Designing a cost effective & strong SAP to MES Integration solution

2014

Keep up with the fast paced activities in MES shop floor & sync with SAP in near-real time

101ERP

Implementation Solutions

Designing a strong & cost effective SAP to MES Integration solution

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Introduction:

Companies today are focusing on integrating their MES systems to their core ERP system such as SAP, WMS systems and many other systems for better productivity, visibility and integrity and also to have one core ERP system for reporting. Usually MES systems are complex and designed to closely interact with machines and control systems at the shop floor or manufacturing locations and needs to be constantly fed with accurate data required for manufacturing to happen from the core ERP systems or other sources and as a result the completion of production activities are then required to be reported back to the core ERP systems or to other systems for further processing. This flow of data across the systems should be quick, reliable and accurate.

Companies spend a lot of money and resources on implementing SAP and MES for their manufacturing operations. It is important for a manufacturing company to react quickly to ever changing demands of the market & also to follow GMP & other regulatory practices. Integrating SAP to MES in an efficient way saves a lot of Inventory costs and associated headaches in managing the inventory, improves visibilities at the shop floors and improves in addressing market demands.

Manufacturing companies usually have these MES systems and core ERP systems provided to them by different vendors or custom built and these systems do not talk to each other in a straight forward manner and in some cases these MES systems are built in-house. Architecting and designing a solution that can integrate the MES system with core ERP system such as SAP cannot be taken as a straight forward task, considering the fact that there are several MES systems developed by various vendor companies are being used by manufacturing companies and sometimes with heavy customization to meet the companies process needs. Usually one-size fits all concepts don't do very well and cannot be applied as a robust solution. It is very important to analyze the manufacturing companies MES system, its process capabilities and integration tools for architecting an integration solution with SAP that works productively for the manufacturing companies.

This paper will give an insight into some of the standard set of interfaces, possible integration patterns that can be leveraged, error monitoring, reporting needs & Implementation plans for an effective SAP to MES integration.

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Integration needs in a Process Industry:

Let us consider process industry practices in bulk drug manufacturing, which typically manufacture in batches that uses SAP as core ERP solution for planning and inventory management. The MES systems used at these manufacturing plants are typically tailored to meet their shop floor needs where the MES systems receive master and transactional data from SAP or other core ERP systems on a near real time basis and then sends back production completion information back to ERP systems. There is a standard 10 or 12 Interfaces that is required for a successful SAP and MES integration. These include master and transactional data such as Material Master, Bill of Material (BOM), Recipe, Production Version, Production version approval, Batch master, Inventory details, Process Order, Goods Issue of components, Goods receipts of header material, Phase confirmation, Batch Gain/Loss, Final delivery indicator, again the standard set interfaces cannot be leveraged out of the box and need some level of customization from SAP and MES sides and may be at the middleware side as well. The other important thing to consider is the integration pattern where these standard set of interfaces will be using between SAP and MES.

1. Master data:

There is a constant need of sending new or changed master data information such as Material Master Data, Bill of Material data, Recipe or Routing data and Production version data to MES systems. The data is pushed from SAP into MES on a high frequency basis in order to keep SAP and MES in sync with respect to the master data.

Whenever Master data is created in SAP or updated in SAP there is a need for constant and accurate syncing of master data between SAP and MES. MES will rely on SAP for accurate data in a timely manner. Older data or a delay in master data to MES may result in negative effects such as GMP deviations. SAP provides several out of the box master data messages that can be leveraged along with some customization for effective Master data interfaces to MES systems.

Some of the common master data interfaces that may be necessary are illustrated in the diagram below, but there could be many other based on the business process,

