

## STEEL CASE STUDY



THE COMPANY:

**ArcelorMittal**  
Dunkerque

*ArcelorMittal Dunkerque annually produces more than six million tons of steel on an integrated steel works plant.*

***SCOOP helps to reduce raw material costs at ArcelorMittal Dunkerque.***

*With 320,000 employees in more than 60 countries around the globe, ArcelorMittal has production plants in 27 countries across Europe, Asia, Africa and America. Its total production capacity reaches 130 million tons (around 10% of the world capacity of steel production).*

*The steel-making plant of ArcelorMittal in Dunkerque specializes in flat carbon steels and owns three blast furnaces (BF2, BF3 and BF4), the BF4 being one of the best performing blast furnaces in Europe. The site also includes two coke plants, two sinter chains, one steel shop with three converters, four continuous casting line slabs, one hot-rolling mill and one cold-rolling mill.*



*« We already had some tools allowing us to calculate the raw material mix required for our production. However, our tools only allowed us to optimize one department at a time. (...) When we saw the N-SIDE presentation in Dunkerque, we were immediately impressed by the fact SCOOP was integrated and produced results in a few seconds. »*

Jean-Marie LIBRALESSO,  
PIG IRON Process Manager

### THE CHALLENGE:

DECREASE RAW MATERIAL COSTS AND IMPROVE INFORMATION EXCHANGE BETWEEN THE DIFFERENT PRODUCTION UNITS

N-SIDE, a company specializing in Operations Research application for the Steel Industry, contacted the Dunkerque site in 2003, and explained the benefits of its raw material optimization tool SCOOP (Steel Cost Optimization) to the management. The site manager then decided to ask Jean-Marie Libralesso, manager of the pig iron process, to have a look at N-SIDE's tool to decrease the total production costs of steel.





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►► « We already had some tools allowing us to calculate the raw material mix required for our production » explains Jean-Marie Libralesso. « However, our tools only allowed us to optimize one department at a time – coke plant, sinter and blast furnace – and after each calculation carried out in one unit, you had to review the impact on the model of the next department in the production process ».

As opposed to the tools already used, SCOOP takes into account the entire set of production steps and computes an integrated technical-economical optimization. This is what led Jean-Marie Libralesso to organise a meeting with N-SIDE, which created this tool after many years of research and collaboration with Belgian universities.

« When we saw the N-SIDE presentation in Dunkerque », says Libralesso, « we were immediately impressed by the fact the tool was integrated and produced results in a few seconds. At first, we thought that it was a simple model with only material balances, but as and when we asked questions, we soon found out that the tool was much more advanced and that it also contains modelling for thermodynamics, yields, chemical balances, product quality (I10, I20, I40...) etc. In order to get the bottom of it, we organized a visit to Liège (Belgium) where our colleagues demonstrated how they were already using the tool. Following that visit, we were convinced that SCOOP could help us ».

During the coal crisis in 2003-2004, the various Arcelor sites had to react to significant coal price variations and adapt as quickly as possible to select the coals required for the targeted steel quality. When this happened, thanks to the integrated optimization tool SCOOP, Arcelor Liège could respond almost instantly to each new market condition, even though calculation is more complex and slower at Dunkerque. When Jean-Marie Libralesso's team went to Liège, they received explanations from SCOOP users and learned how Liège managed to be so reactive to the availability changes.



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Raw material replenishment challenges in the Steel Industry are extremely important: they are a strategic goal. A site like ArcelorMittal Dunkerque, producing more than 6 million tons of steel every year, has a raw material budget close to one billion Euros that represents more than 80% of the total steel production costs. In addition, the replenishment disruption must be rapidly taken into consideration in order to calculate the new ideal material mix making it possible to produce the targeted steel quality at the lowest cost.

### THE SOLUTION:

SCOOP, BASED ON MATHEMATICAL MODELS, MAKES IT POSSIBLE TO CALCULATE THE CHEAPEST RAW MATERIAL MIX FOR A GIVEN QUALITY OF STEEL AND IS COMPATIBLE WITH EACH SPECIFIC PRODUCTION PROCESS

SCOOP (Steel Cost Optimisation) is an application that has been continuously enhanced over the last 10 years. It was developed at the Catholic University of Louvain (UCL) as a study work, and has subsequently become the cornerstone of the Steel Industry strategy of N-SIDE, a UCL spin-off specialising in Operations Research. Mr. Libralesso explains: « ArcelorMittal has many people working in the Research & Development department. We have been building decision-making tools for raw material mix for many years. Some of our tools go into even greater detail than the SCOOP solution. However, we did not have a tool enabling a product mix optimization that took into account the complete range of production phases. This was the major advantage that we perceived in the N-SIDE solution.



During the implementation of the tool, most of the work was to determine which technical details were required for integrated optimization. However, we had to concentrate on the elements that really enhanced the value of technical-economical optimization, and eliminate any non-relevant formulas in that respect. From this point of view, SCOOP implementation was a real success ».

