

Expert support improves quality 24/7

Making steel is a very complex task requiring deep expert knowledge and, ideally, critical process decisions made 24/7. With QuinLogic's Proactive Process Supervision (PPS) software, professional expert advice can be provided in order to support smooth process flow.

Based on rule decisions, the PPS uncovers procedural inconsistencies in daily routine and flags up in cases of critical process deviations. The ExpertShell then visualises the point of interest in the process in a line model, providing, for instance, documentation, images, videos and expert advice in order to enable operators to solve the problem. After documenting the actions taken, the ExpertShell allows operators to give direct feedback on whether the advice was helpful.

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When quality issues arise in a steel mill, it is sometimes the case that the necessary expertise to correct the problem is not available, say, on a night shift or at weekends. This can be overcome by transferring experts' know-how into proactive software and make it available where and when it is needed.

Deviations in product quality can be detected by sensors, and thresholds set based on rules that reflect the context of the parameter. For instance, surface defects in strip can be detected by automatic camera inspection systems.

Proactive Process Supervision (PPS) can then provide expert advice to initiate the steps needed to rectify or avoid the problem. Expert know-how can be brought up in any format, such as pdf documents or image, video or audio files (see Figure 1).

QuinLogic has a set of 'off-the-shelf' configurable software modules covering data integration, rule design, user interface, root cause analyses and statistical process control. A modular Quality Execution system can therefore be set up and extended with more modules at any time.

THE QUALITY ASSURANCE PROCESS

Producing the right specific quality of products is key to any line operation in the steel industry. To do so, PPS software helps to make sure that a product shipped to a customer is certified according to specified requirements, such as:

- Meets the product application
- Meets customer-specific parameters of products
- Meets production cost (sale price) of products

The ideal condition is that all sections of the process route are highlighted in green, indicating that production is in good shape according to the specific quality rules implemented. All deviations are colour-coded yellow or red in each section of the process (see Figure 2).

If a red warning shows up it is time to act immediately. Figure 3 shows an example in Zn galvanising including ▶



Fig 1 Know-how is transferred into software to support quality improvement 24/7

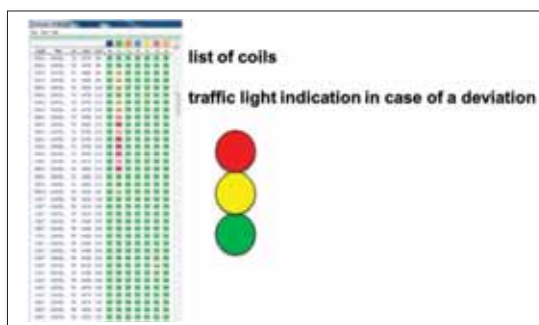
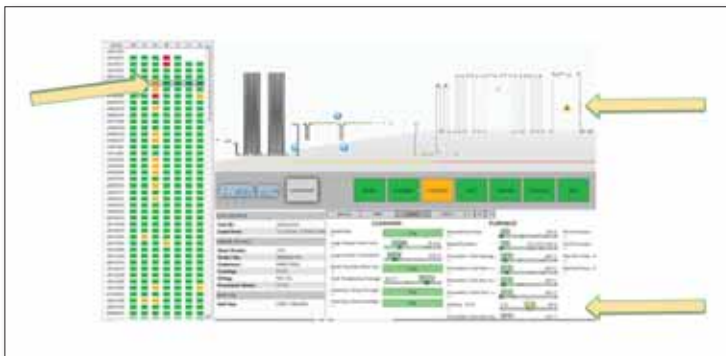


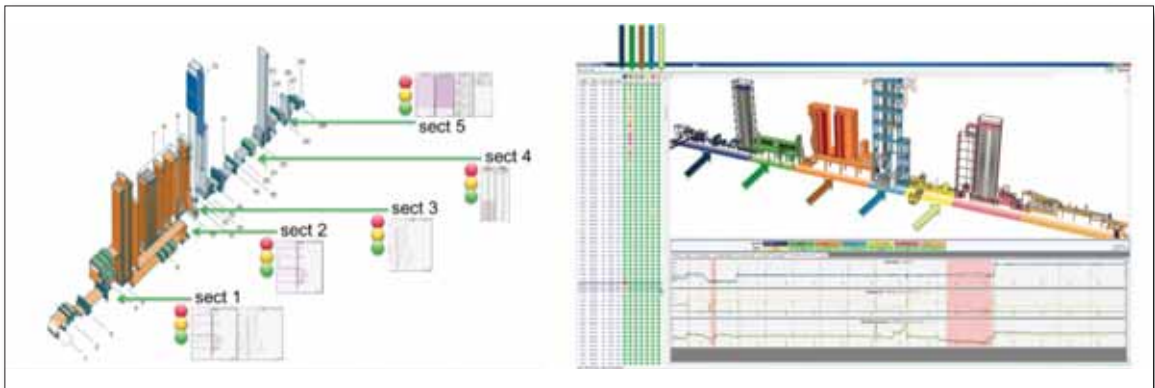
Fig 2 Deviations colour-coded in the respective section



