A new model architecture for improved thermodynamic control in steelmaking

In response to the need for greater flexibility to ever changing process innovations, Siemens have developed a single model architecture covering steel making through to casting which can be easily adapted by plant personnel as process changes demand.

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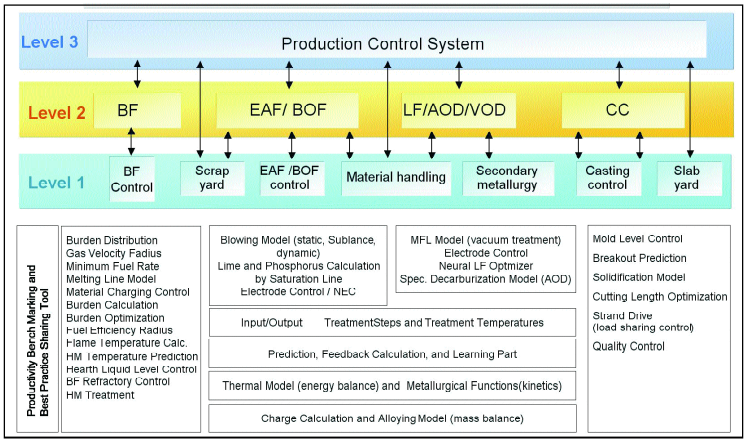
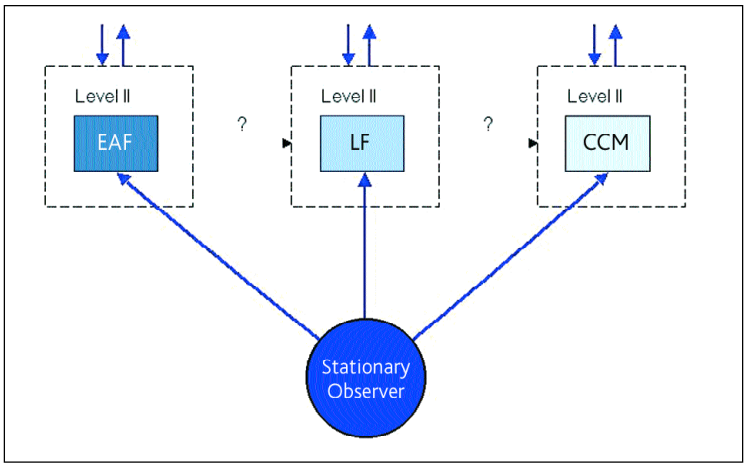


● **Figure 1** ***Siemens integrated automation systems***



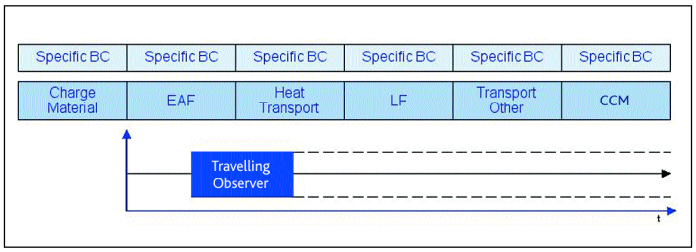
● **Figure 2** ***Principle behind conventional process automation solutions available (BC is boundary condition)***

A fully integrated automation system is enormously important for achieving product quality, process efficiency and cost-effective metals production. The demands being placed by customer product requirements on system architecture and thermodynamic models in electric steel plants are growing extremely rapidly, and steel plant operators are required to modify their procedures in response to changing market needs. Innovations providing optimisation of process steps or sequences, as well as entirely new approaches are revolutionising the automation landscape.

The need for innovation

With conventional automation systems, fault tracking and tracing back to the problem source are impossible, models are typically tailored to a specific plant type and can only be adapted to process innovations with difficulty and with specific regard for intermediate process steps such as logistics. Fierce competition in the world steel markets with regard to product price and quality is moving system suppliers and steel plant operators inexorably towards more highly sophisticated automation systems capable of satisfying requirements for data acquisition, process control, logistics, and dynamic optimisation. For two decades Siemens has been working to meet these customer needs with its own process models and those of technology partners in the process automation area, and a number of reference projects underscore this experience.