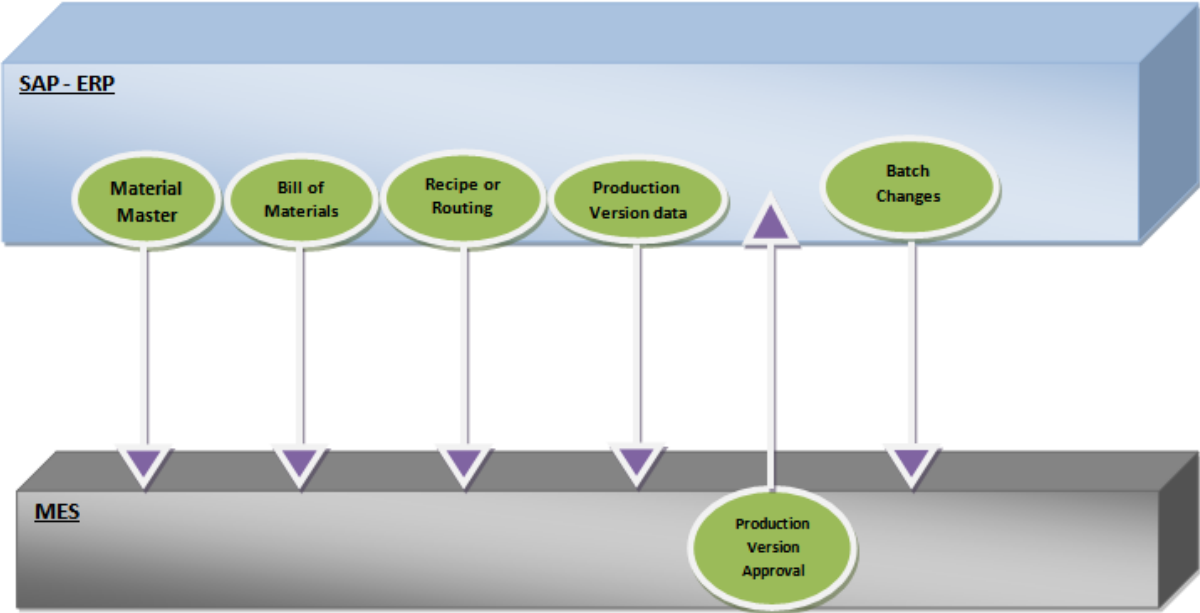# Designing a strong & cost effective SAP to MES Integration solution

Figure 1 – Master data Interfaces to MES

2. Transactional data:

The high frequent interfaces are the transactional data. The day to day transactions needs to be interfaced to MES system in real time or near real time. Starting with process order, batch status information and supply area inventory details. When production activities are complete the MES system will interface back Goods Issue for components and Goods receipts for the finished/semi finished product that was manufactured. In the process industry MES will also send back Phase confirmation message to SAP indicating a particular phase has been completed. In some scenarios the MES system will also send back Batch Gain/Loss transaction back to SAP to level the Inventory used. Finally the order close message is interfaced to SAP that will mark the process order complete in SAP system. The diagram below will give an idea on the interfaced messages.

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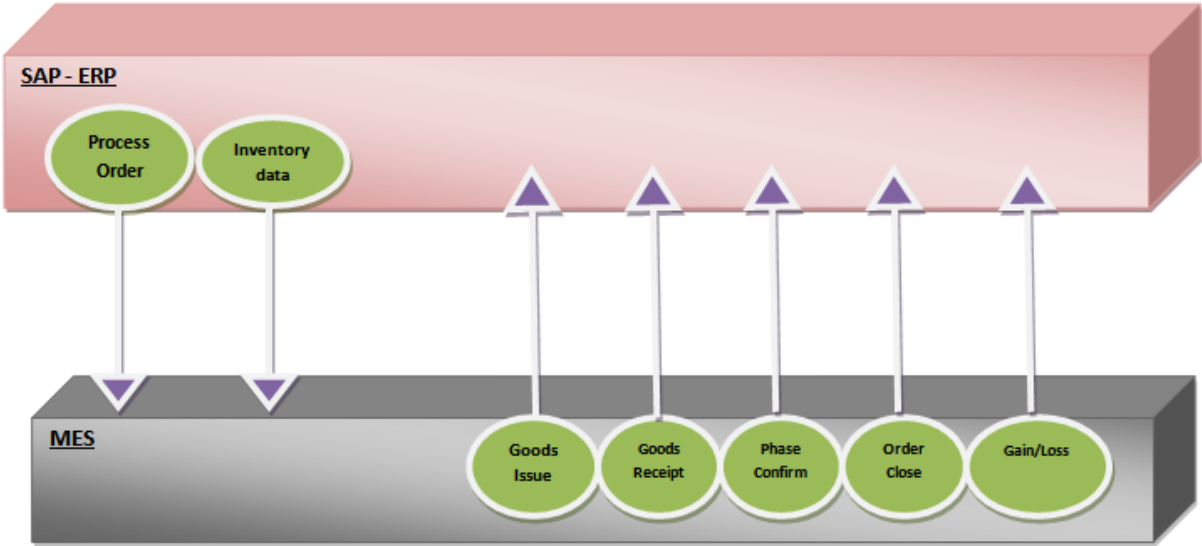# Designing a strong & cost effective SAP to MES Integration solution

Figure 2 – Transactional data Interfaces to MES

Possible Integration Scenarios:

1. File based Integration:

File based integration is used traditionally to integrate with MES systems however we are getting away from it now. In this pattern SAP application creates the message in the form of an IDOC which is in turn converted into a flat file or an XML file and placed on the Unix Landing zone, this conversion of IDOC to a file can be controlled via the partner settings in SAP. Once the file is placed in the SAP Unix Landing zone, we could run some basic UNIX shell scripts to backup the files and move to another folder where MQSI or GIS can pick it up based on some polling mechanism. When MQSI or GIS picks up the file from the landing zone it will delete the file from the landing zone and then deliver the file to the respective MES client based on a routing logic defined in MQSI file flows or in GIS rules.