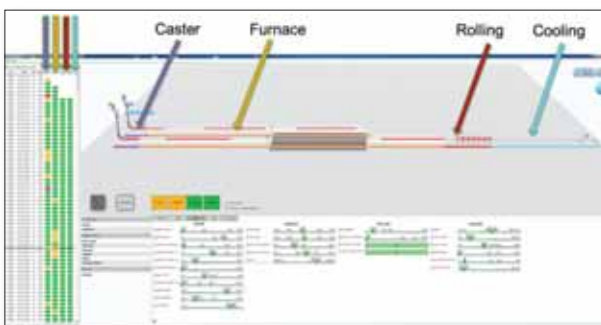
Ⓐ Fig 3 Any deviation will be flagged rule based in the respective section



Ⓐ Fig 4 Quality warnings displayed within the normal production screens



Ⓐ Fig 5 Example of five sections in a galvanizing line



Ⓐ Fig 6 Example of four sections in a CSP line

the expert advice which is displayed together with the red alarm. A yellow warning can be seen as an early sign that a process value is moving towards a limit and should motivate staff to check whether corrective action is needed. Warnings pop up also directly in the production graphics as illustrated in Figure 4.

EASY OPERATION

To make it easier to work in complex production lines with several hundred variables, it makes sense to split a production line into several sections. For a galvanising line it could be five to seven sections, such as entry, cleaning, furnace, coating, temper, chemical treatment and exit section (see Figure 5). For a Pickle Tandem cold rolling mill (PLTCM) it could be nine sections. The PPS system allows any split which makes most sense to a customer's workflow.

Another example is using the PPS in whole process flow following the product from steelmaking to finished coil as illustrated in Figure 6.

PROCESS STEP TRACKING

To follow products in all consecutive production steps a genealogy system is used, taking care of tracking the product in each step and creating reference of all quality related variables throughout the process. This is illustrated in Figure 7.

The objective of a genealogy model is to get seamless access to upstream data for a piece of metal and which reflects all intermediate changes to the material, eg, rolling, cutting, slitting, welding, orientation changes via coiling or line-coupling.

All the data needed to understand which line contributed to a possible deviation can be derived by looking up the final product. For instance, surface data can allow customers to track defects from slab to finished coil and to learn which defects disappear during rolling and which ones get worse. This is very valuable as it allows early sorting of some products or rerouting based on clear know-how, not guesswork.

BEST PRACTICE ADVICE

Supporting documents should be available anytime whenever they are needed. PPS allows linking of all documents, including images, PDF files, video and audio files by drag and drop (see Figure 8).

Supporting videos are a very effective tool for instruction or transferring know-how. It is not necessary to always use professional videos from suppliers. It is the content that is important so a smartphone camera is often enough and a very helpful video can be produced and embedded in the system in a few minutes (see Figure 9).

