Implementation KMES Quality system for acquisition and processing data in chosen foundry

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Received 21.07.2008; accepted in revised form 23.07.2008

Abstract

In the paper, main assumptions, algorithms and functions of author’s KMES Quality system are discussed. Its working version is tested in chosen foundry by near 2 years. This system is applied to enlarge the use of chosen technological data accessible during foundry processes. The data can be introduced by means of keyboard directly in the fields (windows) present on the PC screen according to program commands, instead of report-manuscripts containing measured results, or from the automated measurement recording system by direct data import to KMES Quality system. In the paper, a way of technological data acquisition with their further integration into main foundry databases and their processing, with taking into consideration e.g. kind of casting assortment, current time, sequences of measurements, are presented. Also the capabilities of linking KMES Quality system with SAP R/3 system existing in this foundry useful to quality assurance is show.

Keywords: Assurance quality in foundry, Data mining, Statistical methods, Mould sands properties, Pouring temperature

1. Introduction

Under the end of the 90’s’ of XX century it was noticed the presence of information technologies in enterprises. Majority of enterprises is in possession of more and more larger quantities of data relating to the manufactured products and their parameters, and also the informations, which was necessary to register and then to explore. This makes possible on their analysis to enable the increase the quality of products or/reducing the production costs. On the other hand, the expectations of customers relating to quality of final product as well as service, forced the enterprises to introduce the more perfect technological solutions and also the suitable informatics systems. Many areas, in particular logistics communication, they began much more to require working system. Foundry is the specific field with the ages of technical-technological experiences and know-how based on knowledge. In this industry, there is a large quantity of data, not only technological-productive data but also the economical-financial this one’s, relating to quality and profitability of products. Lots of this data is often not submitted to direct measurements and registrations which would have quick relation with any measurable qualitative value. These values would be helpful to optimization of manufacturing processes and management of their course. The structurally complex computer systems in many companies are implemented. These elements of software cooperate from many databases but they serve mainly to service of non-directly productive areas e.g. financial-economical, sales, planning production etc. The historical data on which these systems base are helpful to creating of statistical correlations,
reports and balances. In this case it is difficult to say about usability in direct quality control. Helpful can be here dedicated solutions designed for individual areas of productive activity based on example on artificial intelligence systems [8].

In the paper it’s shown the foundations and main procedures of the author's KMES Quality system which the key task is making possible to undertake the more correct decisions based on the registered data. This solution is in chosen foundry the independent tool to the basic modules of SAP system and it's the promising substitute of QM module of SAP system [3].

Primarily the KMES Quality system was created in the aim of the acquisition and processing of green mould sand parameters applied to both automatic foundry moulding plant (automatic line A1 and A2) in chosen foundry. The first was the task to replace the existing data input as a form of manuscript with electronic aid. Further the system was broadened about transfer of data with melting plant department as well as in the algorithms are worked out. It was attempt that all or chosen results can be possible to show the use of graphs and after accomplishment of analysis – as reports. The data from individual departments after suitable conversion of formats of files (from registered data) can be accessible from the level of SAP R/3 system as coded ASCII sets [2] or any files accepted by SAP formats (XLS, DOC, DBF).

2. Meaning of data mining in process in creation of new knowledge

The main aim of KMES Quality system which are created and tested in real foundry conditions is effective data exploration. Nowadays this conception is connected with different qualifications such as for example logging some knowledge or the extraction of data called data mining. This is one of the main stages in new (often) knowledge discovering process (KDD – Knowledge Discovery in Database, search the knowledge in databases) [1] which is not always perceived in enterprises and which can contribute to considerable improvement of quality of products and can reduce level of defects in products. Today data recorded in companies exceed the abilities of classical analysis [5]. The exploration techniques are the relatively a new domain however they are based on grounded fields of science such as the statistic or a little bit younger – the machine learning in connected with artificial intelligence problems.

