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E-MAINTENANCE FRAMEWORK FOR THE COLLABORATIVE NETWORK OF SME-S

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Abstract: *This paper outlines the e-maintenance approach and the current challenges for Collaborative Network of SME-s in the era of e-manufacturing and e-business. E-maintenance platform enables to organise the maintenance process in the more efficient way. In this paper we propose novel e-maintenance framework, where existing maintenance knowhow is integrated with Web-services and the principles of enterprises collaboration. In addition, an information sharing enables the exchange of knowledge and intelligence between collaborative SME-s partners. It increases the availability and usage of pertinent knowledge and intelligence for better decisions making within collaborative networks.*
Key words: *E-maintenance; E-monitoring; Collaborative network*

1. INTRODUCTION

The main goal of e-maintenance integration is to increase the reliability and sustainability of enterprise partners in Collaborative Network (CN). The enterprise equipment maintenance is a constitutive and unavoidable process for manufacturing enterprises. Today active monitoring and notification services are widely used in order to support the maintenance process in enterprises. A notification is sent to the appropriate organizations when their performance level falls below the threshold (Camarinha-Matos, & Afsarmanesh, 2008). The production equipment maintenance support is essential for small and-medium enterprises (SMEs), because usually the SME have limited resources and they can´t hold own maintenance department. Under such conditions the purchase of maintenance service is the only way for production SMEs to run the equipment efficiently. The outsourcing brings addition problems (i.e. strong dependency on the Maintenance Service Partner, the availability of service, location, etc.) and can cause the interruption of production process for a long time period.

To cope with the service drawbacks, the Maintenance Company (MC) should be included into CN framework. It enables to implement the real-time monitoring of equipment condition, track the equipment status and efficient planning of preventive maintenance.

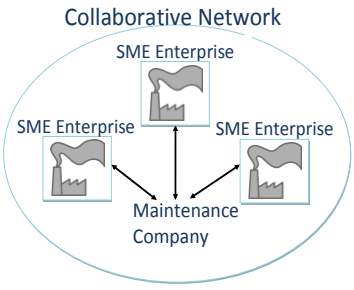

Fig. 1. Framework of Collaborative Enterprises with the enterprise Maintenance Service Company

2. E-MAINTENANCE PLATFORM IN CN

The e-maintenance framework is used to coordinate the maintenance information sharing between different actors (machines, robots, manufacturing facility managers, external partners, business managers, decision support systems, etc.), and to provide the tools for decision making process (Lee, 2003). In the context of sustainable manufacturing, e-maintenance framework enables better decision making (i.e. with accurate and close to real-time information). This framework is integrated with production process and consists of two parts: monitoring and maintenance (Ribeiro L. et al., 2008). In maintenance domain the reliability of the service depends on the reaction time to unexpected events and ability to prevent the malfunctions. As presented in Fig. 2**Error! Reference source not found.** the Web services support the interactions between equipment and maintenance service partner.

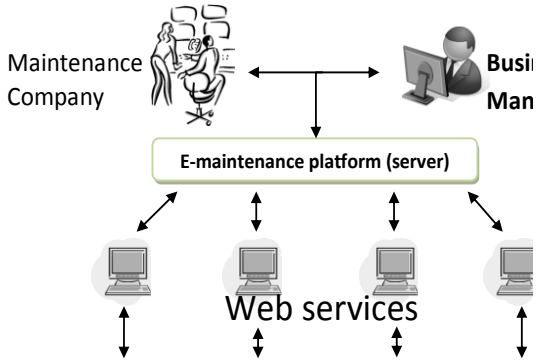

Fig. 2. E-maintenance platform in the future shop-floor

Real-time monitoring enables to discover the malfunction in any part of the process and to contact operator. The information about breakdowns can be stored to knowledge database and analysed. The decision related to the required service and spare parts could be made based on this information.

3. TECHNOLOGIES MONITORING USAGE FOR E-MAINTENANCE

The Web-based monitoring system can be inexpensively applied on existing machine tools. The hall sensors can be used to monitor the machining status without the interference to the machining process (Bong-cheol et al., 2006).

The hardware system prototype enables to collect the data from machines, robots and Automated Guided Vechicles (AGV) through Intranet or Intranet to Host computer as shown on Fig. 3(Wu et al., 2008).

