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WORKING PAPER
Global Make to inventory strategy at BASF SE

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Table of contents

INVENTORY MANAGEMENT AT BASF SE

This paper describes the management of inventory at BASF SE and its chemical plants across the world.

BASF SE focuses on production optimization that could reduce inventory levels and reduce logistic costs. In order to determine the levels of inventory, BASF is supported by the Advanced Planning System (APS) that allows the company to effectively forecast the demand for goods and services in the market and use the existing ERP systems (Enterprise Resource Planning) to manage BASF´s business.

In Mexico and South America, BASF SE has implemented a Shared Inventory Management service that has resulted in the replacement of short term sales to long term contracts and lasting relationship with costumers. *"The Inventory strategy includes the processes of planning, executing, monitoring, and controlling the design, offering, promotion, and distribution of products and services to meet organizational objectives"*[1]

In the past the lack of automated data collection and management information systems resulted in frequent additional costs associated to rush deliveries to maintain customers' promises, maintain the scheduled deliveries and ensure the loyalty and reliability of BASF as the supplier. These additional costs and the business risks motivated BASF to seek for a technological way to manage its inventories. Date collection hardware was implemented and provided to establish a pro-active inventory monitoring system that resulted in better demand forecasting, optimal production planning and more efficient product dispatching.

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[1] Alan L. Milliken. Supply Chain BASF Mexico 2002.

The remote data collection transmits real-time information of inventory data and facilitates the access by the supplier and the buyer. It also forecasts the demands and is able to identify inventory trends, filling cycles and other inventory changes from the historical data record to predict time-to-empty, identify filling sequences, calculate precise inventory volumes, and reconcile shipment & receipt records.[2]

At present, there is no total integration with business systems implemented. Nevertheless, the implementation of shared inventory management will be a base upon integrate the SAP system in the future and manage order fulfilment and integration with BASF's manufacturing facilities.

Inventory process – SAP/R3

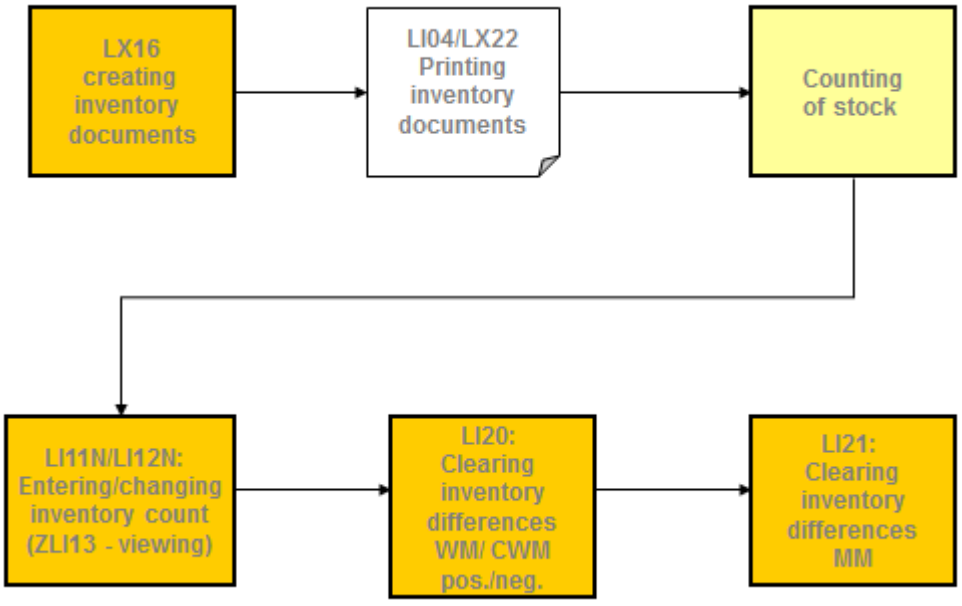

Figure 1: Coatings BASF SE. Inventory process SAP R/3[3]

[2] Alan L. Milliken. Harnessing the Power of Supply Chain Metric. BASF corporation 2002.
[3] BASF Coatings. Inventory process SAP/R3 ppt.

The figure above illustrates the inventory process in the system SAP/R3 from the starting point of the creation of the inventory documents until reconciliation of inventory differences in WM and MM.

GSS/TI Strategy impact on Inventory

At present, a global process for the management of Inventory does not exist, the methodology is decided locally and the production plants have freedom to reconcile the stock manually or in the system.

The global strategy of GSS/TI aims to define a global process for production that covers the manufacturing field of the supply chain and its interfaces. Furthermore, it promotes the use of the following systems to ensure the transparency and transferability of the information across the processes.

Business Systems Integration

The use of planning systems that register business actions is needed to optimize levels of inventory and update supply plans based on accurate inventory data from different operational locations. The integration of systems allows having demand forecasting and receipt reconciliation.

- Business Governance systems[4]: This term refers to the use of shared data that provides integrated support for all the business processes in BASF. Complete integration and avoidance of isolated solutions results in a system in which resources can be managed on a company-wide basis. In terms of inventory the use of governance systems will make easier the planning to forecast the demand.

[4] BASF Intranet.2011

- Process Governance systems: This term refers to standardized, integrated process solutions within the BASF landscape based on business requirements and scenarios. By having integrated process BASF will be able to improve the performance and reduce interruptions to business processes. In terms of Inventory the process governance systems will ensure the optimization of the levels of inventory.
- Shop floor systems:[5] Shop floor systems are used at different levels in decision- making processes as an instrument for monitoring, controlling, planning business operations, and analysing data from the area of production. The shop floor systems contain informative key figures (short lead times, good on-time delivery performance, good capacity load utilization, low costs) which help to permanently monitor the key aims in production in order to be in a position to take necessary action in good time. These systems will provide real time information that will potentially reduce the amount of correction of the inventory.
- SAP Standard transactions: Global BASF transactions in the field of logistics and production. SAP (Z2L) includes a wide range of transactions to complete the processes. In the case of inventory the transaction recommended to do the inventory management are:

LX16	Creation of inventory documents
LI04/LX22	Prinitng inventory documents
LI11N	Entering inventory count
LI12N	Changing inventory count
LI20	Clearing inventory differences
LI21	Clearing Inventory differences.