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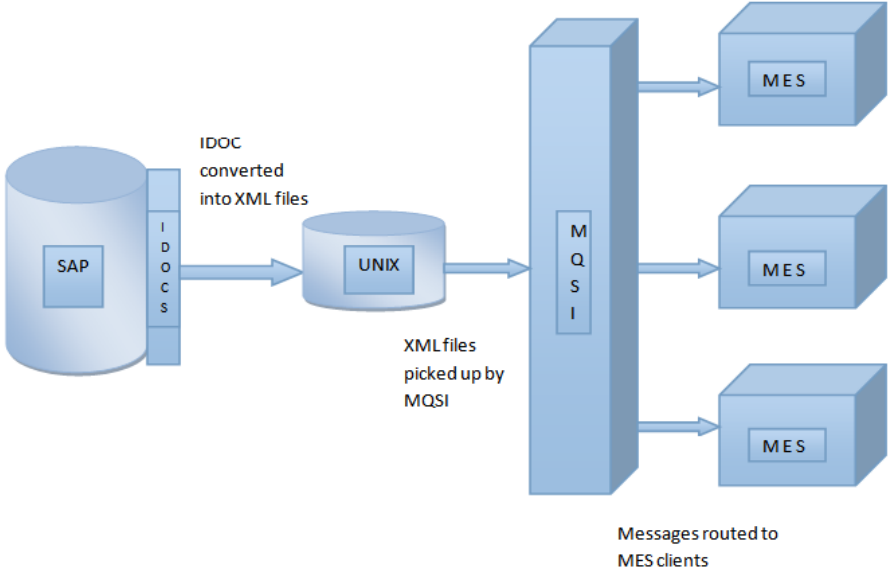# Designing a strong & cost effective SAP to MES Integration solution

Figure 3.1 – File based Integration pattern between SAP & MES with MQSI as middleware
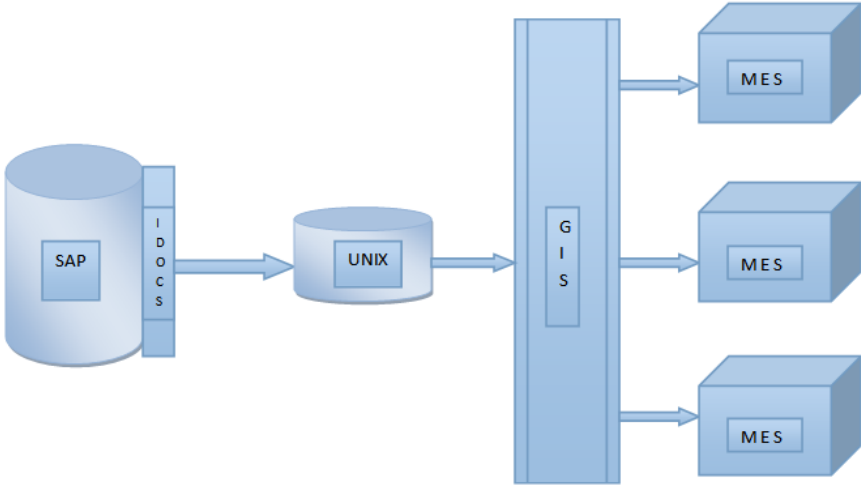

Figure 3.2 – File based Integration pattern between SAP & MES with GIS as middleware

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This pattern may be cheaper to implement and might suit best for small volumes of files moving across to MES. Since we are using MQSI as a middleware it can also do some transformation logic if necessary to alter the value of fields from the flat file or XML file to MES system. Another possible scenario is the use of GIS-MFT.

2. Non-File based Integration using SAP PI & MQSI:

IDOC sent to SAP PI via RFC channel

SAP ECC — IDOCS → SAP PI

SAP PI passing on to MQSI

MQSI → MES / MES / MES

Messages routed to MES clients

Figure 4 – Non-File based Integration pattern between SAP & MES

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File based integration patterns has its own disadvantages. Another modern and more advantageous way of integrating SAP and MES is introducing another SAP PI system. SAP PI is a robust standalone system that can do routing & transformation of messages. The output from PI can be sent to MQSI or even without MQSI the messages can be delivered to MES systems. The good thing about using SAP PI as the middleware system is that it talks better with SAP ECC as it is supplied by the same vendor.

