2009 Ninth International Conference on Intelligent Systems Design and Applications

Intelligent reporting system with e-training capabilities

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Abstract

In high technological complexity industrial systems, the operators' role is more and more critical. They need deeper and deeper specialization and a continuous monitoring of both process and plant to achieve high efficiency and proper working. That requires a continuous training and upgrading of the operator knowledge to react promptly and properly to the different plant/process situation to manage.
Furthermore the process complexity, like in a steel plant, requires the workers at any level have a global vision of the various factory indicators (technical and economical) for a complete understanding of their role and the relationships with the other factory departments.
The paper describes an intelligent web-reporting system with e-training capabilities based on a new information management. The system is able to support workers in daily operational jobs by the availability of an updated knowledge base and to capitalize the Company know-how making it available at different professional levels.

1. Introduction

In industrial systems with high technological operational complexity, the role of operators is more and more critical. That is particularly true in steel industry, where production route of specialty steels (stainless steel and electrical steel) is very complex at each stage and needs a close control of each plant/process parameters to guarantee the required final product quality. Plant malfunction and mistakes in process management can lead to big economical losses, considering the high added value of the product.

Furthermore the complexity of process in a steel plant requires the workers, at any level, have a global vision [1], of the various factory indicators (technical, production, business, economical…) for a complete understanding of their role and the relationships with the other internal factory departments.
The above leads to consider a powerful tool the decision support system based on on-line reporting of main plant/process/product parameters and their intelligent elaboration.
Nevertheless, such systems also represent a mean for a continuous operator training as they contain updated plant/process/production knowledge in a form directly available.
The above leads to classify such systems, delivering knowledge, as a new technological distance education system (asynchronous e-learning) [2] [3].
The paper describes a new approach to the information management that combines on line reporting and training to support workers in daily operational jobs and, at the same time, to increase their expertise. Intelligent reporting and e-training tool have been implemented in a unique system based on a properly structured Knowledge Data Base (KDB).
The system is actually running at Thyssen Krupp plant in Terni.

2. System design

The whole system has been developed by integrating the e-training tool into an advanced reporting system following training-paths previously defined and stored in the KDB.
The system architecture is shown in Fig. 1

978-0-7695-3872-3/09 $26.00 © 2009 IEEE
DOI 10.1109/ISDA.2009.164

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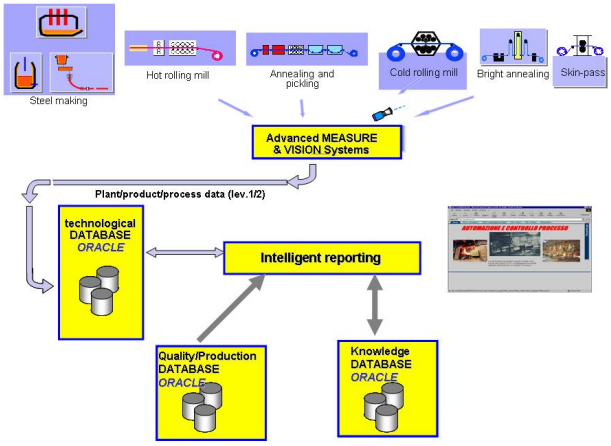

Fig.1 System architecture

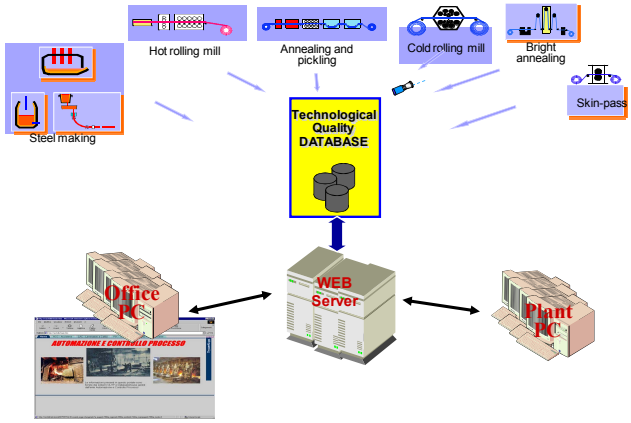

Fig.2 Architecture for advanced reporting

The plant is characterised by a high degree of automation allowing the availability of a huge quantity of information (technical data, business data, quality data …) coming from the different production area of the plant (Steel making, Hot rolling mill, Cold rolling mill, etc...) and opportunely stored in the technological and quality data bases.
A new data base has been introduced to store all the company knowledge that is now available for driven exploitations.
The intelligent reporting module implements the two main parts of the system:

- advanced reporting
- e-training tool.

2.1 Advanced reporting

The advanced reporting is based on a Client-Server architecture as shown in Fig.2
Technological and quality data are processed and delivered, through the Company network, in form of web-report on the Client dislocated in many offices of the plant.
Each final user, after the identification (username and password) can access the reports to which is interested.
The reports show the outputs of the data processing that involves different levels of elaboration, from the simplest ones to the sophisticated analysis based on the application of advanced statistical methodologies, according to the final user role.