- SAP MII: SAP Manufacturing integration and intelligence. This application solves the disconnect between the plant floor and the rest of the enterprise. It ensures that all the data that affects manufacturing is visible in real time.

[5] BASF. Information systems.2011

Including information about orders, materials, equipment status, costs, and product quality.[6]

Best practices stock

GSS/TI has developed best practices that are relevant and involves the level of stocks in the different business scenarios.[7]

- Movement of stocks: The movement of stocks from one storage location should be processed using the transaction MIGO, (e.g. MT 311 or 301) when transport and documents are necessary to accompany the goods.
- Transference of Stock: Transference of Stock is required, if stock moving cannot be processed using Stock Movement. Transference of Stock will always have a delivery and consist of a goods issue (GI) against the delivery at the sending location and a goods receipt (GR) at the receiving location.
- Stock Inspection lots: Inspection lots are created upon the release of the process order. The material produced is booked to quality inspection stock or unrestricted use stock, dependent upon local requirements
- Shelf life: Shelf life defines how long the material can be held in stock before its performance or activity falls below a specified level or time after which it should be re-assessed. Slow-moving, non-moving and aged stock inventory should be proactively managed.

Monthly stock count

GSS/TI has established guidelines to for the stock count, it is recommended that stocks of material used in production are counted monthly to identify the

[6] SAP Help Portal. Application supply chain management.
[7] Hodel, B./Hook, J./Yarrow, P. (2010): Blueprint for Process Integration. M2I (Make-to-Inventory) / B2R (Book to Report), 2011.

differences between the stock figures in the systems and the consumption of materials. When the divergences are high this count should be made more often.

Material with low values can be count less frequently (local decision). The count can be made through the use of the SAP and global transaction such as MB52. During the process local procedures need to be in place to ensure that no system consumptions of materials take place while the stock count is being finalized.

Correction levels of inventory

Arising the count of stock some differences might be identified and decision should be made to correct the deviation vs the book stocks by a posting to a process order or write it off. If the correct quantity required for the process has been physically consumed, then the Bill Of Materials (BoM) should be reviewed (to align it with the consumption). The differences can be corrected by adjustments to one or multiple Process Orders.[8]

An investigation is recommended to identify the cause of the deviations and to reduce the production variances.

[8] Hodel, B./Hook, J./Yarrow, P. (2010): Blueprint for Process Integration. M2I (Make-to-Inventory) / B2R (Book to Report), 2011.

GSS-TI MAKE TO INVENTORY AT BASF SE

Make to Inventory is a company-wide core business process. It describes, optimizes and coordinates all process steps from material entry via production to inventory management. Quality management and site logistics are also integrated parts of process as well as Business process governance, Business Systems Governance and Shop Floor systems Governance.
The aim of Make to Inventory is to provide accurate and standardized processes that will guarantee an improvement of real-time system information, coordination of raw material purchase levels, and real-time stock transparency. Thus, it will provide optimal inventory levels ensuring that BASF adheres to its delivery promises.
In order to define and ensure global operational processes on adequate level, M2I has to define business best practices, and structure the global expert network in order to get collaboration with strategic partners. The first step is to discuss and finalize regional approaches for global benefit analysis and elaborate criteria for pilot selection.

1.1.1 Make to Inventory scenarios

The scenarios structure the whole possible combinations of process steps into a defined list of standard BASF-variants.

All these physical steps are accompanied by transactions and documents generated by SAP which can assist the process. A brief graphical overview is given below:

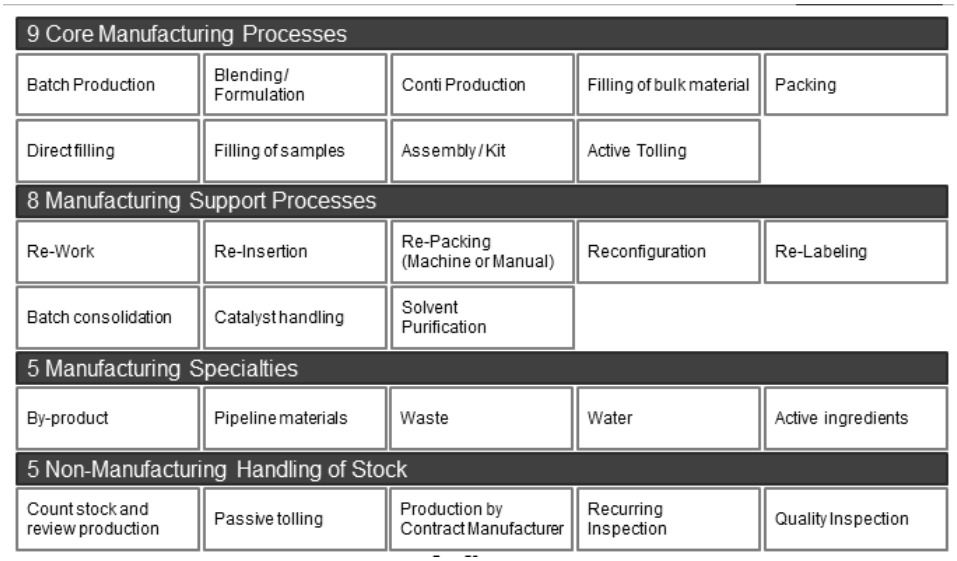

Figure 2: M2I Scenarios[9]

1.1.2 Make to Inventory processes

Make to Inventory (M2I) processes describe, optimize and coordinate all steps from material entry to production to inventory management. All processes are defined to use SAP ERP module PP-PI. Thus, repetitive manufacturing is not supported by the global M2I process model.[10]

The software AENEIS provides a list of End to End processes from level 1 to level 5. The figure below shows the aggrupation of processes.

