EXPERT 5i – SOFTWARE SOLUTIONS FOR MORE STEEL PRODUCTION EFFICIENCY[1]

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Abstract

High quality demands present additional challenges in the current market situation. Automatic surface inspection systems already help by monitoring and documenting defects throughout the individual coil processing steps. But that is not sufficient to optimize production. Being able to make fast, objective, economic decisions for each production stage is necessary to ensure yield optimization. Intelligent decision making requires access to all relevant information and its analysis. The Enterprise PROduction Management Intelligence – EPROMI – utilizes all relevant production data at each stage of the steel making process in a synchronized and integrated way. By implementing the software architecture, each processing step can be analyzed. One or more EXPERT5i applications can reside within EPROMI. These modules help find the right answers to many questions concerning yield and process optimization. For decision-making, the modules access, analyze and weigh all production-relevant data according to specific criteria and then generate knowledge based suggestions for decision makers. EXPERT5i modules provide a complete analysis of each production step. Their integration into the EPROMI quality database enables overviews of both local and global processes. Furthermore, a comparison becomes possible between the company's production data sets throughout the world. The conclusion: the EXPERT5i modules provide objective and optimal decision support. By using the modules, increased productivity is possible – quality becomes plannable, processes and production are systematically optimized.

Key words: Surface inspection system; Process; Production; Decision.

EXPERT 5i – SOLUÇÕES DE SOFTWARE PARA MAIOR EFICIÊNCIA NA PRODUÇÃO DO AÇO

Abstract

A necessidade de produtos de alta qualidade apresenta desafios na atual situação de mercado. Sistemas de Inspeção de Superfície já ajudam pelo monitoramento e documentação dos defeitos durante os passos individuais de produção da bobina. Mas isto não é suficiente para otimizar a produção. Faz-se necessário ser capaz de tomar decisões rápidas, objtivas e economicas para cada estágio da produção para garantir a otimização da produção. Tomadas de decisão de forma inteligente requer acesso a todas as informações relevantes e suas análises. O aplicativo "Enterprise PROduction Management Intelligence" – EPROMI – utiliza todos os dados relevantes da produção em cada estágio do processo de fabricação do aço de uma forma sincronizada e integrada. Pela implementação desta arquitetura de software cada passo do processo pode ser analisada. Um ou mais aplicativos EXPERT5i pode ser integrado no EPROMI. Estes módulos auxiliam a achar a correta resposta as muitas questões envolvendo a produção e a otimização dos processos. Para a tomada de decisão, os módulos acessam, analisam e pesam todas as informações relevantes dos dados da produção de acordo com critérios específicos gerando, então, sugestões baseadas no conhecimento para os tomadores de decisão. Os módulos EXPERT5i fornecem uma análise complete de cada etapa de produção. A sua integração no banco de dados de qualidade do EPROMI permite uma visão tanto local como global dos processos. Além disso, é possível comparar dados de várias linhas e de diferentes plantas de produção. Conclusão: os módulos EXPERT5i fornecem suporte a decisão de forma objetiva e otimizada. Pelo uso dos módulos é possível aumentar a produtividade – a qualidade se torna planejável, desta forma os processos e a produção são sistematicamente otimizados.

Palavras-chave: Sistemas de inspeção de superfície; Processo; Produção; Decisão.

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Introduction

The concept of ISRA Parsytec Software Solutions for more Steel Production Efficiency is based on the state-of-the-art surface classification technology of the Parsytec Surface Inspection System and in the EPROMI software architecture. The Enterprise PROduction Management Intelligence architecture, where resides one or more EXPERT 5i modules, connects inspection, product and process parameters databases bringing all the available information together and combining them in different ways in the EPROMI quality database. According to user specific guidelines or rules, it generates knowledge-based suggestions for decision-makers. Combining all the relevant information it is possible to increase the steel production efficiency by optimizing the processes.