By means of the standard web interface (Oracle portal), the users of each plant area can access to the system and explore the reports of their interest by choosing among the available options.
An example of the web interface for the advanced reporting is shown in Fig. 3

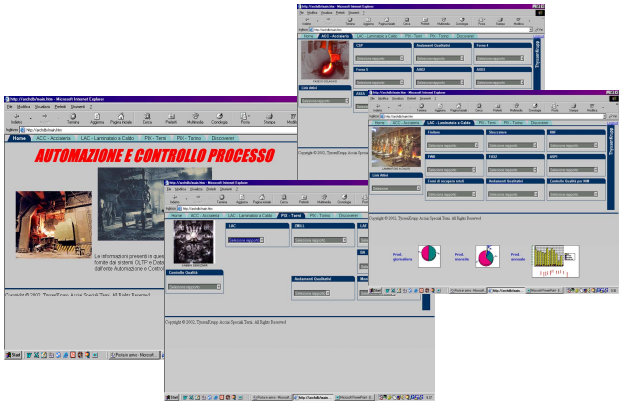

Fig.3 Web interface of the advanced reporting system

The next step has been to transform each single report in a means for training.
A part from the implemented methodology and the chosen technology, it is required a punctual definition of the system end-user typology (line operator, maintenance operator, quality operator, plant performance engineer etc..).
For each end-user the system makes available the information opportunely linked to the report under analysis.
According to the e-training approach, the information, when applicable, have been dressed with all the details necessary to convert the same information into knowledge.

2.2 Knowledge Data Base

Basic point of the system is the Knowledge Data Base (KDB) designed and realised in order to store, organise and re-use the company knowledge in form of "pills", that is grouped to be associated to a specific argument.
In general, the know-how is composed of the "book part" (txt/pdf file) and the "multimedia part" (gif, jpeg…).
A combination of some of the above files is associated to a concept, for instance "*zmill passline*", that is the knowledge relative to the geometrical plant parameters to be set at the beginning of rolling operation at the sendzimir plant .
The knowledge organization reflects this aspect; more precisely the data base is organised in different sections, one for each process/plant, where simple or complex reports/multimedia files are stored opportunely linked to the concept.
Un example of knowledge organization is shown in Fig.3 for the concept "*zmill passline*".

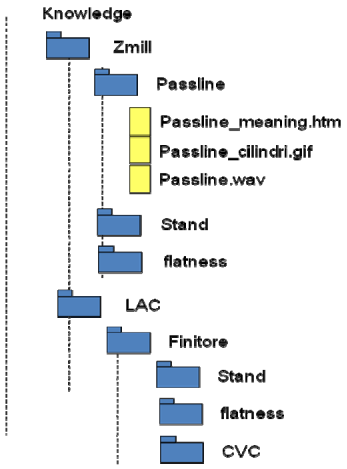

Fig.3 Knowledge organization for the concept "*zmill passline*"

The KDB has been implemented following the entity-relationships structure and using Oracle RDBMS.
Due to the complexity in populating of the KDB, a dedicate data-entry has been developed.
By means of a dedicate interface, authorized users are driven in inserting the documents by specifying the source and destination of each document to be stored.

2.3 e-Training tool

As said before, the basic idea of the approach is to "enrich" the users' daily job with tools able to increase their expertise at each level.
That means to transform a "static" report in a starting point to easily explore all the associated knowledge.
The selected report is displayed in a frame implemented as an HTML page where several areas have been defined for the activation of the e-training functionality, as shown in Fig. 4.

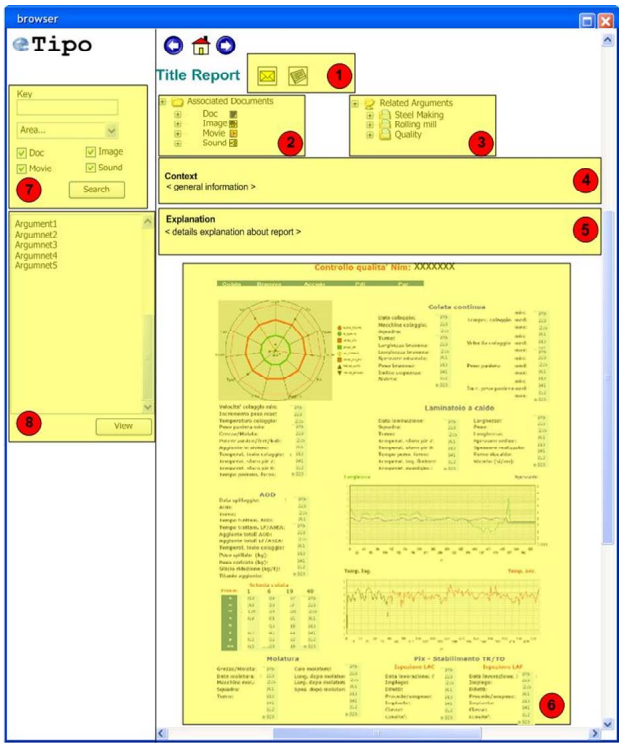

Fig.4 The HTML frame with the report (6, 4, 5) and the areas for e-training activation (1,2,3, ,7,8)

The report, indicated in Fig.4 by the icon number 6, is a section of the HTML page, while two other sections are reserved for a synthesis of the report contents and their explanation, especially in case of outcomes coming from complex elaboration (icon number 4 and 5);
The remaining sections are specialized for the different e-training functionalities. In particular the user can:

- to exploit the documents/files associated to the report (icon number 2);
- to select other reports of the same argument opportunely liked in a pre-defined training path (icon number 3);
- to send/receive a mail to/from process/plant experts (icon number 1);

- to solve test exercises and to send the results to the system administrator for a valuation of the acquired learning (icon number 1);
- to navigate the knowledge data base contents through word-keys and arguments (icon number 7 and 8).

