

# Sensor Platform for Data Management Services in the European Tool Making Industry

Pavel Vitliemov<sup>1\*</sup>

<sup>1</sup>University of Ruse, Department of Management and Business Development, Bulgaria

**Abstract.** Data Management is one of the critical points of the tool industry since all applications are heavily based on the industrial data processing (mould, machine, etc..) as well as the business process that are enabled thanks to such data and their smart interpretation. This paper gives a brief overview of a software architecture for sensor platform for Data Management Services that could be implemented into the European Tool Making Industry.

## 1 Challenges of the European Tool Making Industry

Today's turbulent economic environment confronts the European tooling industry with new challenges: An exclusive differentiation in price has not worked out for European toolmakers over the last years. Furthermore the initial situation for such a differentiation is not given in Europe. Labour and non-wage labour costs have been a major focus in the political debate on Europe as an investment and industrial location. While the debate means an agonizing concern and increasingly acrimonious public discussion about the future of Europe's economy, social makeup, research, social welfare and international competitiveness, every single European company has to deal with these costs in its own way to remain yet competitive. Foreign competitors, that are stunningly boosting their product quality, incite local companies to high performances. Nevertheless, the question how long the pricing pressure can be beard remains unanswered. [2, 6]

Today, a promising approach for differentiation over competitors is to enhance the existing range of products by offering customer-specific services. An intelligent bundling of individual services with the core product (speaking of the tool itself) leads to so-called hybrid products or product-service-systems. But extending the range of product and service offerings cannot just be carried out on the level of operations. As the success of a company is founded in its business model, the latter needs to be redesigned to align strategic and operational objectives. [5, 7, 8]

The European tool making industry faces three major challenges of production in high-wage countries, an increasing product derivatization, shorter product life-cycles and lower factor costs of global competitors. Both the increasing derivatization of the products and shorter product life-cycles describe the change of the customer's focus from individual production to mass customization resulting in an increasing variety of products as well as an increasing complexity in production. This development directly influences the tool making industry

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\* Corresponding author: [pvitliemov@uni-ruse.bg](mailto:pvitliemov@uni-ruse.bg)

which provides the operating resources for efficient and innovative production. Due to the smaller batch size of the individual serial part, the tooling costs make up an increasing share of the overall product costs resulting in lower entitled costs for each individual tool. This increases pressure on the tool shop, especially in high-wage countries, since many operations within the development and production of tools are carried out manually. [1, 3, 4]

Nowadays modular sensor platforms for service-oriented cyber-physical systems are being developed to facilitate incorporation of state-of-the-art sensor technology into an injection moulding tools. Smart Tools are operating resources equipped with state-of-the-art sensor technology which allows them to provide a unique level of transparency of the tool's condition during its operational use. An integrated diagnostic unit provides intelligent data interpretation algorithms while an electronic tool book guarantees safe storage and availability of the collected process data for further applications. [9]

## **2 Data Management Services**

Data Management is one of the critical points of the tool industry since all applications are heavily based on the industrial data processing (mould, machine, etc..) as well as the business process that are enabled thanks to such data and their smart interpretation.

For this reason, a software architecture that is based on loosely-coupled applications (i.e. using SOA compliant approach) able to operate within an enterprise and inter-enterprises environment is defined and proposed. Therefore managing issues like users/services authentication (even within an identity federated environment), access control potentially based on enterprise's access policies, services integration (thanks to the use of formally defined service's interfaces, e.g. WSDL based) and reusability. [10]

Regarding both the functional and technical requirements, two different areas of data management have been considered for Historical and Real Time Data.

For each type of data have been identified the technical solutions that allow to improve the functionalities already available with the background technology and sustain new business models based on such enhanced functionalities.

This paper gives a brief overview of a software architecture for sensor platform for Data Management Services that could be implemented into the European Tool Making Industry.

### *2.1 Historical data management*

Historical process data retrieved from the tool log-book memory can be used for a back-end analysis of the tool behavior and for the evaluation of the past working conditions for different purposes, from technical to management.

Current tool log-book technology is based on generating, according to a company proprietary format, binary log files located into a log-book flash-memory card; files are used to store on a daily basis process data and other information such as stops, alarms, etc. These binary files can be handled from a folder accessible via ftp and uploaded to any other PC provided with the company tools for reading them.

The objective of the proposed work consists on making process data easily available (database) and make them accessible to any authorized user (and application) for different kind of statistical analysis also from a remote workstation. This objective has been achieved through the following components:

- a database structure that allows the storage of historical process values and device configurations for each tool log-book;
- a "data management layer" that can both mask the actual database (DB) structure (therefore relieving applications for knowing DB structure and having to face all DB structure's changes), and perform some operations on the data (e.g. filter data for anomalous data before being stored or made available to applications).