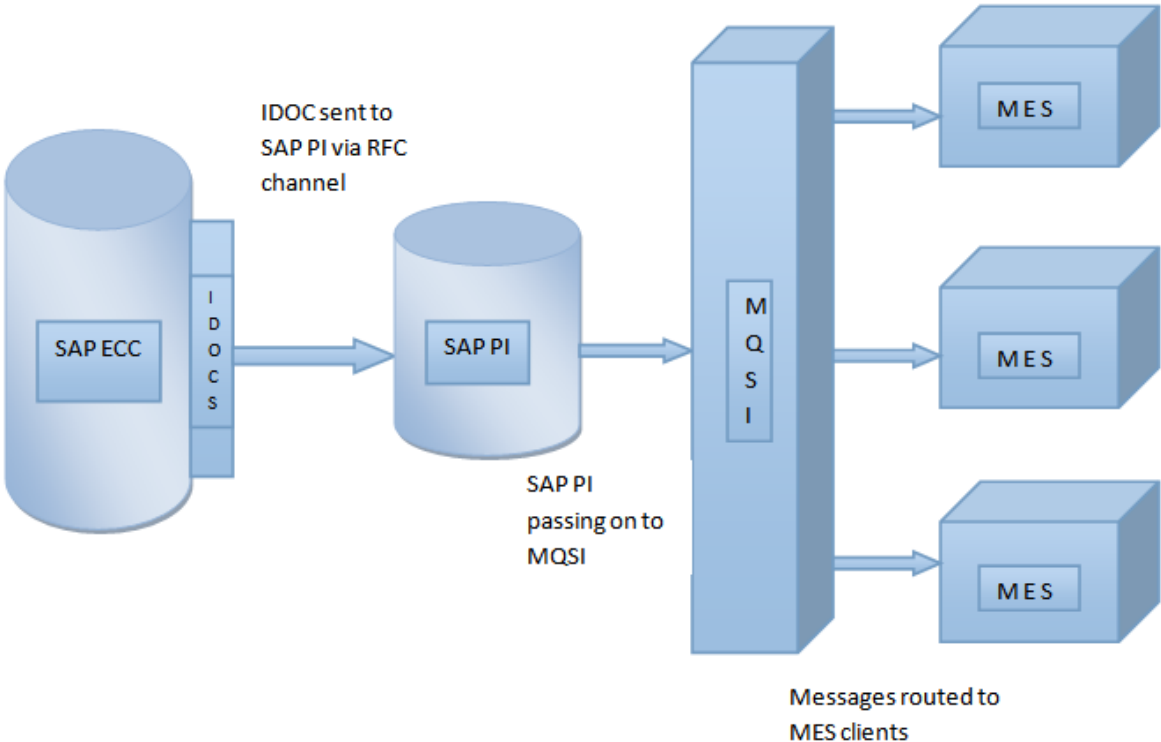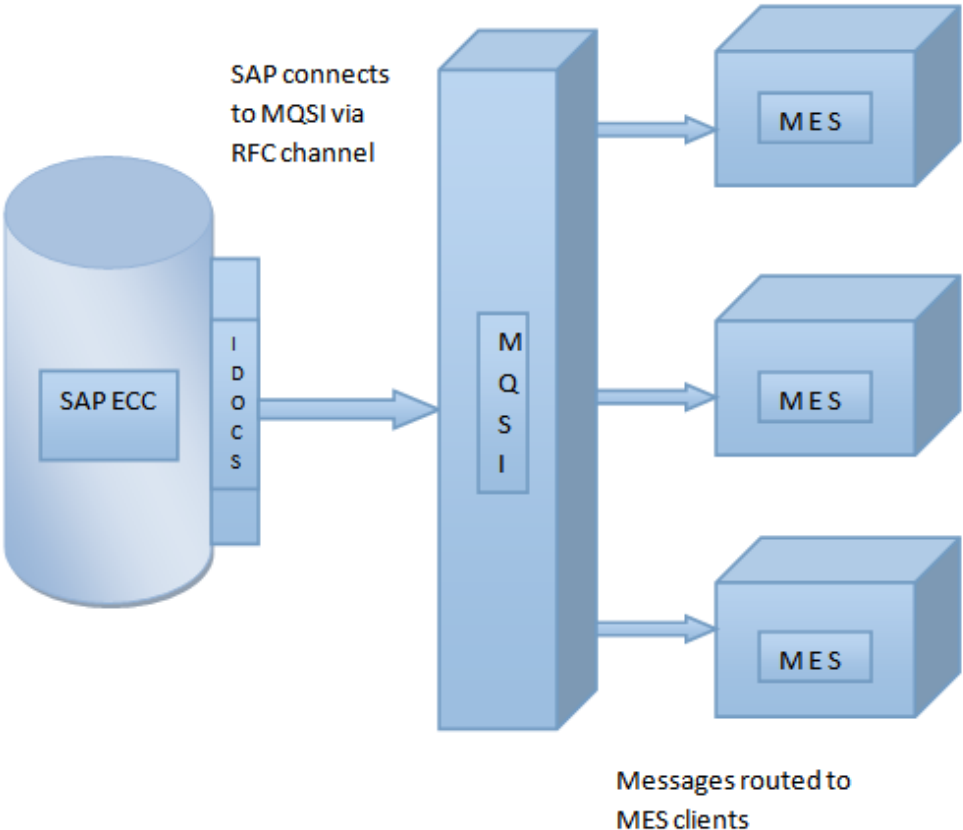## *3. Non-File based integration with MQSI as middleware:*

