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PM INFORMATION EXCHANGE FRAMEWORK FOR DECISION SUPPORT SYSTEMS

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Abstract: *The implementation of Internet technologies has led to e-Manufacturing technologies becoming more widely used and to the development of tools for compiling, transforming and synchronizing manufacturing data through the Web. In this context, a potential area for development is the extension of virtual manufacturing to Performance Measurement (PM) processes. This paper proposes a PM Information Exchange Framework to integrate decision support systems in an internet environment. Specifically, the proposed framework offers a homogeneous PM information exchange model that can be applied trough decision support in e-manufacturing environment. A practical example of data exchange for measurement processes in the area of equipment maintenance is shown to demonstrate the utility of the model*
Key words: *performance measurement (PM), e-manufacturing, B2MML, key performance indicator (KPI), information integration*

1. INTRODUCTION

E-Manufacturing is a concept that has come to the fore in recent years due to Web technologies being combined with the new manufacturing management strategies. E-Manufacturing operates as an information transformation system that maximises the performance of manufacturing operations by using the Web to synchronize manufacturing systems and business systems. Figure1. shows a current e-Manufacturing environment where the different data flows are integrated. The integration comprises the organizational and operational levels, either at an internal or external level of the company.

In this environment, e-Manufacturing allows monitoring the plant floor assets by using the Internet to schedule production maintenance and order supplies in real time via the Web. This allows integrating Manufacturing Execution Systems (MES) with upper level Enterprise Resource Planning (ERP) systems. It also provides efficient configurable information exchanges among manufacturing and customer relationship management (CRM) systems and supply chain management (SCM) systems (Lee, 2003).

The development of ERP systems, which are the core of all management systems, is currently the subject of wide research (Sholten, 2007). The advances achieved have enabled all business resources and processes to be centrally coordinated. Their limitations, when attempting to deal with a plant management environment with the same flexibility as in an administrative environment, are being solved with MES applications. Development strategies stress the use of internet technologies, and the current priority is to integrate decision support systems in the Performance Measurement (PM). Such integration will allow critical manufacturing resources to be optimized and enhance the decision-making process in manufacturing environments (Braam & Nijssen, 2004).
All these tools, platforms and systems need robust information acquisition, exchange, processing and synchronization.

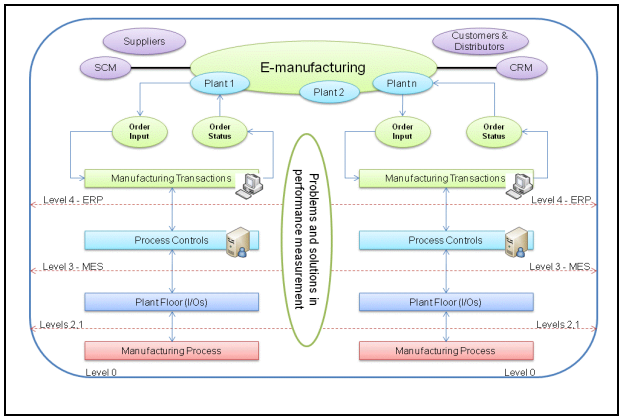

Fig. 1. Integration Using e-Manufacturing

This paper presents a new framework for developing virtual e-Manufacturing tools that can be used by all these systems. Its application will ensure an optimized, homogeneous exchange of performance measurement information via the Web , making easier to apply virtual manufacturing strategies (Seunglak et al., 2008).

2. CURRENT PROBLEMS

Although enormous progress has been made in e-Manufacturing tool development, there are still areas like performance measurement that require research work that will provide solutions to the new problems. The e-Manufacturing function must provide an automated information exchange process that is fluid, transparent and favours uniform information management. This function is not being effectively met. The function is complex to implement due to the large amount of data distributed in industrial plants, coming from multiple sources, such as CRM, SCM, ERP, MES, SCADA, GMAO systems, etc. (ISA, 2003). The reasons behind this lack of integration are:

- Heterogeneity
- Synchronization with real data
- Performance monitoring
- Data Exchange Measurement.
- Cost

This situation makes it necessary to seek new e-Manufacturing solutions for information exchange that are specifically oriented to decision support systems dealing with performance measurement. Such solutions must be feasible in terms of useful results at a reasonable cost.