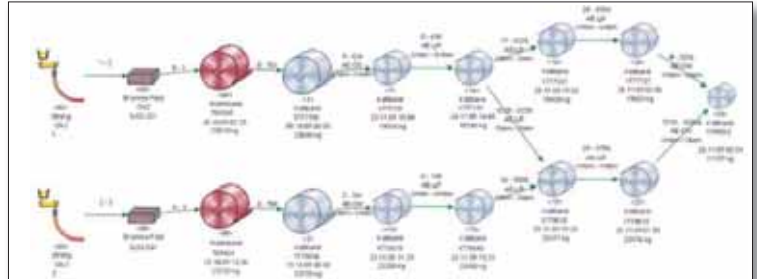


Fig 7 Genealogy approach

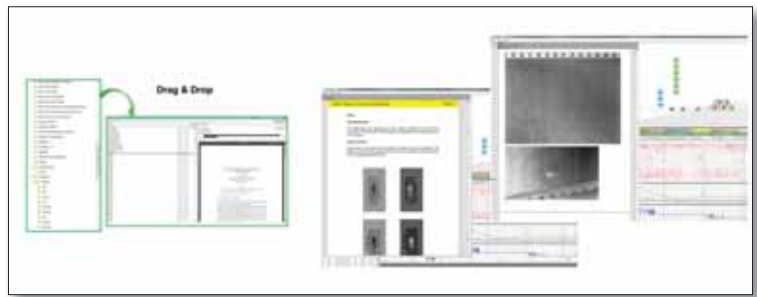


Fig 8 Any documents are available by drag & drop at the point of interest

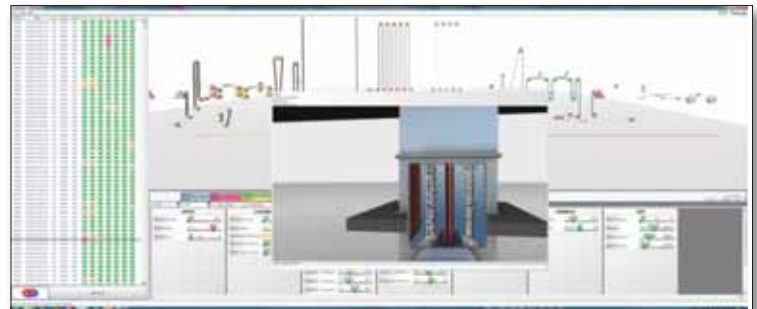


Fig 9 Videos for instruction or maintenance will pop up to support immediate action



Fig 10 Expert Advice is continuously improved by experts and reported in monthly statistics

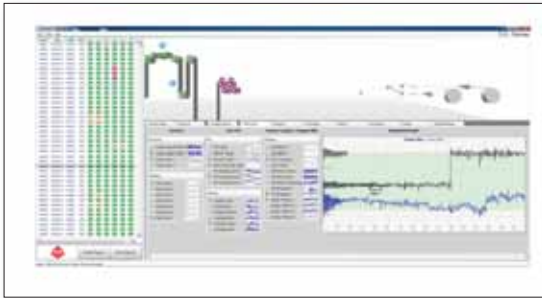


Fig 11 Select variables to configure your personal screen



Fig 12 Select variables and configure your rules

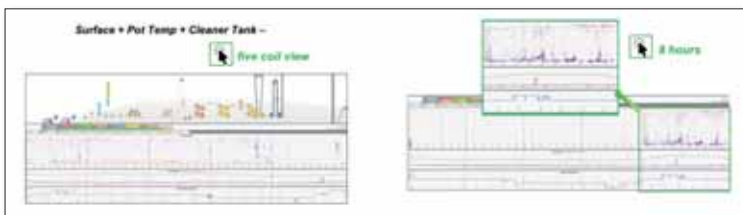


Fig 13 Select number or time period of coils to be stitched to each other

To close the loop for all advice and support information feedback is generated by the operators, as illustrated in *Figure 10* (left-hand box). This allows experts to continuously improve their advice and make it as efficient as possible.

To get an overview of all the improvements, a monthly report is created automatically for all actions taken, reflecting the value of the advices used in the system (see *Figure 10* right-hand side). Besides the continuous improvement, this is also a very good motivation for all involved experts to maintain the system to the highest standards possible.

CONFIGURING THE SCREEN AND RULES

Last but not least, the system provides a very flexible tool that allows process experts to configure the process parameters as shown on their screens to suit their own needs, eg, just by check marking, the variables can be selected and displayed side by side as shown in *Figure 11*. It can also include maps, eg, surface or temperature maps.

Configuration of rules is also easy and can be done by drag & drop (see *Figure 12*). A variable selected is moved to the rule template and the rule is filled in. It can be used for any purpose, eg, checking thresholds or supervising process conditions, maintenance cycles or any other process-related data.

DISPLAY FLEXIBILITY

As well as displaying, say, a single coil the system allows multiple coils, eg, five coils stitched to each other or even the whole shift or day in one row to be displayed, as illustrated in *Figure 13*.

Trend developments over several coils are very easy to detect and take corresponding actions so as to avoid producing several coils with a deviation in quality.

CONCLUSIONS

While expert process engineers cannot be around 24/7, critical process decisions need to be made all the time, including during night shifts or at the weekend. Applying QuinLogic's latest software technology will support a smooth process flow and constant high quality, which is needed in highly competitive steel markets, especially for automotive grades. **MS**

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