COMPUTER-AIDED STANDARDISATION FOR MANUFACTURING AND MAINTENANCE ACTIVITIES

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Abstract

The paper deals with the development and application of computer-aided standardisation (CAS) for the distribution of standardisation data of production and maintenance processes within the company network. Rising integration pressure of company software tools also include CAx technologies. These CAx technologies provide software solutions for different applications, being able to work closely together with ERP-systems, Business Intelligence (BI) tools and further systems. The possibility of integration makes it also feasible to look on the CAS tool and its potential. While CAS is a topic not yet fully discussed, future development may lead to the requirement of integrating the CAS with the ERP and planning system. Approaches, such as CIM, digital factories (DF) and Industry 4.0 benefit from a broader database available with the CAS system employed.

Keywords

CAS, standardisation, Digital factory, Industry 4.0, maintenance

1 INTRODUCTION

Today’s companies require a huge amount of data with the help of which they are able to plan, do, check, and act in all different company fields. Advanced technologies allowed for the integration of various software tools creating a complex network. Data is distributed within those networks automatically, allowing for data synchronisation and fast distribution. Machine-to-machine communication allows for automation further and integration. With rising complexity of those systems, standardisation is getting a topic to be taken into account.

Standardisation is mostly related to process standardisation and standard times. These information are displayed and distributed in common ERP systems. Higher requirements make it feasible to develop tools managing standards in with a wider understanding. These tools are able to give all standard-related information and are called CAS tools. With the integration of these tools into the whole company network the stored data may be used to verify production times. It is further possible to more precisely schedule and to better prepare maintenance works [9]. For further automation and integration, these systems may play a valuable role, though they are not widely used today.

The limited usage of these tools and the limited availability of literature on the topic makes it feasible to have a closer look on the CAS tools. With these tools companies should be able to further increase their machine availability and to more-precisely schedule production and maintenance activities together.

2 CAx

Computer-aided technologies (CAx) are widely used in today’s companies. The term includes technologies and tools such as:

- Computer-aided design (CAD),
- Computer-aided engineering (CAE),
- Computer-aided process planning (CAPP) [8].

CAx include all kind of software tools used to generate computer support in various areas. Since several years, it is a trend to integrate the different systems to generate higher value added for the end user. Data is distributed among the network through machine-to-machine communication allowing for faster transport. Further, data is storable and hence results are replicable [8].

With the integration of the different CAx tools, it is the objective to eliminate the gaps between the tools as well as to avoid overlapping and data interferences. Developed network infrastructures allow for an ever closer cooperation and integration of the tools. While the integration of tools allows for a database of possibilities, it also requires a huge input database. The quantity and quality of data required by those systems is going far beyond a rudimentary data collection. With further engaging of the systems, the systems require more complex data and information.

With evolving data quality requirements, it is also required to evolve the software tools and the underlying logic and standards of the whole framework. While commonly used CAx tools deal with the distribution and visualisation of data, logic evolves with updates or new versions released. The databases of underlying standard mostly only evolve in range, but not vertically. Higher-level standards are not taken into consideration, although they are able to decrease the computer capacity needed in order to develop those standards.

Higher-level standards are standards developing from rudimentary standards by aggregating them. Instead of standardising each activity in the process, it should be possible to make use of previous standardisation results. In case, aggregated higher-level standards describe part of the process precisely, these standards may be employed.
3 CAS

Computer-aided standardisation (CAS) systems are systems for standardisation of various activities and processes. While ERP systems are also able to provide standardisation of activities, CAS systems go a step further. Where ERP systems provide a dataset of process steps and the required time for it, CAS systems use full process steps. Thus, they give additional information, such as:
- times,
- tools,
- spare parts,
- drawings,
- full machine information [7] [9].

The increased complexity and requirement of data of a CAS system leads to the question where these systems might be required. For serial production with huge quantities, it makes sense to stick to the functions a usual ERP system is able to provide. The CAS is able to enhance and facilitate complexer activities and to diminish the effect of a fast-changing environment. Also for a wide range of different activities to be taken, the usage of CAS systems may pay off [7].

CAS systems developed from computerised maintenance management systems (CMMS) which have the task to acquire data on the conducted maintenance, such as the maintenance interval, information on the crucial spare parts and shortages of the machine [3] [4]. One of the shortcoming of CMMS is the fact that companies using those systems made extensive use of the text fields provided [9]. The required detailed analysis of data saved in text-form required a bigger amount of work than initially anticipated.