3. PM INFORMATION EXCHANGE FRAMEWORK FOR DECISION SUPPORT SYSTEMS

A new reference PM information exchange framework is proposed (fig. 2.) that will enable us to move forward in solving

the problems identified in e-Manufacturing management regarding performance measurement. Specifically, the proposed framework offers a homogeneous PM information sharing model that can be applied trough decision support systems in e-manufacturing environment where a variety of technological applications are installed. As a part of the e-Manufacturing architecture, this information exchange framework provides a homogeneous link to harmonise information exchange among the different formats, data and data types existing in the context of e-Manufacturing.

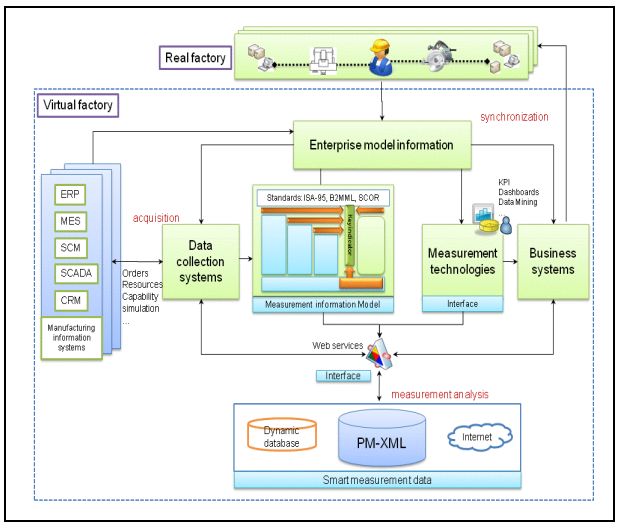

Fig. 2. Performance Measurement e-Manufacturing Architecture

It comprises three sub-systems: a conceptual data model, an information platform and Web Services (WS) architecture. The data model is necessary to unify information among the data acquisition systems, the production management systems and the upper level business systems. The data model is based on developing all the information needed to define and obtain the different KPIs required by the PM processes. The information platform uses XML and B2MML technologies to structure a new set of performance measurement exchange message schemas (PM-XML). This information platform is complemented by a Web Services architecture that uses these schemas to integrate the coding, decoding, translation and assessment processes of the key performance indicators (KPIs). These services perform all the transactions required to transform the source data into smart information that can be used in the decision-making processes.

4. CASE USE

The proposed framework has been validated by developing a prototype for PM data acquisition, consolidation and synchronization. The prototype is applied in a maintenance decision system. The processed data correspond to performance loss measurement in production operations. The measurements are taken from a set of incident records from sets of equipment belonging to various production plants. For such purpose , a test environment was created made up of the following inter-related systems (fig 3):

- A heterogeneous information environment made up of three data sources..
- A Ms-Biztalk environment as the motor for exchanging and converting the measurement data.
- An information platform based on the proposed framework comprising a: an indicator model, a unified data base called PM-DB and the set of PM-XML schemas used for integrating data during message construction and conversion.
- A Web Services architecture developed in Visual C# used for information exchange and the processes defined in the framework.

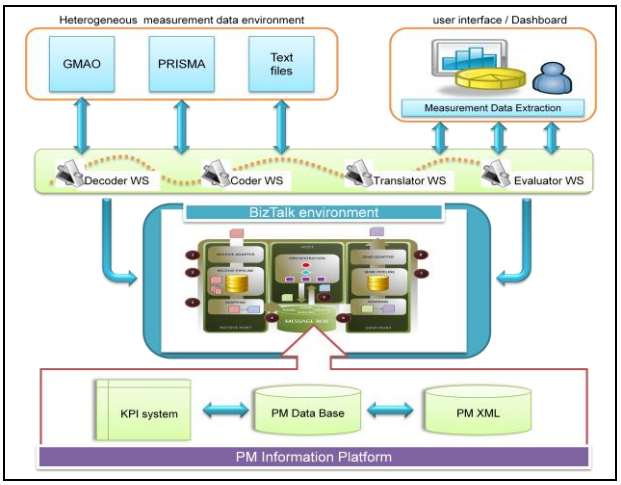

Fig. 3. Functional Prototype

5. CONCLUSIONS

This paper presents a PM Information Exchange Framework to integrate decision support systems. Its application ensures the interoperability required for decision-making information processing procedures in Web environments. Therefore, it addresses some of the gaps identified in literature dealing with supporting PM processes.

Within the proposed framework a practical possibility is presented for unifying data formats and contents to facilitate the transformation, synchronization and analyses required by PM processes. The data model proposed allows modelling the information required by PM processes. The proposed Web Services architecture is capable of performing all the transactions to convert the data collected in the plant or business applications into smart information for decision-making processes. The practical use of the set of tools has been validated through a specific use case of manufacturing equipment performance information management.

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