[9] GSS/TI. Make to Inventory. SharePoint.2011

[10] HODEL, Bruno. M2I Business Scenarios- 04.04.2012 (updated), Ludwigshafen, 2012

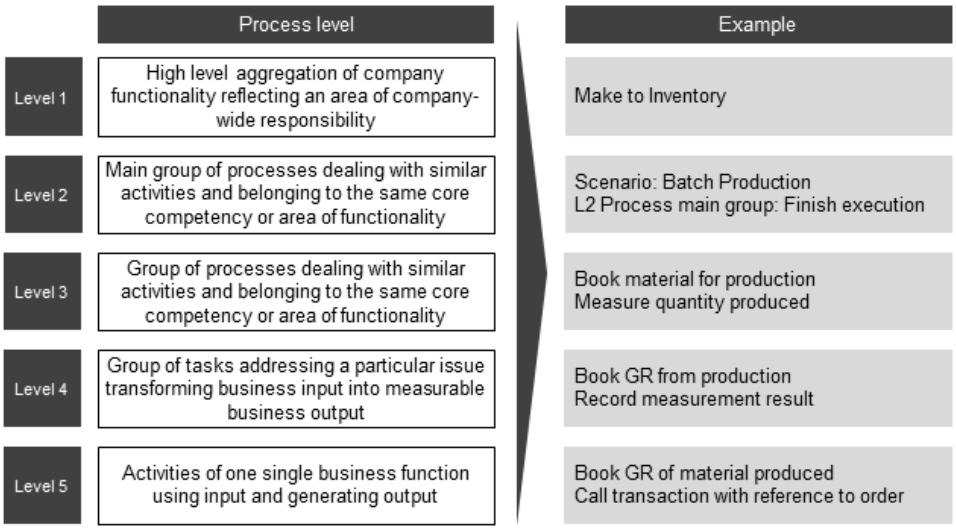

Figure 3: M2I Processes level AENEIS[11]

1.1.3 Solution and systems

Make to Inventory has identified systems that could represent a solution to integrate the supply chain

- Standard SAP

SAP PP:

SAP R/3 has a highly integrated Production Planning System known as SAP PP. This module is divided into two Sub-modules, 'PP-PI' and 'Production General'. This module is in charge of Master data and the Bill of materials; routings work Centres and stores it in one separate component.

SAP SCM:

Result of the computation of production planning performance data. The production plan created in PP/DS can be evaluated in the Plan Analyser using a table of key figures such as setup times or stock levels. The key figures are evaluated by a point system which results in a total score derived either by adding up the individual points or by using a formula.

[11] NEU, Jens. Master presentation GRS/TI "Make to Inventory" - V10.2, Ludwigshafen, 2011

- Support tools

Order cockpit:[12]

An administrative tool for prioritizing offers and verifying the logic of offer detection in the real-time decisions.

Access Database:[13]

Access is a database tool for gathering and understanding all the information. It provides a convenient way to enter, navigate and report out the data.
This tool is useful for collection of contact information accurately from large data base.

- Middleware[14]:

It is software that connects applications. The aim is to link the database system to Web servers. This allows users to request data from the database using forms displayed on a web browser, and it enables the Web server to return dynamic information.

- Quality:

In the area of Quality, Make to inventory aims to integrate the interfaces and develop a strategy in LIMS system.

- Production:

In the field of production Make to Inventory aims to harmonize the ERP systems and establish global guidelines for processes.

[12] http://help.sap.com/saphelp_spm21
[13] http://office.microsoft.com/en-us/access/
[14] http://www.middleware.org/whatis.html

M2I STRATEGY DEVELOPMENT

1.2 Initial situation and scope

BASF aims to have global optimized and harmonized processes, in order to remain the leading company in the chemical industry. Under the overall responsibility of GSS (Global Supply Chain & Process Innovation), BASF has successfully completed the senior project Accelerator which aimed to optimize and harmonize business processes globally. Accelerator focused on core commercial processes like Order to Cash and Purchase to Pay but did not address the end-to-end process Make to Inventory (M2I). Make to Inventory includes all transactional processes in the area of production, quality management, warehouse management and site logistics. To close this missing link, GSS/TI was established in summer 2011 to take over the global governance for the M2I process cluster and drive forward the process optimization and harmonization.[15]

16

Figure 4: End to End processes Make to Inventory[17]

15 KLINGER, GEORGES: IS & SC Report. GSS/TI successfully completes M2I strategy development. 2012

16 GSS/TI Strategy PP.

17 NEU, Jens. Master presentation GRS/TI "Make to Inventory" - V10.2, Ludwigshafen, 2011

1.3 M2I Strategy objectives

The strategy of M2I aims to develop and define global process landscape which applies to all regions, and integrate them in enterprise (ERP) and production (MES) systems through alignment of GRS/TI, GTF, and GS/E.

The project also aims to establish a network of global, regional and business process experts identified as M2I community. Partner with IT Gatekeepers to provide a Change Request “solution team” by combining business process and IT knowledge.

Finally the project proposes Interfaces to other global core processes such as Purchase to Pay (P2P), Order to Cash (OTC), Transport Management (TM), and Non Conformance Management (NCM) as it assumes benefits through cross-functional synergies.

Process optimization and harmonization becomes a major challenge, considering that more than 70 global and regional operational business units with more than 750 production plants are performing M2I operations.