The notion data mining means the on-line or off-line exploration aided by computer [7]. The data mining tools are applied in points where a large quantity of structured and scattered data exists. Databases are the systematic of data and are can own different forms. System KMES Quality makes possible to use bases designed in Microsoft® Excel™. Spacious sometimes inaccessible directly for final user scattered data they can be the source of potential new knowledge. This knowledge should be extracted which is no easy task (which was confirmed during introducing the data from melting plant department to KMES Quality system). New knowledge of distinguished databases or as different structure of the data has the task to reduce considerable the time of analysis. In this aspect it was not possible before and considerable differ to expectations of users. Diagram of new knowledge getting is presented in Figure 1.

3. Foundation and structure of exploration data system

KMES Quality system exists in two versions:
- KMES Quality DW – lets the possibility of recording only input data to further analysis (the parameters of green mould sand); example as the record of parameters represents Fig.2, on which is the main and auxiliary parameters of green sand with them full identification (day and hour of measurement, his number, classification corresponded to casts group, name/symbol, productive line etc.) are marked,
- The KMES Quality FULL makes possible the full parametrical analysis regarding to information from others databases (including registration of results like DW version).

In the system the identification of the workers was foreseen. Worker has own login and password and also diversified authorizations on three levels [8]:
- low – Przeg (monitoring and data analysis),
- averages – Przeg / Dop / Zm (monitoring and data analysis / data adding / data edition),
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high – Przeg / Dop / Zm / Konf (monitoring and data analysis / data adding / data edition / administration).

Every try of interference in system working e.g. introducing the "smoothing" corrections of parameters and additional information into databases is automatically recorded and accessible in any moment for administrator of system.

The highest authorizations possess the authors of the system. In five production module are foreseen:
- the input mould data – recording of measured parameters of green sand with the use of typical technological instructions methods,
- the analysis Wx – analysis of green sand parameters from Wx department, manually introduced,
- the analysis Wy – analysis of liquid iron pouring parameters from Wy department, automatically introduced,
- the analysis Wx-Wy – comparative parameters analysis from Wx and Wy,
- the summary reports (Wx-Wy) – the final reports of summary parameters

and four help modules:
- log in – service of the users' login,
- the setting – control of system, user’s service, import/export of databases, creating new databases etc.,
- instructions – all instructions applied on Wx department in electronic form,
- help – context help for user.

The main tasks the KMES Quality are:
- reporting of recorded parameters attributed to processes,
- generating of statistical graphs and the SPC graph (statistical process control) with the use of the Shewhart cards, dynamically as cumulative sum cards,
- preparation of conversion of information mentioned above with matching to SAP R/3 system,
- facilitation of analyse of recorded parameters changeability, utilization of system during identification of foundry defects for quality control needs.

The modules of KMES Quality system provide transparent and readable for user graphic interface (eng. Graphical Unit Interface, GUI). The example of print screen of KMES Quality, Analysis Wx, shown in Fig.3.

Data can be analysed according to three criterions: year, day or/and user’s range. Electronic records from one day can be presented the most detailed. Not only possibility of combination of the graphs of several parameters simultaneously exists but also distinction of optional assortment and presentation on the graph according to number of measurement or according to time pouring casting process. In the case of positive research finding in database of indicated assortment the message is displayed (Fig.4).

The illustration of one-day data analysis manner is shown in Fig.5.

So it exists the possibility of the combination of graph of the additional separate parameters concerning e.g. influence of humidity of green sand on degree of its compactibility. Additionally the system makes possible to put the filters which limit the quantity presented data, change the type of graph (e.g. pointed graph), displaying of the data in time-relate configuration and addition of graphs to taking down to pair. It consists in combination of two graphs for different data e.g. the optional of green sand parameters with alloy pouring and influence of humidity mould sand on time of pouring.

In fig.6 it was introduced the juxtaposition of all the parameters of green sand on one chart (the possibility exists to add or remove the graphs which represents individual parameters).

The variation of green sand and cast iron parameters taken down in temporary graphs lets the possibility of quick statistical analysis and e.g. to verify in which month the value of individual parameters of green sand and cast iron were deviated from accepted foundations (the upper and bottom line of tolerance, according to the technological cards). The example of such analysis was shown in Fig.7. In the graph the W parameter (humidity of green sand), is correlated with T parameter (the temperature of poured liquid cast iron).
Fig. 5. The example of analysis of green sand properties of humidity parameter (W) in function of measurement number.

