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INFORMATION SYSTEM FOR MANUFACTURING EQUIPMENT DIAGNOSTICS

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Abstract: *The information system for assisting the manufacturing equipment diagnostics and repair based on the pictorial nested structure equipment model has been designed and experimentally tested. It is an open system with gradual structure refining and expanding possibility. Pictorial model can be supplemented with relevant data in form of documents, situation pictures, remarks and other data objects according to the experience gained from equipment operation and problem diagnostics procedures. That information system can be shared among authorized and registered users related somehow to the equipment concerned because it is designed as an application based on internet technologies and client/server structure.*
Key words: *equipment diagnostics, service information system, pictorial object, nested hierarchy*

1. INTRODUCTION

Without exaggeration, it is possible to link any equipment repair procedure success and its efficiency with the machine failure diagnostic analyse. There is a wide choice of diagnostic methods and routines for testing electronic circuits and components, mechanic, pneumatic and other in principle related systems. The real solution of diagnostic problems is mostly facing a complex mixture of electronic, optic, mechanic, pneumatic and other different modules in the equipment design influencing its proper function. There is necessary to evaluate a relative large data amount, especially of design character, for the sake of successful and accurate diagnostics (Hu et al., 2003). The original equipment data is to be found in the equipment technical documentation, like user and maintenance manual, basic troubleshooting manual, and in exceptional cases, there is an overview drawings and schematics documentation at disposal for the new equipment. The service support staff for the specific equipment is trained either in frames of the equipment producer organisational structure or by the authorized representative company. Despite the training quality and its comprehensive content, such training can never cover all design details, and above all, information gained in such intensive way is deteriorated by forgetting process, and by lack of concentration due to excessive training pace and various sort of information quantity. On the other side, the diagnostic experience provides precious knowledge gradually, but there is necessary to record them systematically for the future use in case of same or similar problem. Piece of knowledge important for efficient diagnostics can be derived from equipment operation circumstances, as well (Koo et al., 1999). These circumstances differ at different users according to operator qualification level, working load in batch or continuous operation mode, technological discipline, preventive maintenance standard etc. Therefore, it seems to be very wise to build the existing static data represented by the technical documentation in the dynamic information system with the capability to declassify transparently current data and their continuous extension and modification according to the diagnostic and operation experience integration (Simsion, 2007).

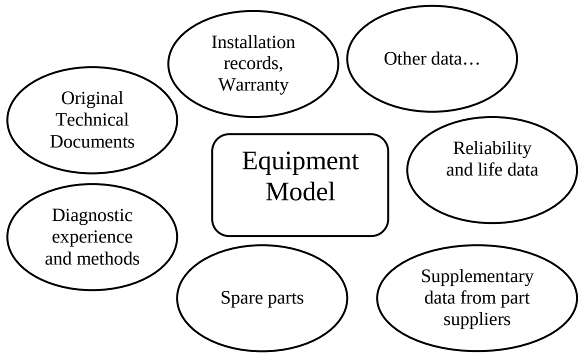

Fig. 1. Data object variants for an equipment model

2. INFORMATION SYSTEM PHILOSOPHY

The concept of information system has to respect the fact that there are people of different profession, qualification and technological experience level cooperating in the organisational system of equipment operation, maintenance, setting and repair. Among these people, we can find not only experts with detailed knowledge of equipment function and design being able to perform diagnostic and repair action in case of failure. There are also other people executing equipment operation, technological management, spare parts procurement and others. All participants are interrelated with the communication space possessing relevant technical terminology and data. This space should serve for unambiguous understanding of transferred instigations. Such instigation could be either the equipment functional failure description for a service intervention, or a spare part to be ordered description. The communication demands are further increased due to the organisational segmentation of involved people. They could represent a few not interrelated subjects. One of the participating subjects is, of course, the manufacturer of equipment concerned who provides the relevant user documentation and possibly the service documentation at the equipment delivery and installation. He is usually the spare parts supplier in course of equipment life period. The other subject is the equipment owner who is interested in trouble-free operation, and also in return on investment. The communication space is also very frequently shared by a third subject whom is the company representing the equipment manufacturer in the area of equipment users. That company mostly guarantees not only sales transactions, but also warranty and out-of-warranty repairs.

The above mentioned brief situation analyse yields a certain idea about requirements on such information system concept ensuring the simple accessibility of data and fault free communication among participating subjects.

Our goal was not to design an all-purpose “omniscient” system containing all possible data including company data. We have aimed our effort at the technical side of keeping certain equipment operable, and create an equipment oriented information system for a servicing company (Teorey et al., 2006). Such system should be accessible for all subjects mentioned above.

