Implementing B2MML with SAP

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ABSTRACT
The Procter & Gamble MES organization is implementing B2MML with SAP. When starting, we found several obstacles including: Lack of examples of B2MML; No desire from the SAP company to pursue a B2MML interface; Our lack of XML skills; Missing automatic interfaces in SAP.

Several factors in our favor included: Support for B2MML at management level in our Information Exchange, Material Movement/Warehouse, SAP Production Execution, and MES organizations; we could use an existing SAP Business Connector infrastructure; our key MES vendor was actively developing a B2MML interface; The WBF XML working group was willing to exchange information.

MES formed and lead a team, with our SAP and Material/Warehouse groups to define requirements, design information maps, acquire interface development skills and resources, develop a B2MML interface for one business’s limited set of SAP transactions, then set the direction for ownership and long term exploitation of B2MML in P&G to maximize lifecycle cost saving.

The work to date will be described including how we worked with the B2MML authors, WBF members, MES vendors, and internal SAP and BC resources to build our pilot interface. Technical specifications for key messages including views of the mapping code will be shown.
PAPER

1 Introduction

Tightly integrating our ERP and MES systems has become focus of many projects to create value in our company. The focus on external information exchange with customers has long been a priority. Now, to achieve the cost savings and improvement in the Supply Chain, information must be exchanged accurately and much more quickly among all information systems within our company. This includes information exchange among ERP and MES system, the focus of the S95 standard.

In the fall of 2003, two of our internal business organizations approached us with the desire to implement an integration of their MES systems with our ERP system, SAP. One business uses a commercially available MES system, which also happens to be the primary recommended MES system for our whole company. The other uses an internally developed MES system. Neither of these systems had an ERP interface. My global MES organization saw this as an excellent opportunity to introduce B2MML to our company. Both MES system owners agreed that if they were to build an ERP interface, it should be built on an existing industry standard message format. B2MML would be that format.

Using B2MML will benefit the commercial MES vendor as they can easily sell this interface to other customers using B2MML. It also benefits our internal MES system owner as this allows them to easily migrate to the preferred MES system when their business plan allows. Unfortunately our ERP vendor, SAP, was not prepared to work with us to develop a B2MML interface. Therefore we chose to develop one ourselves. We worked with one other SAP user in the World Batch Forum to share B2MML implementation techniques and hope to work with others to continue this development.

2 Business Justification

The business justification for standard message formats for information exchange has always been easy to establish, but only when those standards are accepted and used across an industry. Both the internal and external organizations we work with support following the S95 model for ERP to MES communication. However, most have been unaware that B2MML is the specific implementation of S95. I am making it a priority to promote B2MML within my company and with our MES vendors.

2.1 Internal Support

Internal support for a standard XML interface to ERP came from several areas including SAP Production Execution, Material Movement and Warehouse Management, Manufacturing Execution Systems, and Enterprise Application Interface groups.

The SAP Production Execution manager supported our effort and joined our team. He brought understanding of the processing, both standard and company custom processing, within SAP to our team. He oversees design of any modification to the SAP needed to process the messages exchanged with MES.

A manager from our Material Movement and Warehouse Management department also joined our team. He is an expert in communicating the same information with SAP as our MES pilot will, but through custom flat file interfaces rather than standard XML interfaces. He is teaching our MES team how to use SAP and work with the transactions we will be translating to B2MML. More important to our long term goal, he supports replacing the current custom interface between the warehouse system and SAP to
the B2MML standard when such change is deemed valuable and cost effective. Also, the standard will need to mature to include material movement structure. Plus the interface infrastructure with SAP will need to be established and robust first.

My department, Manufacturing Execution System Center of Expertise, has always promoted standard interfaces and understood their long term value. We have a long history of building and replacing custom interfaces with new custom interfaces every 2-3 years. This is often required merely to maintain functionality as computer technology changes. The lack of a standard interface format and the technology to easily use it has kept us on this resource consuming path.

All three of the organizations above were recently placed under the same manager in our Supply Network Execution department. The support of this manager and our organizational synergy has facilitated our project progress.

2.2 Vendor Support

MES Vendors also support a standard XML format for ERP communication. The vendor of our primary recommended MES system has committed to provide an XML interface for information exchange with ERP and other systems. While not exclusive to the B2MML format, this interface will be delivered with a configuration that supports the B2MML format. Users will be free to configure support for other XML formats. We are working closely with this vendor on the initial development of the first phase of this interface, receiving the ProductionSchedule structure containing order header information.