Furthermore, inside the report , sensible areas have been defined for the knowledge exploitation directly from the report itself. An example of knowledge navigation, regarding the coil flatness, is shown in Fig. 5 e Fig. 6

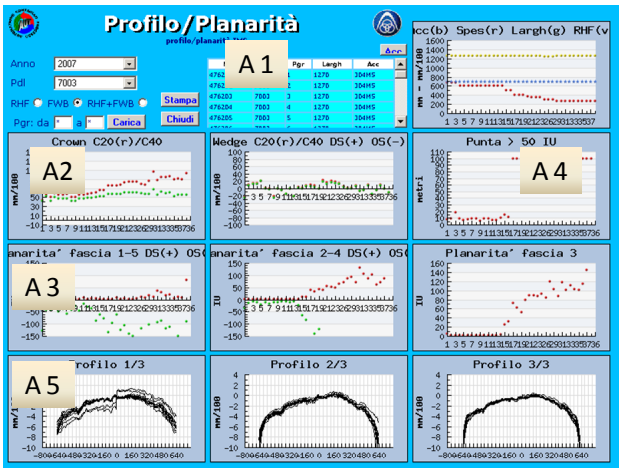

Fig.5 Coil flatness report with in evidence four sensible areas for the knowledge navigation

In the report, selected from the Oracle portal section "Hot rolling mill", each sensible area allows to display further information about the main geometric properties of a coil: crown, profile, etc..
As example, by a click on the sensible area "A2" the explanation on the meaning of such properties is displayed together with the formula to be used for calculation.

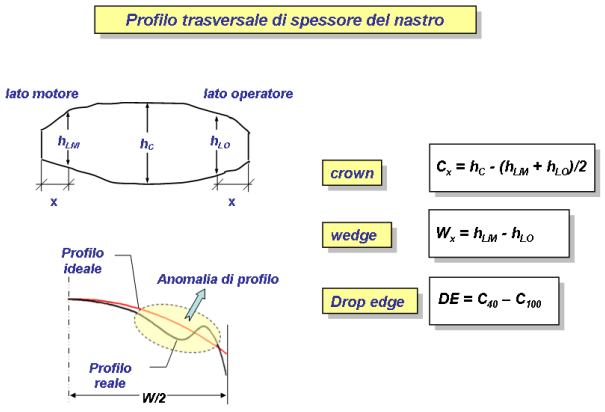

Fig.6 Explanation report associated to the sensible area "A2" of the coil flatness report

The main components for the implementation of the e-training functionality are:

- An interactive tool aiming to provide a feed-back on the user learning level;
- A search engine able for perform research in knowledge data base by means of word-key;
- A navigation system for the knowledge exploitation.

The interactive tool for the feed-back foresees the user can automatically send a mail to the system administrator and/or the technical references for explanations, investigations, suggestions, etc...
In such way, lots of information are collected and analyzed for the valuation both of the usage of the system and of the users' learning level.
The feed-back from users to system administrator is also important to acquire suggestions and indications for the method improvement and for the KDB updating.

3. Conclusions

In this paper an approach to continuous training has been presented.
It is based on the integration of the e-learning capabilities in an advanced technical reporting system.
The efficacy of the approach lies in making available the company knowledge to the daily job of each user, according to his professional skill and predefined training paths, by means of the structured KDB.
The feed-back from the users allows both the valuation of the method and the improvements and/or updating of the system that are mainly related to:

- KDB contents updating;
- elaboration of new reports;
- definition of new training paths.

The developed tool, classifiable as asynchronous e-learning system, can be considered also as an integration of the traditional learning, with the advantage to promote the self-learning, which can improve the effectiveness of training. Furthermore, in the case of newcomers, the simplified method of learning from experienced colleagues allows speeding up the training period.
On the other hand, considering the continuous updating of the tool in terms of new contents and features, the

success of the approach in the training strictly depends on the user initiative to improve his expertise/knowledge.

4. Acknowledgements

Work carried out with a financial grant from the European Coal and Steel Community under the contract RFSR-CT-2005-00047

5. References

[1] "European Steel Technology Platform – Vision 2030", 2004
[2] M.J. Rosenberg, "E-Learning: Strategies for Delivering Knowledge in The Digital Age", McGraw Hill, 2000
[3] B. Chapman, S. O. Hall "Comparative Analysis of Learning Content Management Systems", LCMS Report, 2004-2005