The default object in our information system is particular equipment, and its pictorial model enabling the hierarchical branching from the general composition down to function modules and to basic parts. The pictorial model respects equipment design and composition through the hierarchical nesting of various levels pictorial representation. Those representations start at the main level what is the relevant equipment view (front, back, left side, right side), and continue through sensitive picture areas down to individual parts. The pictorial representation of the equipment model has been chosen as a crucial communication element with the respect to potential users having different levels of technical knowledge. Each pictorial element on any complexity level can be accomplished with further data, for example in text form in different usual formats, or perhaps supplementary pictures and video sequences. The pictorial object representation is much more comprehensible and in a way independent on the knowledge of expert terminology, foreign language or the equipment itself. The advantages come out primarily during failure situation solving when the service engineer receives (mainly via phone) the first information about problem occurrence and its symptoms with approximate location. Both participants can use the internet browser to look at the equipment in relevant areas during that phone call. The pictorial object is very useful also during spare part ordering process when such transaction takes place only between sales coordinators.

The advantages of universal access of information system authorised users can be fully employed only when the user momentary location does not play any role. That is why the computer web interface is the basic prerequisite and concept attribute.

Another conceptual attribute represents the information system openness what means the on-the-fly possibility to fill up and modify data in the centrally administrated data system (Simsion et al., 2005). No equipment gets by on a rigid data model inserted at the very beginning. There are design modifications, components supplied by different suppliers, application program upgrades, experience and reliability data collection, diagnostics, etc. Also the set of equipment is to be extended and new users added.

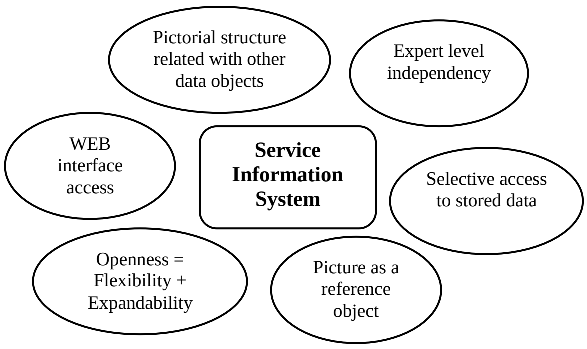

Fig. 2. Information system basic attributes

3. INFORMATION SYSTEM REALIZATION

We have chosen technologies like HTML, JavaScript, PHP and MySQL for our experimental information system realisation. The system for data administration and retaining in the MySQL environment is centralized on the PHP server. The new object entry or gradual completion is possible by system users according to their access rights and data nature via client computers connected to the internet and having a HTML and Java Script compatible browser. The person responsible for object and data entry should be the senior expert or the head of service team. That person is supposed to add new equipment objects, create their hierarchical structure, attribute items, and relevant documentation. Technical details, new knowledge and experience records, interesting details or situation pictures could be inserted by any service engineer having relevant access rights. The supplementary sales and administration data, like spare parts price list, certificates and sales contracts can be inserted by authorized company sales coordinators. The registered equipment users can browse certain areas of the information system, like spare parts ordering numbers and prices. They even can insert their remarks and operational observations which can extend the service team knowledge base for sake of more accurate and more rapid diagnostics or preventive measures. The Java Script application ensured a fast and problem-free HTML operation. The three layer image structure together with Java Script made it possible to realize a system of sensitive area definition in the pictorial objects. These areas are sensitive to mouse click and after that they open access to the lower level of the equipment pictorial structure and further down to individual pictures of design details and parts. Besides the nesting paths to a pictorial detail, it is possible to evocate relevant supplementary data in usual text or multimedia format at each nesting level.

4. CONCLUSION

The experimental realization of the service information system has proved expected equipment pictorial structure communication possibilities and advantages. That pictorial nested equipment model with related supplementary extensible data set can serve for ease of equipment diagnostics and problem solving in course of its operation life. The pictorial model is applicable for any equipment, and the only starting prerequisite is to create the hierarchy based on pictures with mouse click sensitive areas to move in it, and also to append the supplementary data documents. The experimental system application was running correctly with all current browsers in the viewing mode.

As a next step, we plan to optimize the necessary hardware requirements bearing in mind the cost efficiency. The first trial implementation with only a few equipments was aimed at the SMT process. Our next real practical implementation shall be both for measurement university lab devices and for our partner company devices in the area of diagnostics, test and calibration appliances.

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