Fig. 6. The comparison of variation of main green sand parameters (for 21 tests).

Fig. 7. Comparison of green sand parameters (from Wx department) and the pouring cast iron (from Wy department) – synchronizing according to time (RTO system to data exploration [1]).

The parameters of liquid cast iron are correlated in Fig.7. The temperatures of cast iron are recorded in Btrieve base in pouring period (two-colours-pyrometers). The pyrometer, during pouring process, records 8 values where 2 extreme are thrown away (out) and from 6 remaining are recorded in the base Btrieve are calculated average making up final result. Data can be in any moment transferred on-line to KMES Quality system. The sample of mould sand to control and realization of measuring operations including registration of parameters in KMES Quality system, last about 15 minutes. It was possible to infer that the sample of mould was probably taken at the moment of standstill of the automatic moulding plant A2 (15 minutes before registration of first sand portion that about 14:42 – look in Fig.7). In this period it can be already poured other assortment.

4. Towards to the integration with SAP R/3

The measured technological parameters of green sand and temporary-thermal parameters of stream of liquid cast iron are
registered with the use of KMES Quality system. They are the important part and parcel of casts quality control. The KMES Quality system makes possible the integration of this data with SAP R/3 system. These results can be exported to system SAP R/3 by the especially formatted sets of results (the system can to receive files like XLS or TXT).

Moreover the KMES Quality system makes possible the import of different data which come from external sources of information and also their export to SAP R/3 system. That is the next step in developing SAP R/3 application in foundries. Improved conception of use should depend on structural collection of assembled data, much more wider and better. Further processing and data usage by different systems depend on type, quality and quantity of these data. The example of data export (for example TXT files) is shown in Fig. 8.

Fig. 8. The proposed form of data export files from KMES Quality system to SAP R/3 system with using of ASCII code (it is possible to generate data as *.txt files form also their coding)

The presented system is continuously completed about additional modules (now during conceptional phase):

- information from spectrometer laboratory (chemical analyse),
- the mechanical characteristics of cast iron samples (poured separately or/and as cast-on test bar),
- the information about quality of castings (the identified and named defects), regarding the sequence of series of castings realized on automatic plants.

At last all informations should be accessible in SAP R/3 system as one database (conception of modified structure base is necessary) according to relation model or objective model [6].

The comprehensible diagram of connections of the explored data with SAP system is presented in Fig. 9.

5. Summary

The presented KMES Quality system makes possible not only visualization of parameters variations during mass castings production but that what is essential in data analysis which coming from different departments – the synchronizing different parameter values in real time. This makes possible on the fast access to current or/and historical data for any assortment of cast product or for any component of production process (parameters of green sand, liquid cast iron, spectrometer data etc.).

In chosen foundry it was curried out many technical consultations aiding progress of work implementation of KMES Quality system. These actions confirmed right of initial foundations in data mining structure adapted to this foundry. It was proposed in order to enlarge the record frequency of some values of green sand parameters in mould sand laboratory. First effects are already well known – additional parameters of green sand i.e. tension strength, content the montmorillonite-clay, permeability of sand and his erosion-resistance are recorded (still in manuscript) more often.

The system implemented in Foundry, it is the first attempt to database creation, which the aim includes the data acquisition of parameters not recorded earlier in SAP R/3 system, at most only e.g. the schedule and type structure of quantity of foundry defects, results of sale, state of warehouse stocks. In the classical modules of SAP R/3 system the correlation of mentioned in this paper production data and creating of statistical graphs is not possible while the skilful and professional analysis of data using KMES Quality system can reduce considerably the defects level.

It’s intended to include all parameters recorded in KMES Quality system to SAP R/3 database which can to serve in future as interchangeable module, expensive and not adapted to needs of foundrymen QM module (Quality Management) proposed by firms introducing the universal SAP system to different branches of industry and economy.

The KMES Quality system is promising way allowing to obtain better results in quality assurance in foundries.
References