State-of-the-Art Surface Inspection Solutions

A Surface Inspection System (SIS) detects and classifies all kinds of surface defects which affect the quality of the manufactured product. In general, a surface inspection system scans the complete surface of a coil using camera based sensors. The SIS identifies and classifies all relevant surface defects by processing the images and providing a great variety of different information in different forms. The accurate classification is the basis for quality yield management. The state-of-the-art ISRA Parsytec's intelligent classification technology allows naming defect class according to the metal producers' conventions. In the daily decision making processes, defects are checked by appearance, judged by experience, and subsequently appropriate conclusions and measures are taken. SIS ISRA Parsytec technology supports exactly this process in order to become accepted part in the decision loop. Of course, the source for each kind of classification is the detection of non-perfect areas on the strip. Such appearances on the strip are then described by their characteristics. Based on these features, different defect classes can be distinguished by establishing appropriate classification rules. More features imply on a more precise description of a defect and thus better classification resulting in more specific and reliable results. ISRA Parsytec classification software calculates more than 800 features for any of the selected images and additionally employs metal producers' expert knowledge for achieving the best inspection results. By this, surface inspection generates appropriate information for value chain optimizations.

EPROMI Architecture

Considering that the amount of data produced by a typical Hot Rolling Mill Inspection System is around 14GB/day of surface data, Figure 1. The quality and process data, like temperature profile, thickness profile, waviness, material properties, etc., generate another 14GB/day of information, Figure 2. In order to process all the relevant information into decision on all corporate level it is necessary an intelligent quality management software tool, the EPROMI.
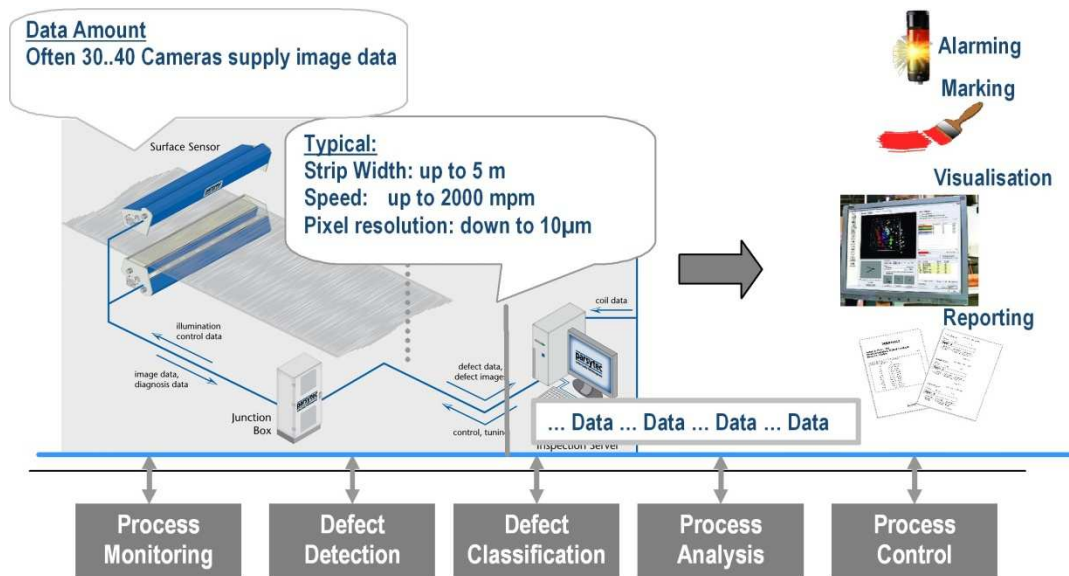
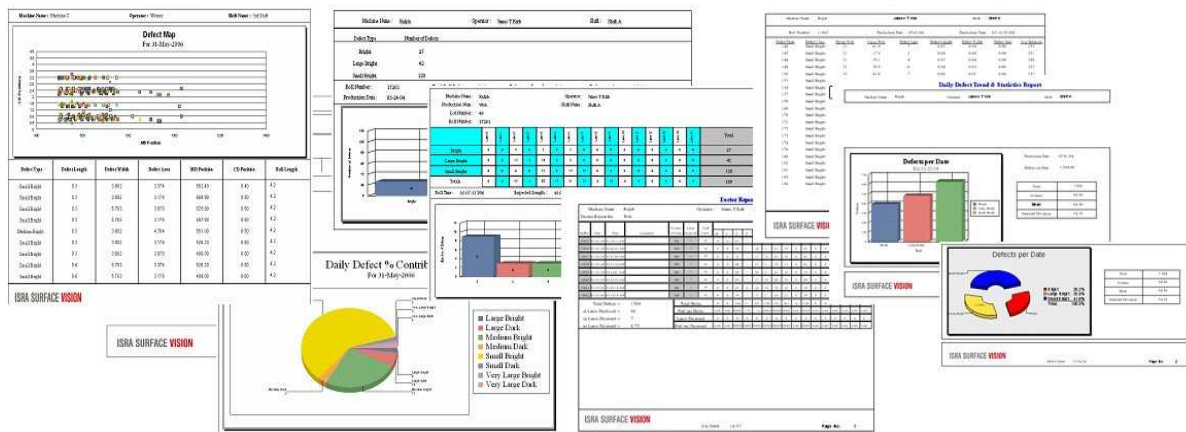**Figure 1** – Data generated by a Surface Inspection System.

