CONTROL IN STEEL

Deliverable 2.3: Categorization List

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1. Aim of the categorization list

This report is a part of the ControlInSteel activity. It is dedicated to impact categorization, which represents a central element to focus a project.

2. Categorization

2.1. Types of impact

There are different types of impact that are produced during a project. Those types can be loosely grouped into the following structure:

- Quality
- Economic
- Environmental
- Safety
- Scientific

Nevertheless, these categories are too vague to get the right impression of the impact, as they can be subdivided more granularly. The subdivision leads on slight interdependences as the borders of impact are not sharply constraint.

Category 1. Quality improvement

Type: Quality

Quality improvement refers to the overall improvement of product characteristics and features, including mechanical properties, increased specification ranges, homogeneity of material characteristics and the reproducibility of these numbers.

Examples: Improvement of thickness tolerance during hot rolling; Substantiall more constant temperature values in a furnace during processing;

Category 2. Defect root cause impact

Type: Quality

Closely related to product quality are defects, especially surface defects. A large group of projects that were reviewed conducted research solely or predominantly focusing on identifying the root cause of failures. Note, that it is already an impact to identify this root cause. Once changing the process to improve quality, this type of impact converges with category 1.

Example: Scale defects on surfaced identified to be caused by temperature effects at the entry and exit of the reheater; Ruptures at the strip sides being more likely while the coiler engine vibrates;

Category 3. Cost reduction

Type: Economic

Cost reduction is one of the most obvious impact types. It addresses projects that helped to ramp down production costs, to safe money at maintenance operations or to enable cost efficient sensorial infrastructure.

Example: Electric scissors can be operated longer than usual, because a project achieved early warning of blade fatigues using a control performance monitoring;

Category 4. Yield improvement

Type: Economic

Another category characterizes projects that led to increases in yield and throughput. The projects then introduced research work or installed technological solutions that achieved this increase by optimization of workflows, quicker performance of tasks that took longer time before and rescheduling due to smart control strategies of the production chain.

Example: Smart control of the furnace allows an improved series of products so that more material throughput is achieved;

Category 5. Power consumption

Type: Ecological / Environmental

Power consumptions refers to the overall electric and thermic energy needed to power the aggregates. If smart control approaches lead to a systematic reduction of such power consumption, associated projects belong into this category. Note, we will explicitly cover indirect channels of power consumption reduction in our scoring approach later on.

Example: Control of a furnace door improves the overall time to keep the chamber on temperature;

Category 6. Waste Reduction

Type: Ecological / Environmental

Control can lead to the reduction of waste. Note, that we categorize a project into this group, as soon as its original concept was indeed focusing on waste reduction. As such, there is a strong interdependence with Quality categories of impact. The reason lies in the fact, that products with minor quality are rejected and typical considered waste products.

In that sense, waste reduction maybe a follow-up impact to the projects primarily targeting quality improvement or defect reduction.

Example: Re-allocation of products to alternative orders by control solutions that allow to alter the process way during the production;

Category 7. Emission Reduction

Type: Ecological / Environmental

Beneath lowering the power consumption, some project directly applied technique to reduce emissions. Examples are activities conducted at the pickling line, reducing emission of dangerous gas contents, projects that actively controlled gas networks to avoid excess flaming or otherwise loosing of existing energy. Please note the difference to lowering power consumption here.

Example: Reduction of flame usage in gas networks; reduction of condenser usage in steam networks;

Category 8. Worker Safety

Type: Safety

Projects that focus on implementing novel advanced automation to actively increase worker safety are allocated to this category. Only a few projects could be found that dealt with this category. Nevertheless, for future considerations, strengthen research that increases worker safety will be of primary interest.

Example: Reduction of strip ruptures;

Category 9. Worker Performance

Type: Economic

Advanced control techniques are capable to actively support staff in doing its job. Roboters or drones are examples that are considered, but also software solutions that help to better control a manually operated aggregate and novel tools for workers are represented here.

Example: Introduction of drones into the production context;

Category 10. Customer Satisfaction

Type: Quality / Economic

Some projects directly addressed research that was conducted to increase customer satisfaction. As a matter-of-fact, it will lead to higher revenue and increased economic benefit, therefore closely related to the other impact categories for quality and economics.

Example: Introduction of new grade is assisted by a new control technique;

Category 11. Enabling Technologies

Type: Scientific

Proof-of-work type enabling technologies such as data management techniques, well established, but not in steel processing applied methods are part of this first type of scientific impact. No research for the method is needed, but it is applied to steel production and its primary impact is clearly to put this technology in place as an enabler for future improvements.

Example: Application and installation of new data streaming, supporting novel online control techniques;

Category 12. Novel Approach

Type: Scientific

If scientificall new, innovative methods have to be researched for application, impact is not only achieved in the above categorized, but moreover also in scientific context as well. Learning how the application field requires modifications of methods, or finding out about the limitations of specific techniques is considered of great interest in scientific communities.