Figure 5 – Non-File based Integration pattern between SAP & MES

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Using SAP PI may prove a bit expensive and instead MQSI can itself be used as the middleware system to do the routing and transformation. This is a proven, stable and cost effective model. The good thing about MQSI is that the changes can be implemented & tested with little resources and costs.

Choosing a workable Integration pattern:

While many possible Integration patterns could work for SAP to MES integration, there are few things to keep in mind to ensure the near-real time & sequencing of data back and forth from both the systems. The most stable pattern will be SAP ECC to SAP PI to MQSI to MES and here is the reason why, ECC talks to PI better as they both are from the same vendor. PI and MQSI also communicate well because both are meant to stand alone irrespective of what the ERP systems are. On top of this IDOC based asynchronous communication in near real time gives us the sequencing of data from and to SAP ECC and it also helps in trouble shooting when problem or failure occurs, on the other hand instead of IDOCs, if we extract data directly from SAP ECC in the form of flat or XML file, it becomes very hard to maintain during problems and sequencing becomes a nightmare. Also MQSI works in queue based FIFO concept, so the message that is sent in the form of IDOCS to PI to MQSI as a message gets routed in the same sequence as it was sent to the MES system.

1. Why sequencing matters

In ECC whenever a new batch is created we send the batch master data in the form of BATMAS or WMMBXY message to MES, let's say when the batch is updated with status changes, like when there is a QM inspection done on a batch it could be released for issue or could be blocked for certain reasons, and when this happens, the status of the batch gets updated automatically due to the necessary QM postings, it is important to communicate the status change of the batch to MES instantly, if there is a delay or failure to do so may result in MES issuing a bad component to the production floor and may become a serious GMP deviation and the batch status may often change and whenever the status changes it is important to communicate the status in the right sequence to the MES system. So the MES system knows what to do during manufacturing based on various statuses on the batch. Another example is Inventory reconciliation between SAP and MES systems. If SAP is throwing out the current

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Inventory snapshot to MES system multiple times a day, it is important that MES process the snapshots in the right sequence to ensure the comparison of Inventory is done in right point in time.

2. Why near-real time matters

The ideal scenario would be real-time integration however due to technical limitations between the systems usually we go for near-real time integration between SAP & MES systems which is reasonable and works well too. Of all the interfaces that SAP & MES send or receive, Batch status, stock status, inventory details such as transfer orders, available inventory in production shop floor or supply area etc needs to be communicated to MES as quick as possible. These data in SAP changes often due to various reasons and it is very important those changes are communicated to MES system quickly. For example, let's say that we have already sent a process order to the MES system, and MES system has already started to use the batch associated with one of the components associated with the phase, while this is going on for whatever reason the batch is put to blocked or restricted status in SAP. If this Batch status change is not communicated to MES, it becomes a GMP deviation. So, as soon as the Batch status changes in SAP, we communicate that to MES and MES will decide what to do with the batch based on the SOP's defined for certain batch status.