1.4 Alignment M2I Strategy

It is important to see whether M2I global strategy is aligned with BASF philosophy.

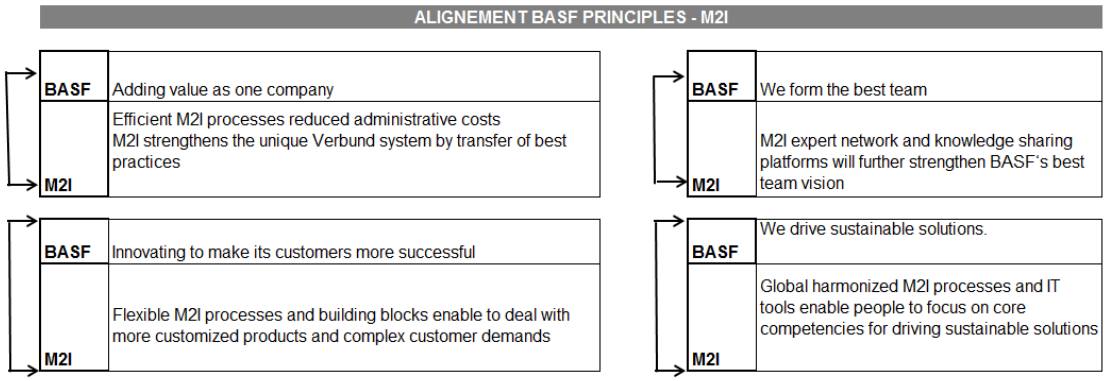

Figure 5: Alignment evaluation: Strategic principles[18]

[18] BASF M2I Strategy. Project Results and Path Forward.2012

As the figure shows it exists a high degree of connection between BASF principles, stated in the four pillars of the strategy and the objectives of M2I, it is also useful to compare the strategy in terms of the supply chain:
The aim of Make to Inventory is to integrate the manufacturing process in the supply chain to reflect the reality in the processes and establish guidelines in the areas of production, quality management and warehouse / storage management.

BASF	Operational and technology excellence. Reliable, low-cost logistics	Differentiated business models and logistics	Establish a community of experts and teams who are close to customers.	Follow the scale, integration and raw material conditions.
STRATEGY SUPPLY CHAIN				
M2I	Process optimization and harmonization becomes a major challenge, considering that more than 70 global and regional operational business units with more than 750 production plants are performing M2I operations.	To reflect the high diversity of production within BASF, flexible To-Be process modules were defined	M2I has to define business best practices, and structure the global expert network in order to get collaboration with strategic partners.	The aim of make to inventory is to provide accurate and standardized processes that will guarantee an improvement of real-time system information, coordination of raw material purchase levels, and real-time stock transparency.

Figure 6: Alignment evaluation: Supply chain

The objectives of Make to Inventory in terms of supply chain are:

- Coordination of M2I processes between different stages of value chains
- Optimized administration of processes along value chains
- System support to create transparency within the value chain and reduce administrative efforts
- Integrated system support to enable effective execution of M2I related process

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1.5 Approach

GSS/TI identified the need to develop an M2I strategy before starting with hands-on implementation projects. Within the strategy development, three major phases were performed:

- Definition of the To-Be process model

Reference program with representative plants in Europe and North America.

- Development of the M2I strategy

The objective of the first phase was to define global the M2I To-Be business processes. To reflect the high diversity of production within BASF, flexible To-Be process modules were defined which provide guidance for all optimization and harmonization efforts in future implementation projects.

In the second phase of the M2I strategy development, a reference program was carried out. Structured workshops with representatives of more than 20 plants were conducted. Major objectives were:

- Validation of the M2I To-Be business processes and identification of local and regional variants
- Identification of best practices
- Identification of major improvement areas and quantification of benefit potential
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The insights gathered from the reference program provided valuable input for the third phase of the strategy development. To have a complete strategy and to fully seize the benefits and impacts of GSS/TI within BASF, strategic building blocks were defined:

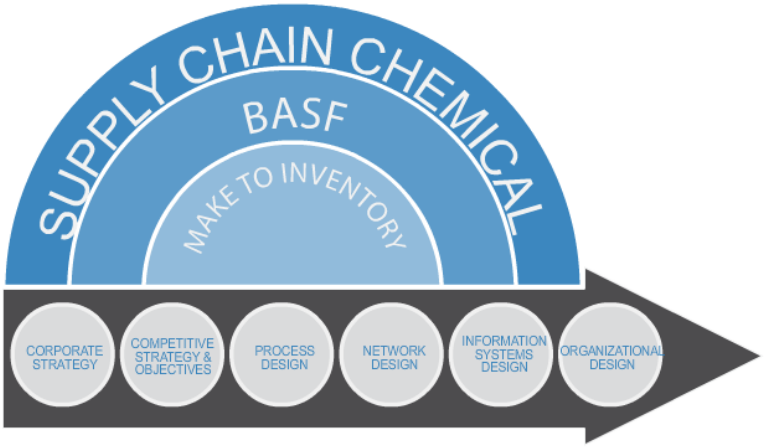


Figure 7: Building blocks Make to Inventory

- Business Processes
- M2I Solutions & Systems
- Organizational Development
- Development of a global M2I expert network and community

These strategic building blocks include recommendations and clear guidance on how BASF will address the challenge of optimizing and harmonizing business processes in the area of M2I.

M2I STRATEGY IMPLEMENTATION

The roll out of the strategy GSS/TI will start in 2012 / 2013. In order to develop and implement the project the global expert must trigger pilots among the production plants, and continue to establish a global M2I community. These pilots will provide an excellent opportunity to validate the M2I strategy and will show first benefits in the identified improvement areas.[19] After the completion of the pilots, implementation projects will be triggered to roll out the M2I strategy globally within BASF. Major improvements are expected to be realized which will significantly contribute to the overall success of BASF.
In order to use best practice and enhance business performance in the supply chain, M2I has to be able to map the current state of plants and point out direction towards best practices in different business scenarios.
As a solution and main contribution of the thesis: Global make to inventory strategy at BASF, a maturity model is developed to map the actual position on the plants and define cluster of maturity to identify a best approach for the implementation phase.