## 2.2 Database structure

The objective of this database is to provide a storage structure for all the common data need for the distribution of the process information, while data required from the applications will be managed not as a (logical) central component but a specific data management structure on the application side.

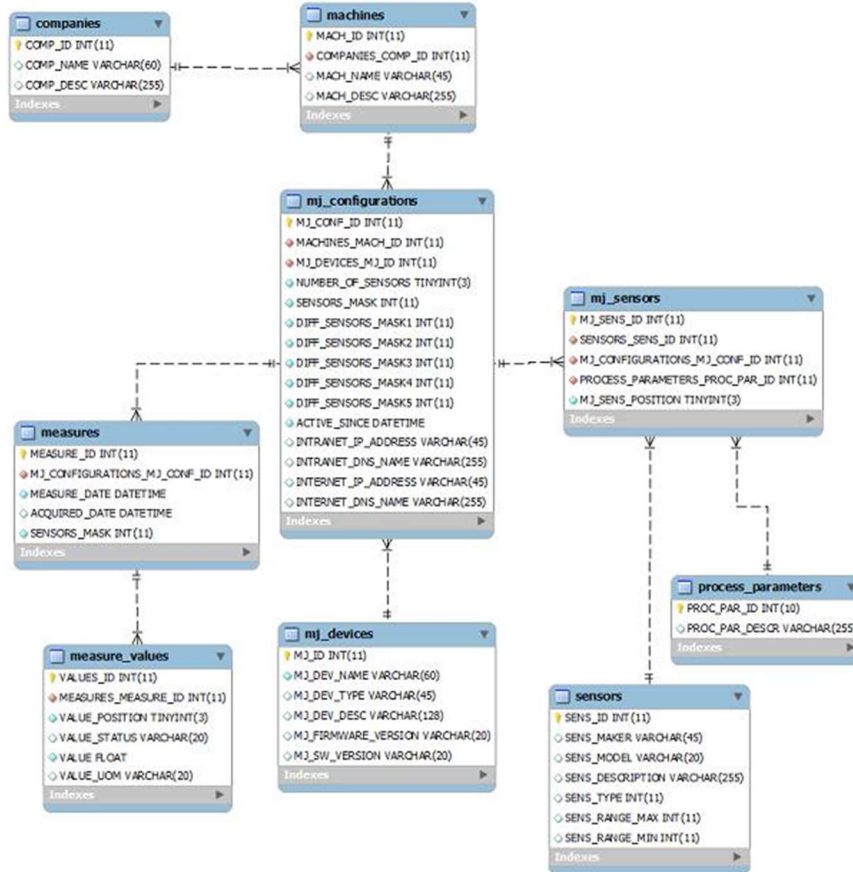


Fig. 1. The database schema

Main purpose for this first set of tables is to store historical values for the process parameters as well as the configuration settings that link the sensors in the mould to a specific mapping of tool log-book monitoring zones (1-23) to which the sensors are connected.

## 2.3 Data Upload Services

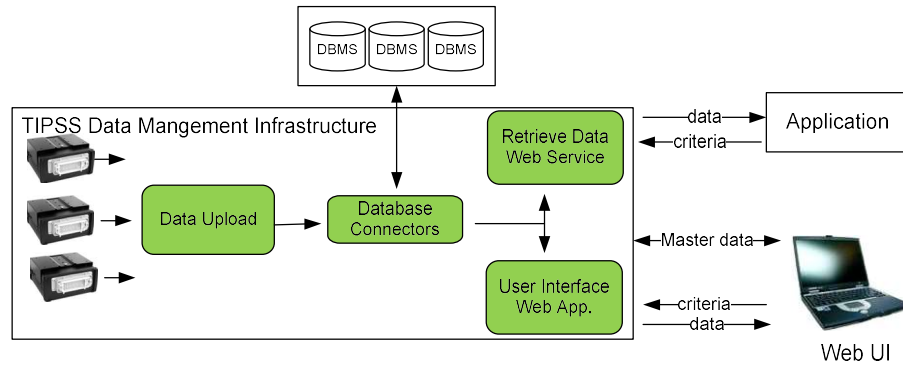
The approach adopted for the upload of logged data is represented in the following picture. Process data collected from a tool log-book device through an ftp connection can be uploaded to a local database and from there retrieved from any authorized application or service available on the platform.

From an IT architectural point of view the data management environment for historical data is represented in the figure 2.

The Data Upload component is in charge of gathering the historical data from the tool log-book logfiles and uploading to any type of DBMS using the database connectors provided

from the Xaware framework. It is based on two synchronized and schedulable procedures (developed using Powershell scripts launched through standard Windows OS utilities):

- The first gets the log files from the tool log-book memory, converts the files into a text-csv format and moves them into a specific folder corresponding to the Company/Mould-Jini location within the file system;
- The second processes the text files and uploads data to the database.