Figure 2 – Generation of Decision Support Data.

The EPROMI is the architecture of a system capable of making fast, objective and economic decisions for each production stage to ensure yield optimization, Figure 3. Intelligent decision making requires access to all relevant information and analysis as fast as possible. The EPROMI utilizes all relevant production data at each stage of the steel making process, from slab to finishing in a synchronized and integrated form. The EPROMI database connects to the inspection system, product and process parameters databases bringing all the available information together and combining it in different ways to generate useful information. The overall quality is tracked by having all the relevant data synchronized by time and coil location, providing consistent information to understand and improve the process and production.
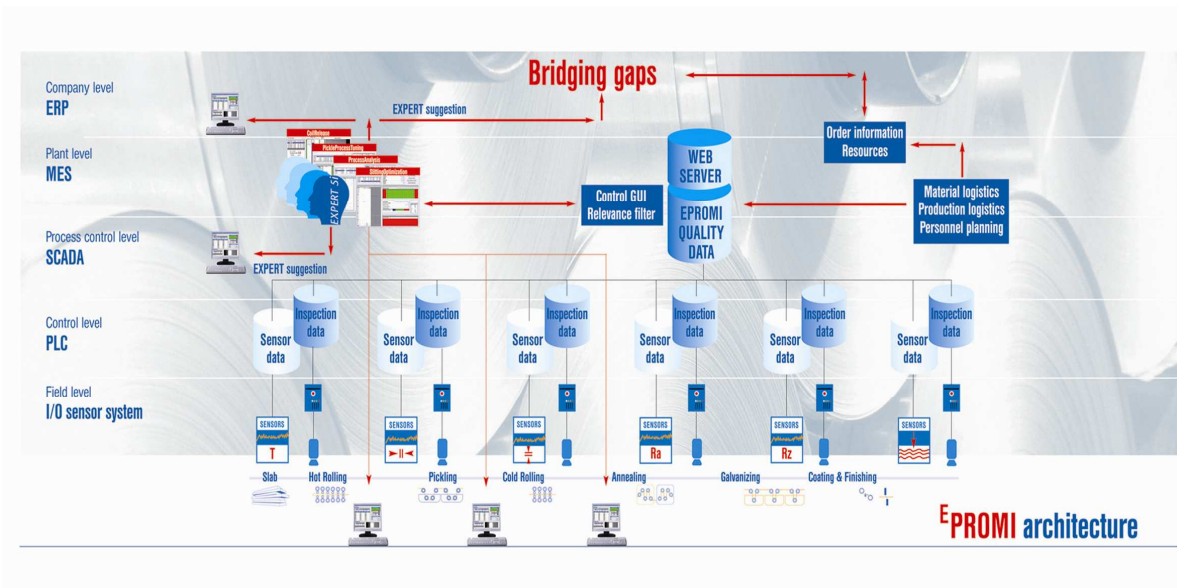
Figure 3 – Epromi: The Quality Management Architecture.