2 Development of a mapping tool for use in (GSS/TI) implementation phase

“By having an overall performance and adopting a strategic view of the processes a company can increase the overall performance.”
Ths maturity model aims to aid GSS to position the maturity of its plants worldwide relative to (Production, Warehouse and Quality) areas and assumes that plants could present different level in different processes.

Need and requirements of GSS/TI for a quick assessment tool

[19] Kinger, Georges. Implementation GSS/TI strategy.

Even though it exists different models to measure the maturity level, there only exist a few that take into account other considerations that are important for Make to Inventory such as size and transferability of the processes.
This model pretends to follow a multi- dimensional approach and to define new strategies. Furthermore, this tool is expected to be of easy application to be transferable to 230 different manufacturing plants.

2.1 Purpose of the model

The aim of this model is to measure the maturity level of plants based on an evaluation of best practices within the scope of Make to Inventory. This will be a key parameter when defining the position of plants (Situation As it is) and developing strategies to define requirements to achieve certain level of maturity (To be situation).

By understanding how harmonized are processes in the areas of Quality, Warehouse and production, and determining whether plants have End – to – end processes that are reflected in the systems GSS/TI will be available to provide solutions that can result in a better performance of the whole supply chain.

2.2 Introduction to model

2.2.1 Test structure: Areas scope M2I/ Process governance systems

(Quality, Warehouse, Production) / (Business systems, Process Systems. Shop Floor Systems)
This model combines the typical maturity models in two-dimensional way, (where one axis describes the practices to be measured for maturity and the other axis outlines the degree or level of maturity for each practice) and the maturity model SCMAT that states five maturity levels.

The following figure represents the structure:

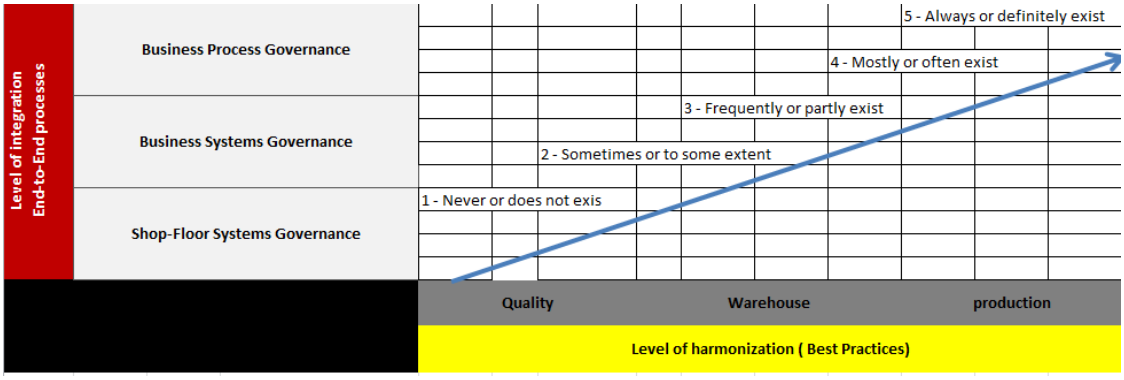


Figure 8: Structure Model

2.2.2 Test content: Best practices in supply chain operations

This model is developed in line with other maturity models proposed by the Supply Chain Council such as SCOR and SCMAT. It adopts best practice statements and questions that are found in the survey of Global Make to Inventory strategy, as well as the following documents:

- Business scenario Blueprint
- Overview M2I
- Blueprint_M2I Planning.doc
- Blueprint_Process_M2I_B2R_Cognis_ToBe.doc
- M2I Target Blueprint Technical.doc
- Quality Best Practices
- Workshops with expert members

2.3 Guidelines for test analysis

2.3.1 Guidelines for test procedure

This model can be carried out by GSS/TI at BASF either alone or with a group of consultants. The test-team gives qualitative experienced-based answers to each stated best practice according to what they believe is the company's current maturity. This could be made by email, in a Telco or during a reference visit.
The main objective is to answer the related best practice in the ranging from 1 = "never or does not exist" to 5 = "always or definitely exist".
After this evaluation is made the team will immediately notice some pain points coloured in red.

2.3.2 Guidelines for test result analysis

First of all, GSS/TI should discuss during workshops their understanding of best practices in the area of quality, warehouse and production. It is also essential to agree on a maturity score for every practice that will be evaluated.
The highest maturity level correspond to world best practice in a determined area, a well performed company does need to have best practices in all its capability areas, as other dimensions should be considered in the model such as the size of the company. GSS/TI will have to classify the areas considered as being more important.
The result of the evaluation will be create a graph were experts will be able to identify easily potential improvements (gaps). As the figure below shows:

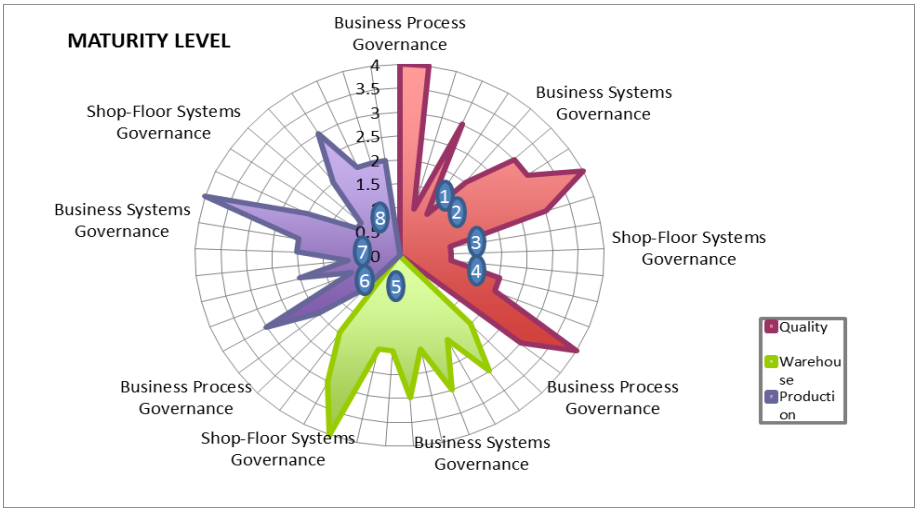


Figure 9: Maturity level results

Once the graphic is shown experts could do an analysis of gaps identified across the supply chain.

Besides that, based on the maturity level a number is given that will indicate one of the following levels of maturity with a detailed description:

1. AD HOC: understanding of supply chain management. The practices in the supply chain of the plant are not structured and are ill defined. There is not measurement of the performance of the processes. The roles and tasks are not clear within the employees inside the site. Little or no knowledge of best practices. The lack of information results in non-traceability. Low connectivity in the process produces high waiting time.
2. DEFINED: Low understanding of Supply chain management. Basic operational processes are defined and documented. Jobs and organizational basically remain traditional. It exist some measurement to indicate the performance of processes. Value based optimization off-line. Different points of information about the processes in the supply chain, constant variation between the physical and system inventory. The systems are used for basic functionalities (MRP).

3. LINKED: Good understanding of supply chain management. It exists control procedures in some sections of the supply chain. The level of collaboration is high but there are gaps in some of the processes. The use different systems (LIMS, PANDA, and SAP) can result in an issue for the transferability of the data. Some discrepancies between information and physical location may still exist across sites. The capacity of the warehouse could be used better compared to the production, confirmations are done automatically.
4. INTEGRATED: High understanding of Supply chain management. Value of line processes is well described. The measurement of the processes permits to manage timely the bottlenecks of the production. There is a transferability of knowledge between the supplier, the distributor and the users. Guidelines of Make to Inventory processes are available. There is a traceability of all the processes by having the information in the systems. Some discrepancies between the physical time and the Stock time are managed properly thanks to the status management and the code of variants.
5. EXTENDEND: Complete understanding of supply chain management. The process documentation describes in detail the activities to complete a process. Appropriate measurement allows consistency and comparability. The collaboration allows having end to end processes with connectivity between the supply chain actors. Total scheduled adherence, the orders are posted with quantity confirmation and planned time consumption. The information in a central point such as SAP/ ERM facilitates the flow of information, usage decisions and total traceability of the processes. Planning, forecasting and replenishment are coordinated across the supply chain.

2.3.3 Guidelines for Implementation of strategies:

For the implementation phase the model will made two distinctions:

- Maturity levels (1 – 3): Short term improvement potential

In the beginning the global experts should focus in this maturity level in order to guarantee a global level of maturity for the all production plants within BASF. The strategies will be oriented to a process level, in operational levels.

- Maturity levels (4 – 5) Best worldwide plants

For the plants situated in this position, GSS/TI should focus on strategies to increase the size of the circle in all the capabilities areas that were measured. An example of this could be the implementation of interphases between systems.

2.4 Implications for practitioners

This model could represent a simple and quick tool which could be used as an eye-opener for Global Make to Inventory strategy. This model will give a hint of the areas of improvement and can fruitfully be used in other projects to evaluate the maturity across diverse supply chains.

2.5 Implications for further research

The model presented here is not finally developed and need further adjustments in the structure and content. The areas could be redefined (systems) and best practices should also be up to date.
At the moment an analysis is made to include other dimensions in the tools such as the size of the plants this will results in a better understanding and reference point to determine the situation to BE.
Further research on the topic will be welcome and highly recommended.

2.6 Conceptual definitions:

- Level of Maturity: For the purpose of this analysis, maturity will be considered as the level of understanding/ strategic view (Manufacturing within the supply chain) against the level of activity/ performance: what are

the actions taken by the plants to accomplish their understanding when doing manufacturing processes[20]. These actions include:

- Level of integration: This term refers to the level of connectivity across the supply chain. In Make to Inventory, this concept is represented by End – to – end processes that represent the whole supply chain from P2P to OTC. For the purpose of this analysis the level of integration will be measured by the use of governance systems.
- Level of Harmonization: This term refers to the adjustments of differences among different processes. For the purpose of this analysis best practices are considered in the three areas within the scope of Make to Inventory: Quality, Production, and Warehouse.
- End – to – End processes: This term refers to the beginning and end points of the supply chain. The theory embraces the philosophy that eliminating many steeps in the supply chain will optimize the performance in the processes. In Make to Inventory End-to-end processes represent the relevant business scenarios, e.g. confirmation of process order. These scenarios structure the whole possible combinations of process steps into a defined list of standard BASF-variants.
- Business Governance systems[21]: This term refers to the use of shared data basis that provides integrated support for all the business processes in a company such as BASF. Complete integration and avoidance of isolated solutions results in a decentralized system in which resources can be managed on a company-wide basis.
- Process Governance systems: This term refers to standardized, integrated process solutions within the BASF landscape based on business requirements and scenarios. By having integrated process BASF will be able to improve the performance and reduce interruptions to business processes.