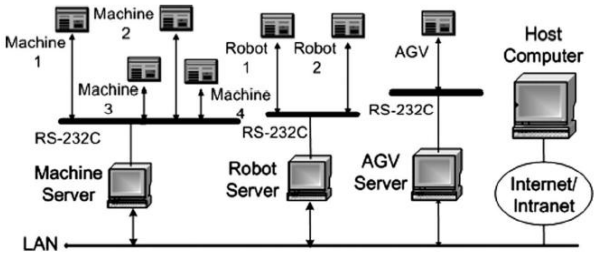

Fig. 3. Prototype system hardware structure

After that the maintenance related data can be sent from the client host computer to the server by service-oriented communication architecture based on (Manufacturing Messaging Services (MMS) and Web Services.

The bottom layer of this communication architecture is the basic Network technology, such as TCP/IP and HTTP. The construction of this layer is based onWeb Services and Database technologies. It is authentically object-oriented technology and the basis for communication subsystem execution. Web Services technology is the platform for real-time interaction of various modules. The different modules are communicating to each other by the means of Web Services accordingly to the interface specifications defined by MMS. In such way the uniform message transmission structure can be realised. In manufacturing communication subsystem the database is used for storing and managing of the maintenance related information. The upper layer is used for realization of VMD and other control modules. The various interfaces are defined accordingly to MMS and Web Services, and their internal realizations are implemented to correspond to the definitions of each function.

4. E-MAINTENANCE BASED PROBLEM ELIMINATION PROCESS CASESTUDY

The manufacturing enterprise produces mechanical parts. It has CNC Machines Park that is maintained by service partner. The nearest CNC machine service centre is located 200 km from the enterprise workshop. In case of the machine failure, the problem solving takes an unacceptable amount of time. The machine failure elimination process is illustrated on Figure 4. When the break down is occured, the production manager calls to maintenance Service Company. In order to identify the source of the problem the service company sent the technician to the site. After the source of the problem is identified by technician, the service company orders the required spare parts from the central warehouse. The technician is able to fix the problem after the spare parts are received.

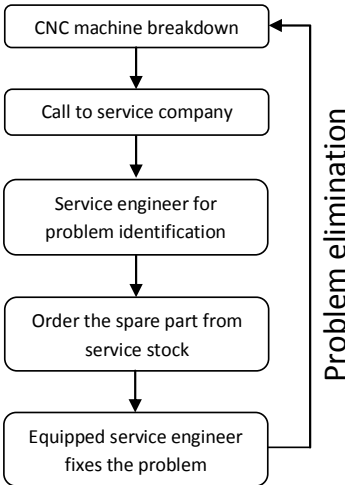

Fig. 4. Problem elimination process

Depending on the type of malfunction, it can take up to 3 working days to eliminate the problem today. During this time those machines are idle. If e-maintenance approach the idle time can be reduced up to 4 times. In addition thereis also the possibility to prevent the malfunction. The framework of the e-maintenance framework is introduced in the Figure 5.

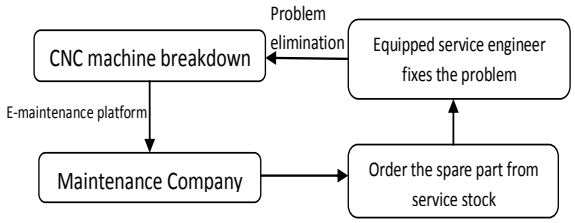

Fig. 5 e-maintenance framework

The novel framework is used by monitoring devices for real-time monitoring of machine centers. The web services sent the collected from the equipment information to the web-server of Maintenance Company. A technical specialist is not required to be on site in order to identify the source of the problem and to order the spare parts. The required information is sent directly by machine centre.

5. CONCLUSION

The introduced framework for e-maintenance in collaborative network is a part of general project. The main goal of the project is to build a framework for collaborative network. E-maintenance approach enables to increase the reliability of the equipment used in future collaborative network. It enables to minimise the idle time of equipment and to complete the manufacturing projects on time. The proposed framework enables the real-time monitoring of equipment condition and improves the quality of maintenance service provided by specialised partner in the collaborative network.

6. ACKNOWLEDGEMENTS

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