Example: Changing machine learning approach to adopt to steel processing constraints like volatile machine parks and great product diversity;

3. Scoring principle

3.1. Impact distribution scoring principle

To find a suitable way for determining the impact of a project, we defined a scoring system that focuses on the most dominant impact channels according to the above categorization.

The rules for this scoring are as follows:

- Each project gets 5 impact points
- Points can be allocated to each category in 0.5-point steps
- Not all categories can be represented in one project

The reason for such an approach is to maintain a fair picture of the overall distribution.

3.2. Categorization for the disseminated projects

	Quality improvement	Defect root cause	Cost reduction	Yield improvement	Power consumption	Waste reduction	Emission reduction	Worker safety	Worker performance	Customer satisfaction	Enabling technologies	Novel approach
CEFLA	2	0	0.5	0	0	1	0	0	0	1	0.5	0
7210-PR/338	1	2	1	0	0	0.5	0	0	0	0.5	0	0
7210-PR/339	2	0	0	0	0	1	0	0	0	1	0	1
7215-PP/076	2	0.5	0	0	0	1	0	0	0	1	0	0.5
CASTDESMON	2	0	1	0	0	1	0	0	0	0	0	1
IPCDS	0.5	0.5	1	1	0.5	0.5	0	0	0	0	0.5	0.5
SHAPEHPM	2	0.5	0	0	0	0.5	0	0	0	1	0.5	0.5
AUTOCHECK	2	0	0.5	0.5	0.5	0	0	0	0	1	0	0.5
S5	2	0	0	0.5	0	0.5	0	0	0	2	0	0
GLOBALSHAPECONTROL	1	0	1	0	0	1	0	0	0	1	0	1

Table 1. Projects impact categorization.

	Quality improvement	Defect root cause	Cost reduction	Yield improvement	Power consumption	Waste reduction	Emission reduction	Worker safety	Worker performance	Customer satisfaction	Enabling technologies	Novel approach
SOFTDETECT	1	2	1	0.5	0	0	0	0	0	0	0	0.5
IMGALVA	2	0	0.5	0.5	0	0.5	0.5	0	0	0.5	0.5	0
SensoCont	1	0	0	0.5	0.5	0.5	0.5	0	0	1	0	1
Smartfire	1	0	0.5	0.5	0.5	0.5	1	0	0	0	0.5	0.5
FinalPlateFlatness	2	0	0.5	0.5	0	0.5	0.5	0	0	1	0	0
Awicco	1	0.5	1	0.5	0	0.5	0	0	0	1	0	0.5
HIGHPICK	1	0	0.5	1	1	0.5	0.5	0	0	0.5	0	0
Linecop	1	0.5	0.5	1	0.5	0.5	0	0	0	0.5	0	0.5
Edgecontrol	0.5	0	0.5	1	0.5	0.5	0.5	0	0	0.5	0.5	0.5
SensorControlPilot	1	0.5	0.5	0.5	0.5	0.5	1	0	0	0.5	0	0
Deffree	0.5	2	0.5	0.5	0	0	0	0	0	0	1	0.5
SISCON	1	2	1	0	0	0	0	0	0	1	0	0
Fosucor	0	0	0.5	2	1	0.5	0.5	0	0	0.5	0	0
MICROCONTROL	1	0.5	0.5	1	0.5	0.5	0	0	0	0	0	1
Flexpromus	0.5	0	0.5	1	0.5	0.5	1	0	0	0	0.5	0.5
Cognitive Control	1	1	0.5	0	1	0	1	0	0	0	0	0.5
OPTISHAMP	1	0	1	1	0	1	0.5	0	0	0.5	0	0
ICONTENS	1	0	0	0.5	0.5	0.5	0.5	0	0	0	1	1
TECPLAN	0.5	0	2	1	0.5	0	0	0	0	0.5	0.5	0
DYNAMO	0	0	0.5	0.5	2	0.5	1	0	0	0	0	0.5
ICONSYS	2	0	0.5	0.5	0.5	0.5	0.5	0	0	0	0	0.5
I2MSteel	0.5	0	1	1	0.5	0.5	0	0	0	0.5	0	1
PUC	1	0	0.5	0.5	0	0.5	0	0	0	0.5	1	1

Table 2. Projects impact categorization, continued.

