two key pillars of FIMECC i.e. linking Digitalisation and Sustainability. It also covers more subtly the Holistic Lifestyle Approach through its physics based systemic

approach. This mindset is invaluable training for young students to help improve the resource efficiency of our society.

To optimise the SHOK concept benefit and to accelerate the research, a co-operation practice has been agreed between FIMECC's SIMP programme and DIGILE's D2I program – Especially the WP2 "Methods, Algorithms"-project. The purpose of the co-operation is to enable synergies in the area of advanced modeling and data management. It also enable peer-to-peer learning, building on the achieved results and wider utilization of results across industries. While the process management practices differ between the programmes (Waterfall vs. Sprint) the practical co-operation takes place in DIGILE's D2I programme's sprint meetings in which a SIMP specific session is arranged 1-2 times per year.



Effective knowledge transfer and wider utilisation of results are enable through joint workshops between FIMECC's SIMP and DIGILE's D2I programmes. The chosen method enables co-operation although the management methods differ between the programmes (Sprint vs. Waterfall).

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[1] Suomi kestävän kaivannaisteollisuuden edelläkävijäksi – toimintaohjelma, Työ ja elinkeinoministeriön julkaisuja, Konserni 15/2013 (note this includes Old Outokumpu data – New Outokumpu data for 2012: sales 9.4 B€ and 16,000 people after Onoxum acquisition)

[2] http://ec.europa.eu/environment/resource_efficiency/news/up-to-date_news/02052013_en.htm

READ MORE ABOUT SIMP

SIMP IN MEDIA 2015

- "Diginatiiveja koulutetaan metallin vientiin", Tekniikka&Talous 18.8.2015, paperilehtiversio
- "FIMECC ELEMET -ohjelma päättyi: tavoitteet ylittyivät", Materia 1/2015
- "USING SECONDARY RESOURCES – TOWARDS SYSTEM INTEGRATED METAL PRODUCTION (SIMP)", Outotec, 30.1.2015
- "Tuotantotekniikan tutkimusta ei ole ajettu alas", Tekniikka&Talous 16.1.2015

SIMP IN MEDIA 2014

- "Akateemista pohdintaa ja ajatusmalleja yrityksille", Aalto University News 9.5.2014
- "Academic considerations and thinking approaches for companies", Aalto University News 9.5.2014

Program is active:
Yes