We are also maintaining contact with several of our control system vendors. They are supportive of the B2MML standard. Several are members of the World Batch Forum. We anticipate approaching them soon to discuss plans to bring B2MML to the factory floor in our company. The most likely first step would be the processing of the ProductionSchedule structure from SAP just as we are now prototyping with our MES systems.

3 Scope of our Pilot

Our pilot project has two phases. These will involve development of a B2MML interface for both MES systems and SAP.

First is the download of orders and bills of materials directly to each MES system. This would eventually replace a process of manually entering this information in the MES system from a report generated from the ERP system. This information is sent to both types of MES systems. This is the first B2MML interface for both using the ProductionSchedule structure.

In the second phase we will send material consumption and production data from MES to ERP using the ProductionPerformance structure. Only our internally developed MES system will perform this phase. The goal for this business is to reduce the amount of data handling and touch across the manufacturing departments. The current amount of data handling limits the speed to react to market and operational needs, limits the ability to reduce response time to operational issues. If successful we can increase Supply Chain visibility; enhance planning information from the plants, and speed up the inventory confirmation cycle. Our once daily back flush operation to recalculate inventory levels will be replaced by at least hourly transfers of actual material quantity changes from MES to ERP.
4 Practical Problems and Overcoming Obstacles

4.1 Business Connector Infrastructure

A Business Connector Infrastructure is already in place in our company. The EAI organization gave us the following assessment of their infrastructure. They recommended that we proceed with Business Connector as our means to implement a B2MML interface for SAP.

The strategic EAI tools are TIBCO BW (Business Works) and SAP Xi (exchange infrastructure). We are working on architecture plans to introduce these products (and some new capability such as Business Process Modeling, End-to-end Transaction Monitoring) and sun-set other products (Business Connector, AI, i3, etc). Both TIBCO BW and SAP Xi are at very early stages of deployment and they are not yet in production. SAP Business Connector is the primary technology that fills the EAI (data transformation and transport) gap right now. It is heavily used by Supplier Connectivity and Supply Network Planning. One of the questions we are going to look into is how to phase out Business Connector, but I can assure you that actual sunset of BC will not be before 3 years. A key challenge of this migration is that the mapping functionality on the current version of BC (flow language) is built on proprietary technology. We know that it is possible to move to open standards by upgrading BC. Once we are on open standards, we expect that it will be easier to transport our setup to strategic EAI technologies, however we did not finalize all the options/implications and plans of such a transition.

However, we learned that there was not enough capacity to add our B2MML interfaces on the existing infrastructure. The support organizations that existed were owned and run by the specific application users, like Supplier Connectivity. They would not be able to support our B2MML applications.

We did find one project group that had capacity for our application. We will have to own, develop, and support our own application. So we will limit our use of this system to just our two pilot applications. We have begun a formal process to get a fully supported global infrastructure for MES to SAP Business Connector applications. This infrastructure could be quite large as we have hundreds of MES systems that would be exchanging information such as orders, materials, inventory, quality, batches, specification, and recipes via B2MML with SAP.

4.2 Learning B2MML

Learning B2MML required more than just reading the B2MML documentation. The documentation was clear in its descriptions of the specific structure of the XML. However, there were no examples of how to use some of the more open and flexible aspects of the standard. Once we had committed to the use of B2MML in our pilot project, we found it necessary to hire one of the B2MML authors to work with us to match our SAP transactions to the B2MML fields.

The most unclear concept in B2MML that we needed to use is that of the Process and Product Segments. Definitions of these are not included in the B2MML documents, but are only available in the ISA S95 documentation. Those documents are unfortunately not freely available. We had to rely on the contract services we purchased to help us understand and apply these concepts to our requirements.

One requirement was to send two types of information from the MES system using the ProductionPerformance structure. One is periodic reports of material production and consumption that contain quantities of material that are to be used to adjust inventory. The other is an order confirmation that contains quantities of material that are to be compared to inventory and confirm and close the order. We discussed how we might distinguish the processing of the same.
MaterialProducedActual information in the ERP system and decided to use different values in the ProcessSegmentID. A short definition of a Process Segment is a business view of production. So in our case we had two business views of the same data, making product and confirming orders. We chose to use “MAKE” and “ORDER CONFIRMATION” as the ProcessSegmentID respectively. Our Business Connector application processes each SegmentResponse differently based on this value, generating different messages to SAP.

```xml
<?xml version="1.0" encoding="iso-8859-1" ?>
<ProductionPerformance>
  <ID>1234567890</ID>
  <PublishedDate>1999-03-01T00:00:00</PublishedDate>
</ProductionPerformance>
```

**ProductionPerformance Example for ProcessSegmentID = MAKE**

Once we had the understanding of the B2MML structure, our team of SAP, MES, and B2MML experts created a detailed specification of the mapping of SAP message fields to those structures. We are using a custom IDOC message for Order and Bill of Materials information from SAP. We are using a standard SAP IDOC message for Material Consumption and Production information from MES. We are modifying a custom SAP IDOC message to contain the Order Confirmation information from MES.