Controlling the Interfaces for effective integration:

Irrespective of the Integration pattern we choose, controlling the flow of Interfaces is an important aspect of successful SAP to MES integration. These ideas are based on best practice and it will work in the process industry, Let us take only some of the commonly used interfaces and analyze how the flow of interfaces makes an effect,

1. Material Master:

This is the first message that typically gets interfaced to MES system. We all know Material Master has many fields and MES does not really care about all the fields that are on the Material Master in SAP and Material Master field gets updated often due to various reasons in SAP and not every change needs to be communicated to MES system. So understanding what fields does MES care and a bit of customization from SAP side & necessary settings to trigger the Material Master interface such as

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MATMAS can really be the ideal solution around Material Master Interface. It is also important to trigger the interface only when the fields of interests on the material master get changed.

2. Bill of Materials:

Information about the BOM or Bill of Materials in SAP can be sent to MES via BOMMAT message type and BOM may have many alternates and it is important MES knows which version of BOM in SAP it is dealing with when authoring their own recipe. MES may need to know certain field values that may not be available in standard SAP and hence a bit of screen customization is required to accommodate extra field values. Triggering the BOM interface should also be done whenever it is changed in SAP.

3. Recipe:

In SAP, Recipes are created and sent to MES system in the form of LOIROU message and MES system needs to set up their own recipe based on the information on the LOIROU message received from SAP system. Setting up of recipe might be a little tedious work in MES and it may involve series of approval workflows after authoring in MES. SAP does allow the Recipes to be changed, it might be a better idea to have a control in SAP that basically stops interfacing changes recipe, instead have a process of creating a new recipe and interface it to MES system, which will trigger another round of approval process in MES.

4. Production Version & Approval of Production version:

A production version is a combination of Material, BOM & Recipe. So which BOM & which Recipe are tied to a particular material is what a Production Version says. A BOM could technically have multiple alternates and technically recipes can also have many counters in SAP. A production version ties both together and keeps a validity date. The important thing here is that the production version must be sent to MES before process order is created and sent to MES. The production version which ties which BOM and which recipe is being used must also be acknowledged by MES system to ensure MES and SAP are in good understanding. So it might be a better idea to do a bit of customization in SAP to monitor the production version outbound to MES and in turn MES sends back a confirmation or approval back to SAP. Only upon this check is validated process order must be sent down to MES.

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5. Batch:

Batch status interface or Lot status interface is a very sensitive interface and this can be sent to MES in the form of BATMAS or WMMBXY message types and critical thing here is that batch information needs to be downloaded to MES in near-real time and in a proper sequence because the same batch gets sent to MES a multiple times. A change pointer mechanism in SAP can be used to send the message out to MES whenever a new batch is created or changed. Also, setting up of classes to hold required field values is another option to send more information to MES. This may also lead to some amount of customization in IDOC structure to accommodate new fields in the classes. Triggering of the batches must be instant unlike other IDOC where we can control the triggering and sending the IDOCs to MES in a more controlling fashion thru cron or batch jobs.

6. Process Orders:

It is important to keep in mind the MES approved production version is what we are using in the process order before it gets interfaced. Only then MES can start the shop floor execution as per the recipe and BOM that it has already established. It is also important to consider setting up controls in SAP to ensure the production version is in approved status before the process order can be sent to MES. When the process order is created in SAP, in some cases it is possible the batch for the manufactured product is also created as a default and this needs to be sent to MES as well but only after the process order is sent to MES. Some MES systems may create a batch if SAP does not send it to them in time or send at all where the manufactured goods receipts needs to happen. Any batch determination against the process order line item must also be on the interface. Message types such as LOIPRO can carry process order data to MES.

7. Other messages that may be interfaced to MES:

Inventory related messages such as Handling unit information or transfer orders in SAP may sometimes be referred to sub-lots or containers in MES. Only HU or TO inventory that is relevant for PSA's are relevant for MES system. So these messages can go in the form of WMMBXY or WMTORD message from SAP to MES. Inventory compare reports are another example to certain MES systems, where the snapshot of inventory from SAP is sent to MES for comparison.

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8. Inbound messages from MES to SAP:

Once process order, batch and inventory details are successfully sent and settled in MES, the system will start their EBR/weigh dispensing process and as a result of successful processing/completion of every phase MES will send back to SAP goods issue message telling SAP which messages have been consumed and other associated details, so that SAP can do necessary transactions to adjust the inventory against the process order. At the completion of every phase MES sends a phase confirmation message to SAP indicating that the phase is complete and necessary components have been consumed. This will mark the process order phase as complete and allows costing to take care of necessary entries. At the end of production MES will send goods receipt interface for the manufacturing product that will post necessary increase in inventory in SAP followed by a final delivery indicator message to close the process order in SAP. During interface design it is important to let MES system know which message structure must be used for what transaction in what format. A copy of XML schema from SAP should be sent to MES for accuracy in structure of the IDOC that MES sends to SAP.