**Fig. 2.** Data management environment for historical data

To complete this data management area, two other specific tools have to be realized:

- a web service for the extraction of specific set of data from the database; the service is devoted to return to any registered application an XML file containing all the historical data pertaining to a specific set of parameter values of a Mould (identified, i.e., by “CompanyName” and “Mould-Jini”) within a specified time slot;
- a web based UI allows a graphical and simplified master data management (tool log-book configurations, process parameters, etc.) by not DBMS expert users. [14, 15]

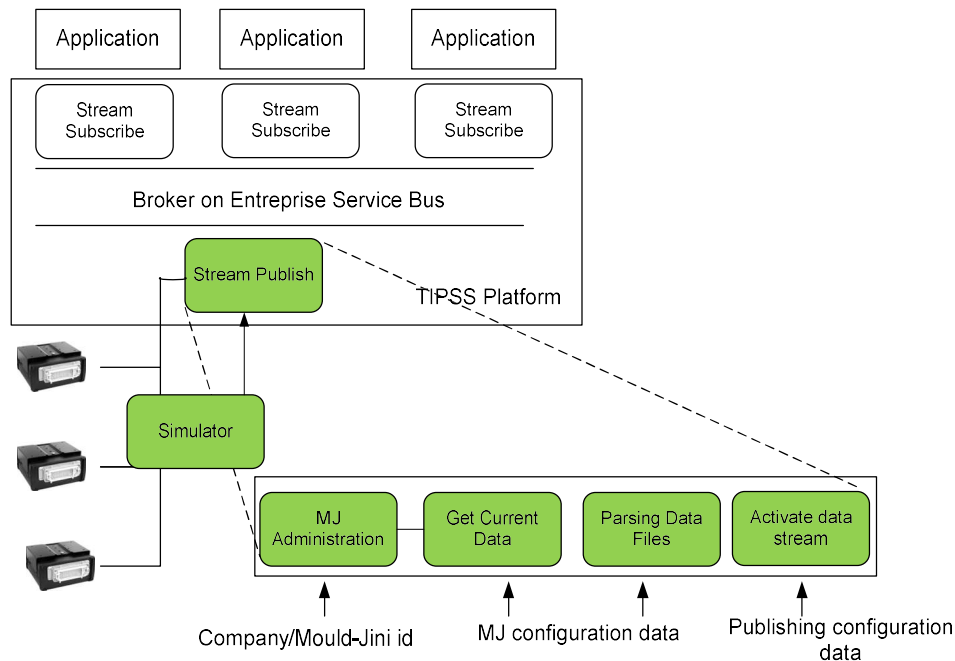
#### 2.4 Real time data management

Real Time data management is one of the most relevant tasks of this work package. Such type of data, according to the common principles adopted for the SOA infrastructure, as collected from the field devices (log-books) must be provided in a general way as a service available to any application (decision support, process/quality control, etc.) for an effective integration without requiring too much specific data connectors.

Current tool log-book technology uses an internal microprocessor where can be implemented a web server, based on their own proprietary technology, for a limited graphical data presentation, some simple process control tasks and basic setting operations by using a generic browser.

The objective of the proposed work consists on allowing authorized users to access any tool log-book from local and remote workstations and run applications using the related real time process data in order to detect problems and prevent defective working conditions.

In the following picture an architectural view of the platform devoted to the Real Time data management is given.



**Fig. 3.** An architectural view of the platform devoted to the Real Time data management

The proposed system is mainly based on three main set of components in charge of:

- getting Real Time process data developing the software module that uses the basic data mashup services of the Xaware framework (details);
- providing streams of Real Time process data using a specific message broker publishing the data streams on an Enterprise Service Bus. Multiple processes can in parallel access to the same stream for different purposes;
- managing the publisher modules providing the administrator with simple tools for the identification and configuration of the real time data sources (tool log-book web services and similar ones). [11, 12, 13]

All the modules should be developed using the Xaware framework. A message broker and an Enterprise Service Bus on the other side should be used to instantiate the publishing mechanisms.

### 3 Conclusion

This paper presents an approach of platform design that can be applied to develop a modular sensor platform for injection moulding tools. Furthermore the platform could be focused on surveillance strategies for injection moulding tools to deliver solutions for the online early detection of tool wear using state-of-the-art sensor technology. First experimental research using a solid borne sound sensor provides promising results on the application of this technology to prevent damage from the tool and increase tool reliability and efficiency of serial production.

The platform implementation can result in supporting European tool making companies in their effort to further integrate themselves into the preceding and following processes of their customers. This allows them to develop new innovative service offerings in the area of after-sale to differentiate themselves from global

competitors in order to overcome the challenges of production in high-wage countries.

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