With a broader understanding of process tools, including the standardisation itself, the CAS takes over the initial task of a CMMS. For maintenance, the CAS is able to monitor the activities undertaken on the machine, saved as a dataset. The ability to store further required documents and data makes it possible to have all needed documents and information on hand. Today’s CAS tools are not itself able to provide data analysis. Their benefit is the ability to work with a far wider range of data and data types than the CMMS. While both tools act as a feeder database for further systems, ERP systems are able to provide the underlying logic [9].

4 CAS and maintenance

CAS were developed for maintenance purposes [7]. A higher degree of information in the maintenance area shall decrease maintenance times and maintenance cost by eliminating unnecessary losses. Total productive maintenance (TPM) asks for the elimination of losses in the company to increase productivity, having its main focus on maintenance [12].

Maintenance is a non-value added process in production companies, normally characterised through downtimes and incurred costs. With concepts searching to increase productivity in production, different maintenance concepts (RBM, RCM, PM) had been developed and set the focus on a cost decrease of maintenance activities [3]. Issues in quantifying the success of these activities make it hard to invest into more reliable maintenance approaches [9].

The CAS is able to provide standardised activities and processes for maintenance activities. A crucial condition to allow for a standardisation of maintenance activities is the elimination of uncertainties and unknown maintenance activities to arise during a breakdown. Foregoing machine and equipment breakdowns and unplanned maintenance makes it possible to diminish the range of maintenance activities on a machine through enhanced productivity [7].

The same is valid for control and diagnostics activities. Eliminating the failure-search through planned preventive maintenance blocks and standardised diagnostics activities allow for a more precise scheduling in the company’s enterprise resource planning (ERP) system. The distribution and processing to further systems in the company network allow for a scheduling of planned maintenance blocks in the production planning system. The success of a cooperation of CAS and ERP is indicated by the maintenance cost and the maintenance breakdowns occurring in a given time interval [9].

5 CAS in Industry 4.0

The CAS system requires a huge variety of data and effort to get its database filled. For non-value added activities, such as maintenance, the effort is seen as not-justified. Maintenance activities are therefore mostly not standardised and not planned and scheduled properly. Subjective estimations are more taken into account than the possibility of a more precise scheduling [9].

Due to the limited literature and publications on CAS systems, an application of CAS systems in the industry 4.0 framework or in digital factories (DF) was not discussed. Turning towards autonomously-working companies where data exchange is done automatically. Machine-to-machine communication allows for a frequent data distribution and gives an actual picture to other production processes. The monitoring unit should be able to have all required parameters gathered to make fast decisions [11].

ADF fully controlled by computers requires a huge database with accurate and actual data. These systems work on the basis of data and do not allow for a subjective decision-making. Further, it requires parameters that allow for the decision-making and to allow for a decision*OK or ‘NOK’. Today, parameters are almost static and are only changed during re-standardisation or after a longer time interval. DF’s have to be able to react flexibly to parameter-changes based on empiricism. Each decision requires therefore an actual data to be assessed and a parameter that it can be checked against [5].

Systems like the CAS are able to provide the parameters to be checked as well as the supporting data for further actions. These further actions refer to the production planning where maintenance blocks have to be scheduled precisely. In a fully computer-controlled environment such as the DF, the CAS system is able to employ its full strength. With an increasing database through time the CAS is able to give a clear picture on the processes. CAS systems are also able to support further computerisation approach, such as for complex maintenance activities [9].

Industry 4.0 requires the integration of computer system resources through machine-to-machine communication [11]. While DF’s focus on one given company in order to integrate all systems and create a virtual picture of the production company, industry 4.0 goes another step forward. It may also take data and information from outside the company. Internet and cloud services may provide data through direct communication with the company IT infrastructure. Rudimentary low-level standards may be available through a cloud service, highest-level standards have to be established directly in the company to get the most precise results.
6 Conclusion

Integration of different software solutions, such as ERP and CAx tools, changed the company network into a system of machine-to-machine communication. CAS tools are able to provide a further part of information to the whole network: standards.

Standards not only referring to production times represent a crucial basis for production and maintenance activities. Precise descriptions of activities and the further precise scheduling provide an advantage for manufacturing companies. These companies are able to decrease cost and to enhance planning as well as machine availability.

The CAS is not only a tool for standardisation, but it is also a tool for enhancing productivity through maintenance. CAS, originally developed for maintenance scheduling, may also be used for production in order to employ higher-level standards. These tools are able to contribute to DF and the closely-related Industry 4.0-concept. DF’s may rely on the strengths of the CAS in order to evaluate the ongoing in the company. CAS is a tool that may prove its abilities in the future when DF’s are put into reality. A database of standards makes the concept capable to work in fast-changing environments. It is applicable in cases usual ERP standard modules [1] [6] are not sufficient for the demanding requirements of DF’s.

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