	Quality improvement	Defect root cause	Cost reduction	Yield improvement	Power consumption	Waste reduction	Emission reduction	Worker safety	Worker performance	Customer satisfaction	Enabling technologies	Novel approach
SOPROD	0	0	0.5	2	0.5	0.5	0.5	0	0	0	0.5	0.5
DYNERGYSteel	0	0	1	0.5	1	0	1	0	0	0.5	0.5	0.5
MICROCONTROL-PLUS	1	0	0.5	1	0.5	0.5	0	0	0	0.5	0.5	0.5
INFOMAP	2	0	0.5	1	0	0	0	0	0	0.5	0.5	0.5
ORSC	1	0	1	1	0.5	0	0	0	0	0.5	0.5	0.5
GASNET	0	0	0.5	0.5	1	0	2	0	0	0	0	1
AUTOADAPT	0.5	0	0.5	1	1	0	1	0	0	0	0.5	0.5
Cyber-POS	0.5	0	0.5	1	0.5	1	0.5	0	0	0	0.5	0.5
MACO PILOT	0	0	0	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5
SUPPORT-CAST	1	1	0	1	0.5	0	0.5	0	0	0.5	0.5	0
FlexGap	0	0.5	0.5	2	0.5	1	0	0.5	0	0	0	0
NEWTECH4STEEEL	1	1	0.5	0.5	0	1	0	0	0	0.5	0.5	0
RADIFLAT	2	0	0.5	0.5	0	0.5	0	0	0	0.5	0	1
DYNREACT	1	0	0.5	2	0	0	0	0	0	0.5	0.5	0.5
AUTOSURVEILLANCE	0	0	0	2	0	0	0	1	0.5	0	1	0.5

Table 3. Projects impact categorization, continued.

3.3. Result of category scoring for the reviewed projects

Based on the scoring introduced above, we can analyze how RFCS projects systematically distributed their impact on the category space.

Figure 1 yields the evaluation results in form of a bar chart. There is a predominant contribution of projects committed to quality improvement (in general). Compared with this number of projects a much lesser part of projects was devoted to power consumption, waste reduction and emission reduction. But please note, the bar chart reflects only sums over all relevant years. A more detailed analysis will follow in the final report of the project that indicates the motion of impact over time. Please also note the shortcoming of worker safety and worker performance.

Another interesting result is the fact, that RFCS-based projects very well achieve impact in the scientific category. That means that the flow of innovative solutions and, with a slightly lower factor also enabling technologies, are constantly being fed into real-world steel production.

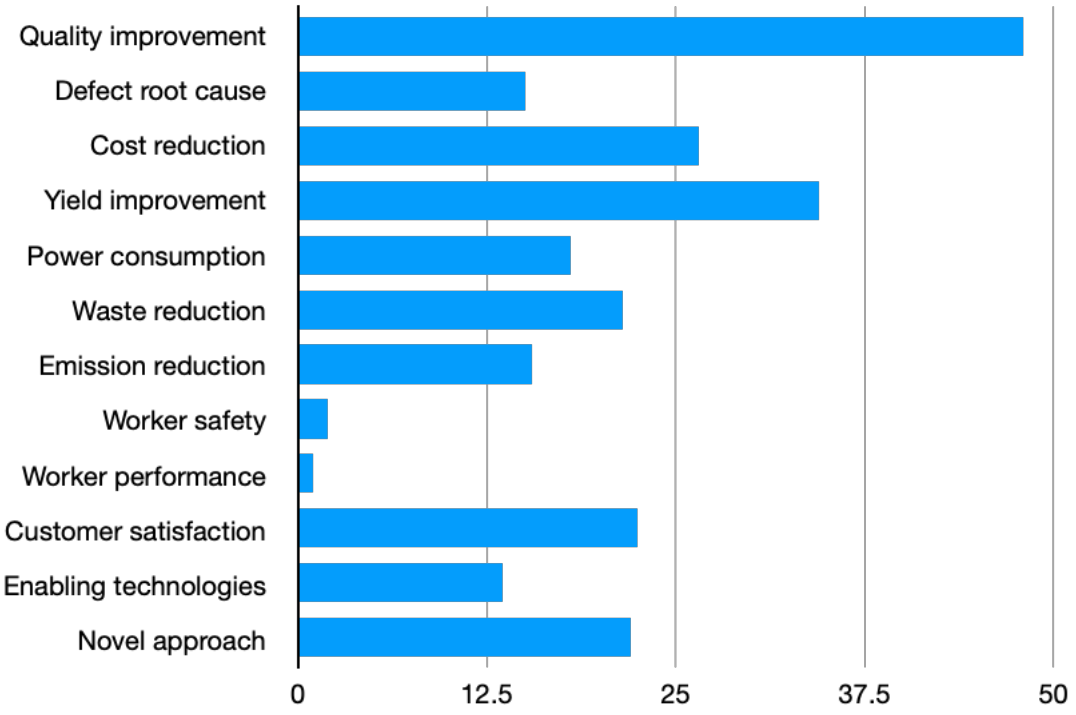

Figure 1. Evaluation of the scored impact categories, reflecting the distribution of impact covered by the reviewed projects.