Reporting & Error Monitoring:

In SAP there are several reporting tools available to check the status of the interfaces. This helps in near-real time error monitoring. Simple customizations can be done to send an email alert when an IDOC fails in SAP be it inbounds or Outbound. Similarly middleware systems such as SAP PI, GIS & MQSI have its own reporting & error monitoring tools available to monitor the RFC channels, message flows & adapters to check for errors.

Implementation Methodology:

Our customers can take advantage of our robust and cost effective project delivery plan using ASAP methodology using standard industry best practices. Please see below for a high level overview of our implementation path for an integration project.

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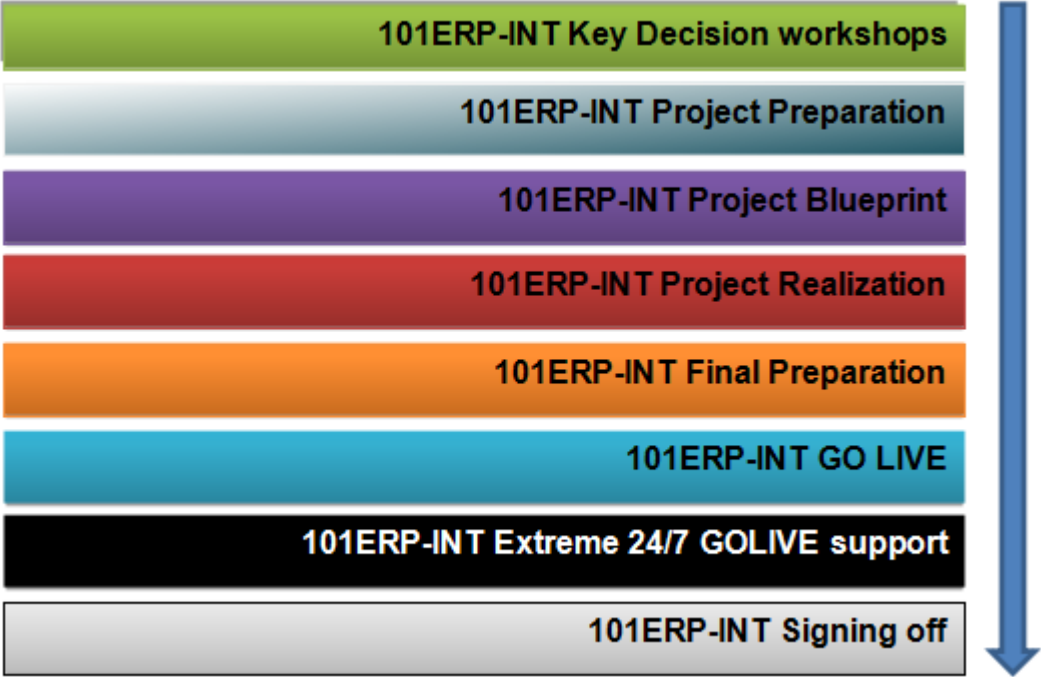# Designing a strong & cost effective SAP to MES Integration solution

Figure 6 – Implementation Methodology

Manufacturing companies can take advantage of our Robust & cost effective SAP Integration Implementation, Deployment & Support solutions. Our solutions are based on recent trends in technologies, home grown templates and excellent SAP Integration team that can deliver what was promised to our customers. Our delivery model is simple and provides great detail of Visibility and helps our customers to have a 24/7 coverage even during implementation and of course during extreme care during GO LIVE.

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Offshore coordination
Status Updates
Project management assistance
Solutions Design assistance
QA Testing
Extreme care 24/7 GOLIVE Support/assistance

Remote SAP Delivery Office – US

101ERPTEAM GLOBAL DELIVERY MODEL

Remote SAP Delivery Office – Offshore

SAP Team at Customer's site

Onsite coordination
24/7 Normal support and Extreme care assistance
ABAP developments
Configuration
Unit Testing