EXPERT 5i Modules

To make a decision, the EXPERT 5i modules access all the available production relevant data of the product (surface, thickness, width, flatness, etc.) via the standardize EPROMI quality database. Within the EPROMI architecture it is possible to install more than one EXPERT 5i module that analyze and weight the information collected in the EPROMI quality database. The EXPERT 5i modules quickly help find the right answers to the many questions concerning to flat steel production yield and process optimization. There are available 14 Expert 5i modules for different tasks along the various production lines, Figure 4. With these modules the steel producers can continually improve their quality management and with that, their lead in the market. To make a decision, the modules access all the available production and resource and planning data, as well as information about material logistics and personnel planning from the MES and ERP systems.
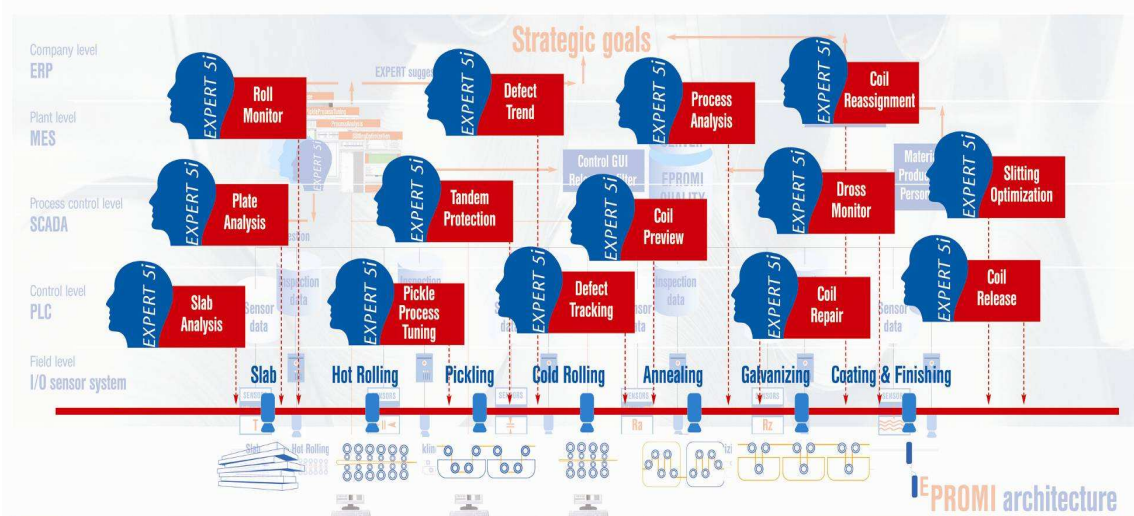

Figure 4 - EXPERT5i Quality Software Modules in the EPROMI Architecture.

The modules are design for each step of the production process, Figure 5 and 6, and they are:

- **SlabAnalysis** shows areas of the slab suspected of defects and allows an interactive defect analysis. Results are precise repair instructions and a simplified release decision.
- **PlateAnalysis** indicates defective areas of the plate surface, promotes targeted repair and release decisions and increases throughput while decreasing repair costs.
- **RollMonitor** evaluates and provides a visual image of the severity and cause of periodic roll marks. If several rolling stands are involved, the stand that causes the defect is identified. Timely roll changes help prevent defective coils.
- **PickleProcessTuning** generates suggestions for an optimal pickling speed, provides a visualization of the degree of scaling and the temperature of the coil from the previous hot rolling process, thereby optimizing the throughput while reducing over pickling and residual scale.
- **TandemProtection** alerts the mill operator of specific defects (defect image, location and type) that could cause a coil break and damage to the cold rolling mill and makes suggestions to avoid this type of serious process incident.
- **DefectTrend** shows synchronized long term trend data of relevant process variables spanning multiple coils. Process variables affecting coil quality can be easily isolated and improved.
- **DefectTracking** isolates the origin and cause of defects and tracks the defects through the entire production process. Defect causes are quickly resolved, reducing scrap while optimizing repair decisions.
- **CoilPreview** shows defects from one or several previous production processes, issues warnings and reduces processing defective material, repairs and downtime. The throughput is optimized.
- **ProcessAnalysis** provides a visual correlation of process parameters with the resulting surface quality, offering concrete analysis of the cause of the defects. Process defects can then be quickly identified.
- **CoilRepair** evaluates the quality of repair measures that have been taken and frequently prevents the downgrading of coils. The advantage: Improved material utilization and higher profit.
- **DrossMonitor** warns of increased density of dross defects. Result: Process optimization in the galvanization area and avoidance of inferior quality.
- **CoilReassignment** reassigns blocked material to different customer orders with matching requirements, thereby ensuring improved material utilization and higher profit.
- **SlittingOptimization** uses the surface quality data and flexible quality rules to optimize the slitting plan to achieve the highest yield.
- **CoilRelease** provides a quality analysis of the coils and issues a release suggestion for the next process or for the end customer.
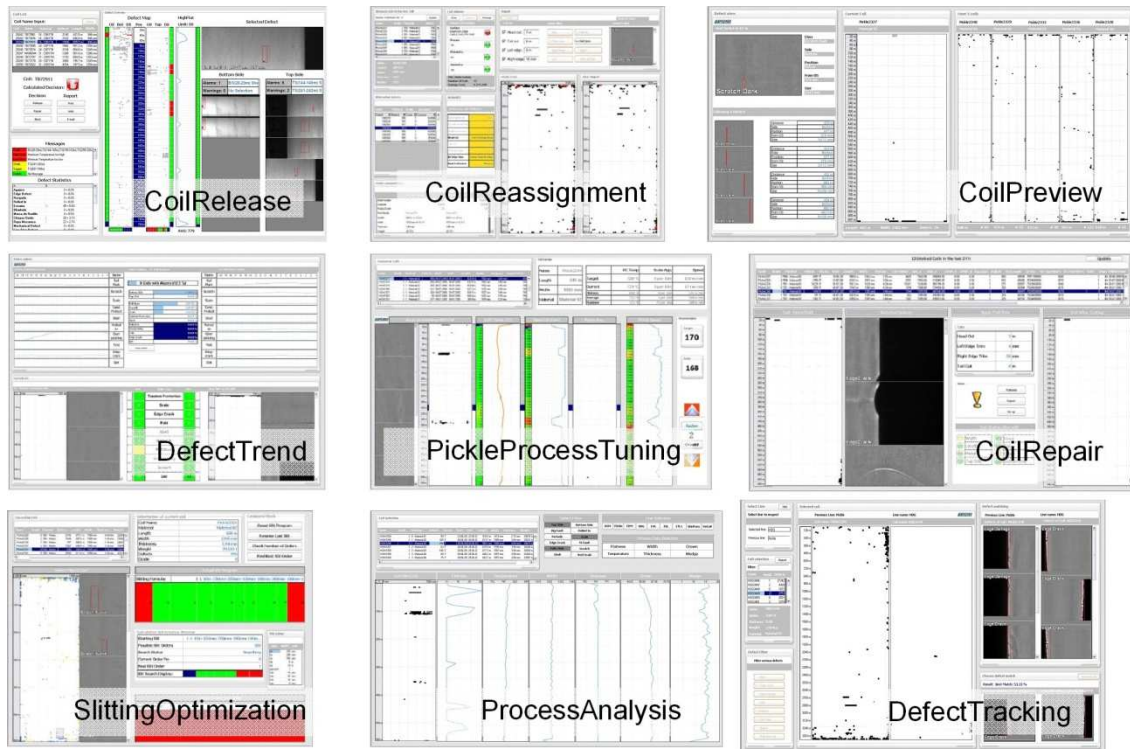
Figure 5 – EXPERT 5i Modules.

Figure 6 – EXPERT 5i solution matrix.