### 4.3 Business Connector Development Resources

As the owner of the B2MML process within my company, I must know the Business Connector code and tools, even if I am not the primary developer. Plus we needed to find a developer for our code as I did not have the time or expertise to do it and meet our schedule.

The very small group that owns Business Connector in our company did find time early in our project to train me on the general structure of the tool. We eventually found a group of Business Connector developers being used by our Supplier Connectivity organization who could give us some of their time to develop the first phase of the transformation code between B2MML and the IDOC message structures in SAP. While we searched for this development team, our design team from our SAP, Material Movement, and MES organizations had time to finalize the design of the interface between SAP and B2MML. The detailed design I created from the input of our project team allowed the Business Connector developers to quickly begin work and deliver our needed code modules.

### 4.4 B2MML Record Definition in Business Connector

Record definition for B2MML in the Business Connector development tool proved somewhat difficult. The schemas would not load using the tools that normally loads XML schemas in this tool. For this problem, we were able to obtain help from another World Batch Forum member and repeated conference presenter on the topic of B2MML. They directed us to their software contractor who had coded their B2MML interface in Business Connector using version 1 of B2MML. This contractor provided us with the actual code package from Business Connector with their record definitions. They too were unable to read the schema. However, they were able to create the record structure from an
example of the XML file. As we were using version 2 of B2MML, their package could not be used directly. But, I was very easily able to edit their B2MML example files to conform to version 2. I easily created the record structures in Business Connector from these example XML files.

To be sure the management of the record structures through changes in the B2MML standard remains easy, I created separate record structures for each part of B2MML that is used repeatedly or recursively.

For example, **Location** is referenced in several places, including within itself. The Location record is defined once under the B2MML.Common folder. It contains only three elements, two String fields and one Record Reference List that refers to itself, **Location**, designated by the shortcut arrow on the Record List icon in the following figure. The recursion within Location is now defined. Location can be used anywhere and be guaranteed to be defined identically.

In addition to recursive structures, commonly used simple structures can be defined as Record Reference Lists instead of Record Lists to make future modification to them easy to manage. Doing so is an added step after the default record structure is created from the example XML file. However, this allows the record structure to remain flexible while ensuring its consistent definition. I plan to convert all the commonly used Record Lists to Record Reference Lists as my project schedule permits. **Quantity** is an example of this.

Also, during coding it can be necessary to use a part of the B2MML structure as a temporary working area. To be sure these temporary structures match precisely the B2MML substructure they copy, defining them as separate records and referring to them in the main structure proves most useful. **MaterialConsumedRequirement** is an example of this in my application. The Business Connector tool allows an easy migration from a Record List to a Record Reference List. If the Record to be referenced is first copied and saved. Then the record containing it can be modified by adding the reference and removing the original record structure without saving in between. If changed in this manner, the resulting record will have the same structure as the original. All uses of the now referenced fields will remain unchanged in the code.
Left: ProductionPerformance Business Connector Record
Upper Right: Business Connector Package Structure
Lower Right: Location Record Reference List Example
4.5 Version Management

While the Business Connector tool makes it easy to modify a record structure and propagate that change to all code modules, known as services, such propagation is usually not desired in a production environment. If one MES system is using version 1 of B2MML, we cannot send a record structured after version 2 of B2MML to it until it is ready to process the new structure. The B2MML interfaces should have no trouble passing over new structures in the XML that they are not prepared to receive. However, some of the difference between version 1 and 2 changed existing structures, such as quantity and the any structures.