Customer workshops
Project Management
Customer status meetings
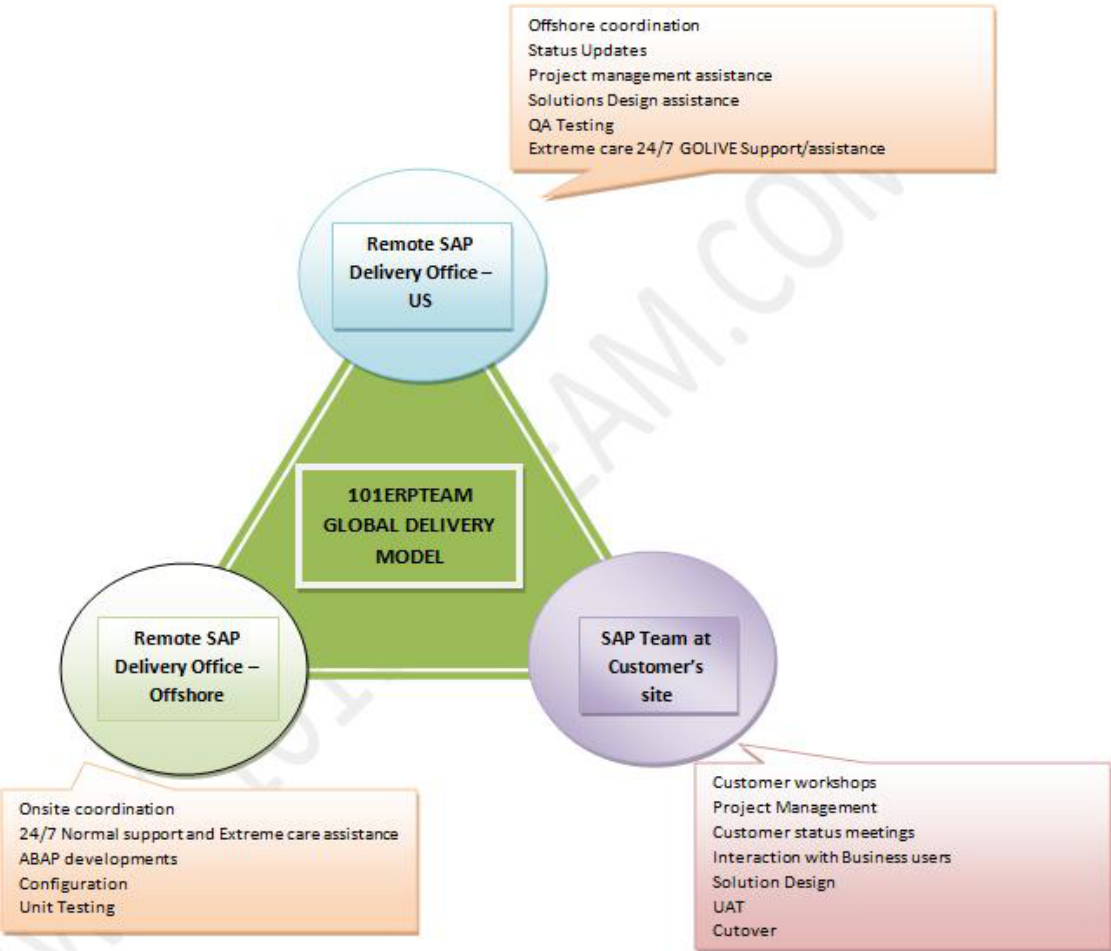Interaction with Business users
Solution Design
UAT
Cutover

Figure 7 – Delivery Model

Important factors determining the cost benefits:

1) With Industry best practices, lessons learned, expert & reliable team members, there is always cost savings for our customers.
2) High level initial requirements analysis (KD) is done even before we formally sign a contract, so our customers do not have to spend on initial analysis.

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3) 24/7 support during go live or after go live, this way issues gets resolved in time & 24/7 design & development, this way we deliver the solution quickly

4) Very narrow production outage window, thus saving business impacts

5) You can take advantage of our Cloud model, if required. This way the landscape establishment and maintenance costs can be significantly reduced.

Conclusion:

SAP to MES integration plays a critical role in process industries. It is important that the standard set of interfaces is leveraged with some of customization for an effective integration. Well of course there could be other interfaces between SAP and MES that might be critical for an organization, which should also be considered during analyzing the requirements and ensure it is compatible with the standard set of interfaces. 101ERPTEAM can assist in analyzing your current ERP architecture and provide a cost effective end to end Integration solution that will assist your manufacturing operations to realize value added advantages in reducing inventory costs, reacting to market demands and visibility at shop floor & to be ahead of the competition. Our implementation methodology is based on industry best standards with core focus on saving costs and providing flexible solutions at the same time. Our implementation team follows best practices from the industry and follows ASAP methodology for a full cycle implementation. With this, you certainly save implementation costs.

For more details about how 101ERPTEAM can assist your organization in realizing a cost effective End to End SAP to MES integration please email BDM@101ERPTEAM.COM

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