Siemens recognised that not only intelligent data acquisition, management and evaluation systems would be required, but also that innovations in the technology of the production process itself, would soon become of great importance. Siemens Iron & Steel Technologies, therefore, has developed an



● **Figure 3** ***The principle of the new model architecture***

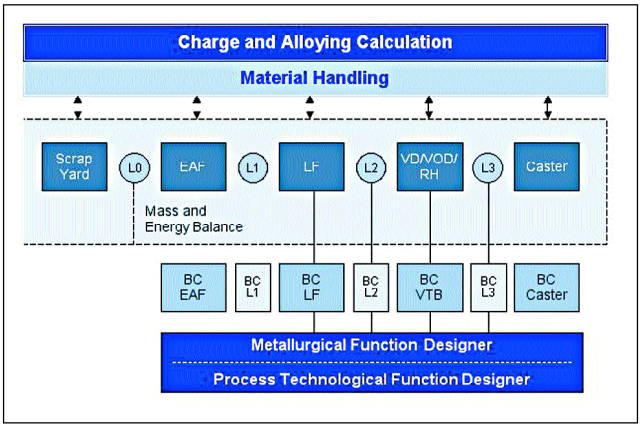
open model structure, which enables the plant operator to adapt the model to innovations in the process across its entire length, so making it easier and more flexible to use.

As can be seen in *Figure 1*, Siemens covers the entire model spectrum in iron and steel manufacturing (models for downstream processes are not listed here). *Figure 2* depicts the principle behind the process automation solutions currently available. The stationary observer views process sequences from a fixed standpoint outside the process and auxiliary sequences, such as transport actions, are typically not observed. Furthermore, current models are adapted only to the needs of a particular process sequence, run on a process computer, and are protected in such a way that the plant operator can only influence them with great difficulty. Adaptations to process changes or process innovations can only be made with source code manipulated by specialist personnel.

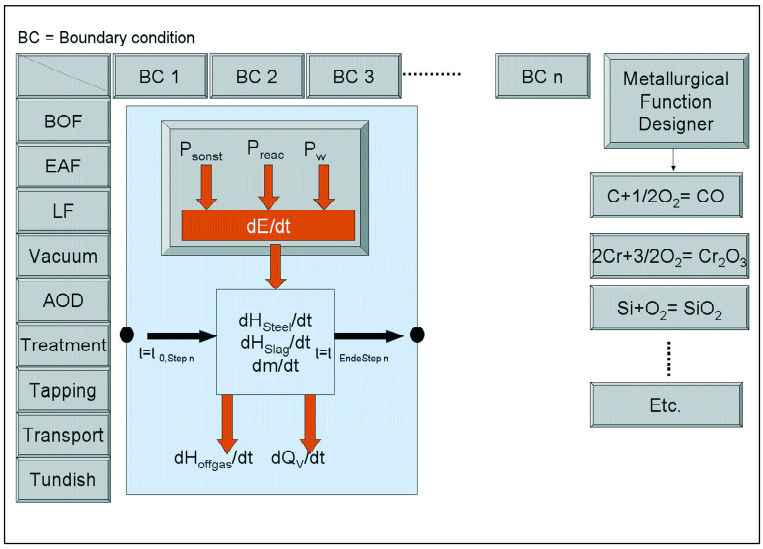
Introducing a new model architecture

The new Siemens model architecture returns to the fundamental principles of classical thermodynamics, in which the first law of thermodynamics for open and stationary systems provides two points of view. The first involves an external, stationary observer, as is found in previous solutions on the market (see *Figure 3*). The second, however, provides for a travelling observer (see *Figure 4*) who, himself, experiences the changes in the process chain. This later type of observer is the basis for Siemens new model architecture.

Within this approach, instead of individual models for each process stage, there is only one core model for the steel and equipment in the entire process chain from EAF, ladle furnace and vacuum process through to the caster. The structure is purely object-oriented, meaning that specific process components, such as metallurgical and process functions, are implemented over time as changes in boundary or start conditions. These functions are not situated in the model core, but can be injected from outside. The flexibility of this new approach is such that the plant operator can enter dynamic variables into the system or design them himself (see *Figure 5*).



● **Figure 4** ***Implementing the Siemens model in an electric steel plant***



● **Figure 5** ***Modular model for all processes***

Summary of benefits

- One basic model for all process steps
- Easy parameterisation via metallurgical/process function designer
- Easy integration of new process steps
- Easy deletion or substitution of existing process steps
- Easy adaption of new process expertise
- Lower engineering and maintenance costs by customer personnel
- Open and object-oriented structure

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