Optimizing the Use of the Data for Fast, Reliable and Profitable Decision

The amount of data generated by the enterprise production is huge, Figure 7. Only with the use of appropriated tools it is possible to compile all the information in a fast and reliable way to have information about production and process in order to make intelligent decisions.
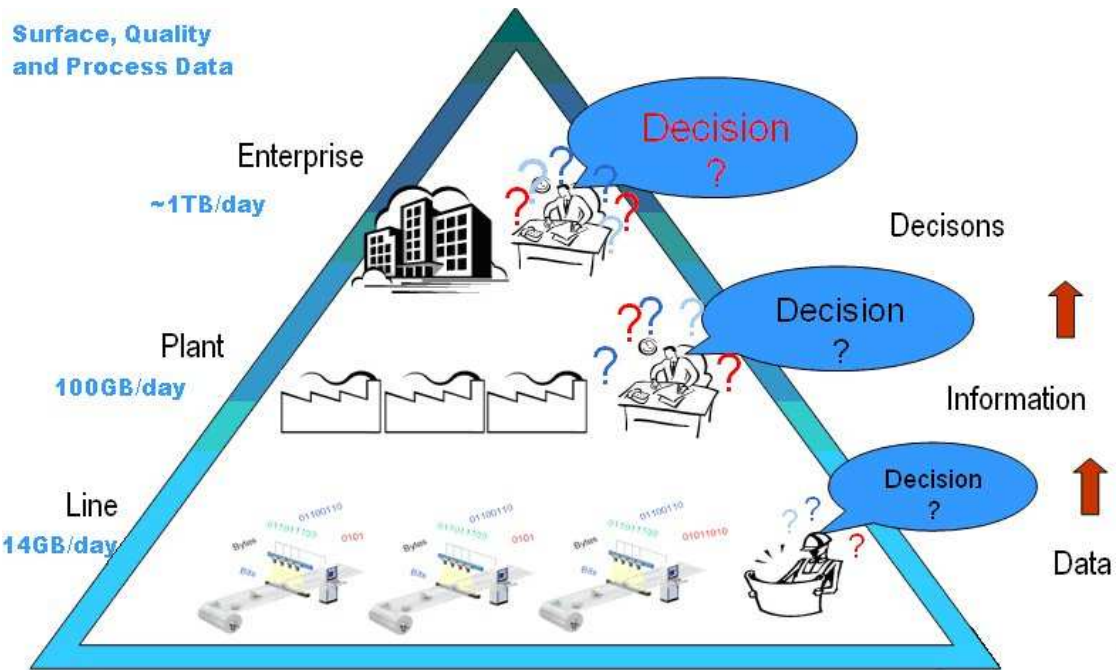
Figure 7 – Quality Data in an Enterprise: From Data to Decisions.

The Enterprise PROduction Management Intelligence architecture with its EXPERT 5i modules is the tool to achieve these goals. A solution that takes into account thousands of details and data points and reduces them to answers to any coil quality concerns Quality then becomes planned, coil processing and production become efficient and huge savings are materialized, achieving higher quality, productivity increase and processes improvements. The system is the ideal tool for corporate evaluation as benchmarking line productivity, corporate quality data access, productivity site monitoring, evaluation of the process chain efficiency and productivity analysis per customers, for example.

The EPROMI architecture is unique due to its comprehensive approach to process variables, coil surface quality, and MES and ERP integration. The industry standard ISRA PARSYTEC surface inspection and defect classification, combined with EPROMI delivers an unparalleled quality management framework encompassing all critical production data – from temperature sensor data up to resource and order planning, is an incredibly powerful approach to improving profitability.

Conclusion

Surface defects make surface inspection indispensable. The Surface Inspection System enables the detection of surface defects and thereby gives the possibility to repair defects where possible or to eliminate their causes. The system contributes to the enhancement of the produced material by reducing downtimes due to fewer coil breaks, by producing less scrap and finally by gaining high-quality steel products. But only the surface inspection system data is not sufficient to optimize the process and production. Intelligent decision making requires access to all relevant information and its fast and objective analysis. The EPROMI architecture within one or more EXPERT 5i applications finds the right answers for the decision-makers.