[2020] Yarrow, Paul. Maturity definition.
[21] BASF Intranet

- Shop floor systems:[22] They are used in different levels in decision- making processes as an instrument for monitoring, controlling, planning business operations, and analysing data from the area of production. The shop floor systems contain informative key figures which help to permanently monitor the key aims in production (short lead times, good on-time delivery performance, good capacity load utilization, low costs) in order to be in a position to take necessary action in good time.
- SAP Standard transactions: Global BASF transactions in the field of logistics and production. SAP (Z2L) includes a wide range of transactions to complete the processes.
- SAP MII: SAP Manufacturing integration and intelligence. This application solves the disconnection between the plant floor and the rest of the enterprise. It ensures that all the data that affects manufacturing is visible in real time. Including information about orders, materials, equipment status, costs, and product quality.[23]
- SAP ERM[24]: SAP Enterprise Risk Management. This application is an integrated framework to proactively manage entreprise risk in contect of corporate strategy and business performance.
- LIMS: Labor Information und Management System. Application that support the workflow and data management from the laboratories to the site where production is located.
- PANDA: Production and Distributed Analysis system. Designed for analysis as well as production

[22] BASF. Information systems.
[23] SAP Help Portal. Application supply chain management.
[24] http://www.sap.com/news-reader/index.epx?pressid=7707

3 Test of Maturity Model: Reference visits

The model created was tested in eight reference sites, to measure the level of maturity of the plants, and to see possible clusters of classification.
With the help of experts from Make to Inventory and Camelot consultants, the questionnaire was reformulated based on real information from reference visits during multiple workshops. (See survey appendix A).
Afterwards, the evaluation of each questionnaire was made obtaining the results shown in the table below:

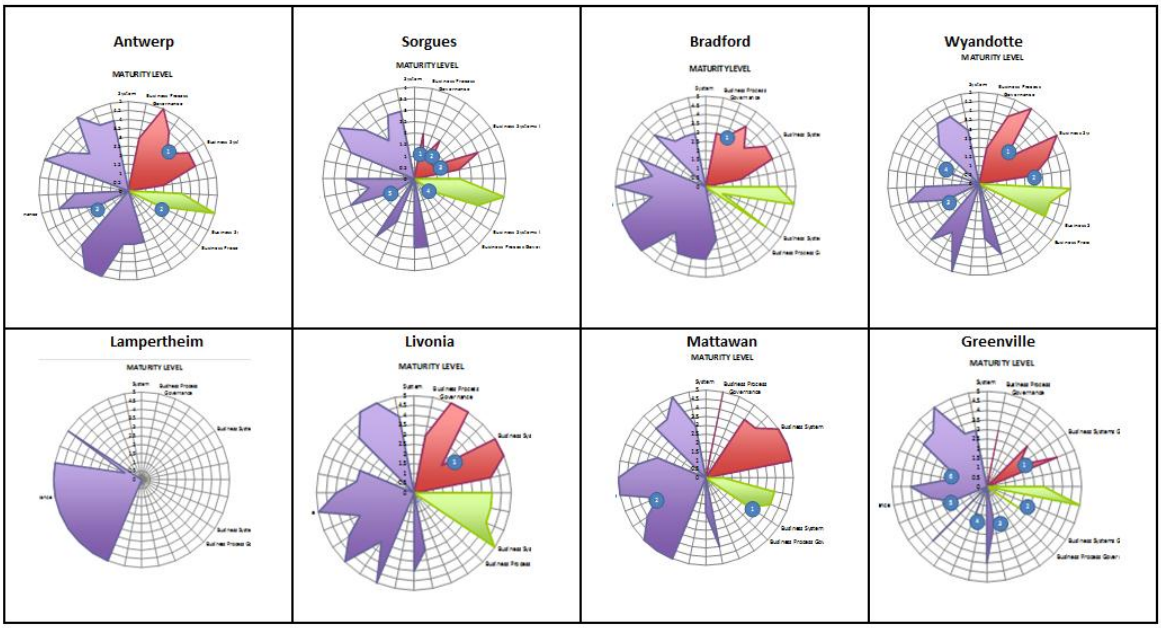


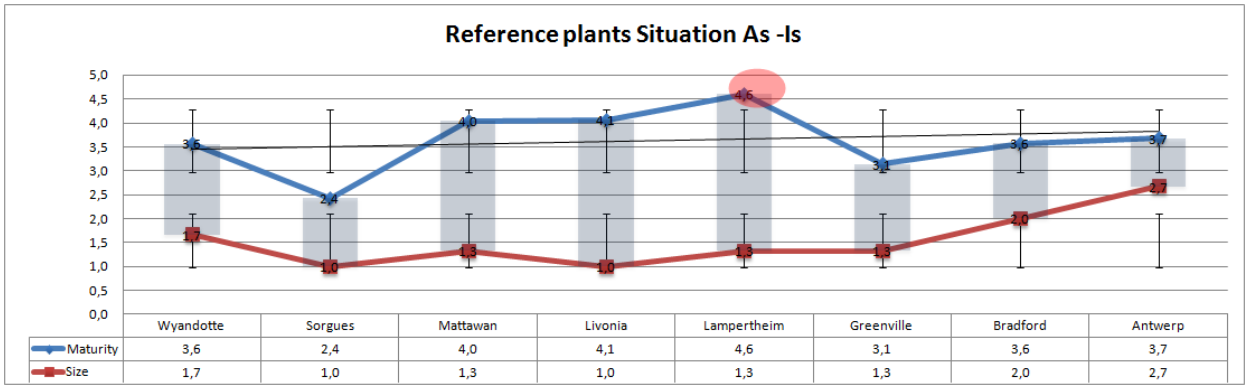
Table 1: Maturity Test. Reference visits

As the table shows for each reference visit three areas were considered: Quality (Red), Warehouse (Green) and Production (Purple). In each of these areas best practices were evaluated and given a ranking from one to five depending on the performance of the plant.