We separated the services that are called by each system from those that do the mapping. Each MES system calls a unique service when sending a particular record structure to SAP. SAP uses a different destination, known as a Partner Profile, for each MES system when sending a message. This allows the individual routing services for each system to be managed separately from the mapping services. Routing of messages and selecting the processing method can be changed from the one version of B2MML to the next, one system at a time. This is also useful when simply changing the code we use to process B2MML in Business Connector. On the development system, as we change the mapping service logic and record structures, we want to be sure we have thoroughly tested them before releasing them. On the production system, even fully tested new code may not be moved into production for all systems at the same time. Often manufacturing systems have rules that require new software to only be installed during scheduled production downtime. Perhaps the system has validation requirements necessitating the execution of a validation protocol for each installation.

5 Key Challenges Ahead

5.1 Change Management

Change Management will be a key aspect of the S95 infrastructure we put in place. Installing an automatic interface between ERP and MES, while speeding the exchange of accurate business knowledge between ERP and MES, can also rapidly transmit an error generated by a design flaw or oversight causing damage to key business information.

Change will come in many forms including, rollout to new MES sites, hardware infrastructure upgrades, mapping logic improvements, new messages, message infrastructure change away from Business Connector flow language, XML technology changes, and B2MML and BatchML standard changes.

The World Batch Forum must help us in the change management challenge by ensuring that the standard is upwardly compatible and universally understood. Upward compatibility will require that care is taken to ensure that a structure is placed in the standard correctly from the beginning. The understanding of the standard can be improved with more documentation, specific examples, test cases, and dynamic participation of the user community. I look forward to participating with the World Batch Forum XML Working Group as much as possible on both of these aspects.

5.2 Using All of B2MML and BatchML

Encompassing more of the scope of S95 and S88 information exchange in our future infrastructure is a requirement of projects at our company in the next fiscal year. The requirements for information exchange from ERP to MES include Production Schedules, Bills of Materials, Recipes, Material Master Data, Quality Test Plans, Material Location, among others. The requirements for information exchange
from MES to ERP include Material Consumption, Material Production, Material Movement, Quality Test Results, Electronic Batch Records, Electronic Signatures, plus others. Beyond these requirements, information will likely need to be exchanged with other systems such as Warehouse Management, Planning, Maintenance, some of which are not part of our ERP system, SAP.

We are designating roles in our MES department, one to oversee the Business Connector infrastructure used by MES, the other to own the B2MML interface application with SAP. Both these roles will require updates on the technology direction of XML and SAP. In such a large company with islands of project management and system development, both the people in these roles will need to actively promote the use of B2MML and this Business Connector infrastructure as the primary means of information exchange.

The owner of the B2MML interface will need to work closing with the World Batch Forum to understand the proper application of the standard to our business requirements. Sharing methods of integration and even Business Connector code among a community of SAP B2MML interface users outside our company will be required to make the development and maintenance of our interface cost effective and poised for replacement by a vendor supported solution in the future. This community should encourage SAP to adopt the B2MML and BatchML standard by including interfaces that use these standards in their base product.

5.3 Promoting B2MML and BatchML

Promoting B2MML as the standard implementation of S95 is very important. We found universal support for a standard message format for information exchange and widespread knowledge of the S95 and S88 standards. However, our internal and vendor system owners were not aware that B2MML was the XML implementation of the S95 standard. Before software vendors will build a B2MML or BatchML interface into their product independent of a specific customer request, these standard schemas will have to be accepted by the ERP and MES vendor community.

Not only should the system developers at MES and ERP vendors be the target of this promotion, but so should the developer building a custom interface for use only within his company. If such developers are aware of B2MML and have easy access to its documentation and the related S95 documentation, they can build their internal system to use B2MML thus positioning their company to easily migrate to an off the shelf application that also uses B2MML. Therefore, the ISA standards documents need to be more freely accessible and reproducible. Plus a comprehensive library of examples of the many uses of B2MML will be most valuable to expand understanding of the application of B2MML.

A dynamic and productive user community, mentioned under the topic of change management, is key to this promotion. Not only must we know about the standard, but it must be cost effective to implement. If each company must build its own interface to a common system, such as our ERP system, SAP, these solutions will not be cost effective. Without acceptance of B2MML by the MES and ERP community, custom interfaces, sold by vendors to protect their market share or developed by users as a quick and easy short term solution will continue to propagate.

This user community must work with vendors to encourage and facilitate their development of B2MML and BatchML interfaces in their products. We must put pressure on those vendors that choose not to implement this standard by showing them the value achieved by building an interface to a single industry standard. But most importantly, the user community and the World Batch Forum must work to ensure that the B2MML and BatchML standard are worth standing up for. They must be the true and complete implementation of the S95 and S88 standard.