Another important point considered by Mr. Libralesso was the Knowledge Aggregation aspect. « Each production site », explains Mr. Libralesso, « over time developed its own local formulas. Indeed, not everything can be found in scientific literature. It sometimes takes years to establish relations that may be empirical, but which are the most appropriate for a production process. This is the core of our knowledge allowing us to produce steel by using the optimal process on a day-to-day process. All this knowledge, aggregated over many years, is invaluable for us. However, this knowledge has been scattered over several departments for a long period of time. Some of the people who created these formulas, specific to the Dunkerque production process, no longer work there, and everything was not always documented in full detail ».

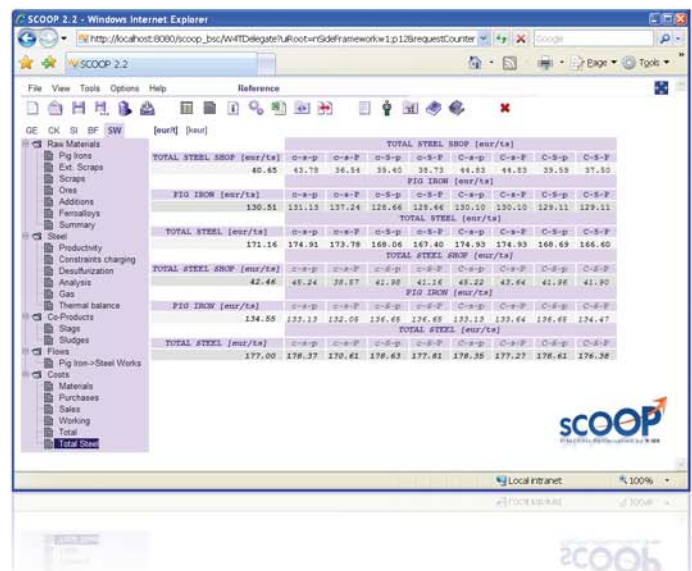
All chemical, thermodynamic, logistic and other kinds of formulas dedicated to the Dunkerque site or resulting from the literature are documented in the tool. A simple mouse click on a hyperlink text on the screen makes it possible to see the details of a variable, then the formulas it is used in, with links, in some cases, to other kinds of documents like

book extracts, scientific articles... Then, using other hypertext links, one can access the other variables and formulas involved.

A scenario comparison tool allows the user to test many different assumptions and compare them. For instance, we can compare different production levels and see their influence on the production cost per ton of steel. We can also compare different crushing capacities and their impact on the process, etc...

« SCOOP is a high performance tool », says Jean-Marie Libralesso. « However, it is not a tool for an inexperienced person: you need some knowledge of the production process for its setup. Hopefully, SCOOP provides a mechanism for error detection in the event of an infeasible solution that points the user to any inconsistency in the parameters ».

In 2008, Mrs. Geneviève Allesina took over the position of Mr. Libralesso. She is also actively using the tool to calculate the annual budget, the opportunities to use some raw materials, the impacts of corporate decisions regarding the use of defined raw materials, the optimal distribution of the burden between the blast furnaces, ... etc. After the crisis in 2009, Mrs Allesina also used SCOOP in order to calculate the consequences of reopening the second sinter chain.



## THE BENEFITS:

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PRODUCTION COSTS ARE REDUCED BY BETWEEN 1€ AND 4€ PER TON OF STEEL

« Our first calculations show us potential benefit of about 2 Euros per ton of steel », tells Mr. Libralesso. « However, you must weight this number because, in our situation, the materials chosen by the tool are not always available since we need to share available materials between other production sites in the group. Of course, when our buyer tells us that a material is not available, we are able to adapt easier and quicker with SCOOP, and find a replacement product or product mix that would match our technical constraints. I believe it is realistic to say, because of this specific limitation, that the benefit is closer to one Euro per ton for ArcelorMittal Dunkerque, which is significant, taking into account our production level (more than 6 million tons) ».

## THE FUTURE:

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### A CONTINUOUS IMPROVEMENT

In 2010, ArcelorMittal Dunkerque has decided to start a project to upgrade its version of the SCOOP tool. Among several technical enhancements to the steelmaking models, ArcelorMittal was pleased to benefit from the newly developed Sensitivity Analysis tool of SCOOP. The Sensitivity Analysis permits the variation of one of multiple parameters between predefined boundaries, and the start of multiple simultaneous optimizations for all the parameters between them. Trend graphs can then be drawn to visualize the impact of the various parameters. The Sensitivity analysis can be performed for technical parameters (chemical content, productivity impact, etc.), economical parameters (raw material price, availability, etc.), production levels or burden charging across Blast Furnaces.



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### KEY BENEFITS:

- Quick return on investment through a complete integration of the different production phases
- Enhancement of the information exchange between departments
- Knowledge aggregation in a common tool
- Quicker reaction to change in market conditions or raw material shortages
- Technical-economical negotiation tool calculating the best raw material choice

« *Our first calculations show us a potential benefit of about 2 Euros per ton of steel* »

**Jean-Marie LIBRALESSO,**  
**General Manager, Iron Making**  
**Department - Process Coordination**



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