A consolidated result for these three areas is shown for each plant in a graphic where the observer can see the gaps in numbers. This analysis is useful to understand the actual position of the plants and the areas of improvement.
On the other hand, the model also showed the size of the plants, as a hint of how far the level of maturity could be increased depending on the complexity.
This analysis will provide suitable information for the implementation of the global Make to Inventory at BASF SE.

3.1 Situation As - Is

The first results show that the average of maturity for the reference visits is 3,6 what means that most of the plants have a good understanding of supply chain management. Nevertheless, there are gaps in some of the processes and there are different systems in use that could result in issues with data transferability. Another observation was that during the exploration phase plants of different sizes were considered, this shows again the validity of the formulation of Make to Inventory strategy. The higher size was Antwerp that is considered as a Verbund site and the smallest plants were Livonia and Sorgues. In the table below there is a detail description of Maturity and Size for each plant considered.



	Wyandotte	Sorgues	Mattawan	Livonia	Lampertheim	Greenville	Bradford	Antwerp
Maturity	3,6	2,4	4,0	4,1	4,6	3,1	3,6	3,7
Size	1,7	1,0	1,3	1,0	1,3	1,3	2,0	2,7

Figure 10: Model test plants

As the figure illustrates the plant with highest level of maturity is Lampertheim. Nevertheless the validity of evaluation for this plant was very low, taking into

account that the maturity was based just on 13 questions out of 33, reason why it is highly recommendable to verify the survey for this plant.
On the other hand, the plant with lowest level of Maturity is Sorgues, due to the fact that the plant presents several weaknesses in the area of Quality. The plants of Wyandotte (3.6), Greenville (3.1), Antwerp (3.7) and Bradford (3.6) show a level of maturity linked and the plants of Mattawan (4.0), Livonia (4.1) and Lampertheim (4.6) showed a very high level of maturity.
Even though, this first evaluation is relative and based on opinions rather than scientific data it outlines an overall situation of the plants in study. It is also required to allow a tolerance error of 5% to get a better and more reliable measurement of the test.

3.2 Areas of Improvement

In this first analysis, several gaps for different plants were identified using the information of the survey. These improvements were contrasted to results provided by Camelot based on the visits to have a complete analysis of improvements, the information is summarized below:

Name of the plant	Insp. Lots	Batch Number	BMBC	Relevant training	Cockpit	Interface SAP to PCS	Integration QM	WM	Labeling
Greenville	x	x	x		x		X	X	
Sorgues				x	x	x	X	X	X
Bradford				x		x		x	X
Wyandotte	x	x	x	x	x		X		X
Antwerp					x		X	X	X
Livonia	x	x		x	x	x	x	X	
Mattawan		x	x		x		X		
Lampertheim		x						x	X

Table 2: Improvement areas reference visits[25]

In the table above, it can clearly be seen that we can see that there are improvement areas with high level of transferability is the case of the Order Cockpit, the integration of QM and the implementation of WM/ EWM.

[25] Results reference visits.

Other areas that are also important are the automation of the Batch Number, Labelling among the other benefits.

4 Guidelines strategy GSS/TI

4.1 Towards the model to BE

For the implementation of the M2I strategy, some areas of prioritization have to be identified. In the case of the plants analysed one option will be to cluster the plants based on the level of maturity versus the size.
One first approach was made where four different clusters were identified.

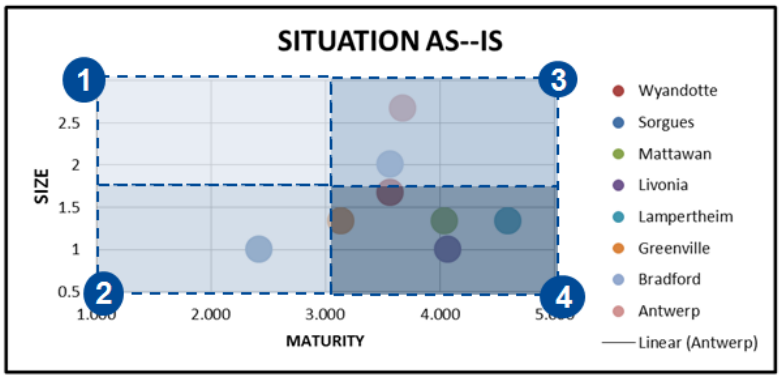


Figure 11: Clusters of maturity

As figure 11 shows, there are four clusters identified: First cluster with high size and low level of maturity with no plants, second cluster that represents low size and low level of maturity, in this level the plant of Sorgues is positioned and it is considered to be a cluster with high level of transferability as at present many plants with the same size show similarities in the level of maturity.
In the third square the plants of Antwerp and Bradford are positioned, this cluster represents high size and high level of maturity and finally we see the forth cluster were most of the plants from the reference visits are positioned and that represent small plants with significant level of maturity.
During the pilot phase one approach to increase level of maturity might be to focus on big plants with small maturity and follow this direction towards high maturity and small size, as a result the order of prioritization will go in this sense: (1, 2, 3, 4) and

the objective is to reach the highest and the most suitable level of maturity depending on the size of the plant.
These clusters will be considered as an option to determine the level of transferability among plants and it will be a reference to determine an estimative of benefits and area of improvements, and mobilizing and convincing BUs/plants to participate in M2I implementation projects.
Once this first step is done and a promising area is identified regard to improvement potential, it is highly recommendable to go to the plants complete deeper assessments to identify specific needs.

4.2 Strategy inside the plants

To increase the performance and reach a high degree of harmonization concerning M2I related processes and solutions, Make to Inventory should design an implementation plan for each site.
Meanwhile, for some of the plant is needed to start the implementation from phase 1 for others it will be more convenient to start in phase 2 depending on the complexity of the plant, size and degree of harmonization. It does not exist a fix plan for all the plant but this road map might be used as a guideline.

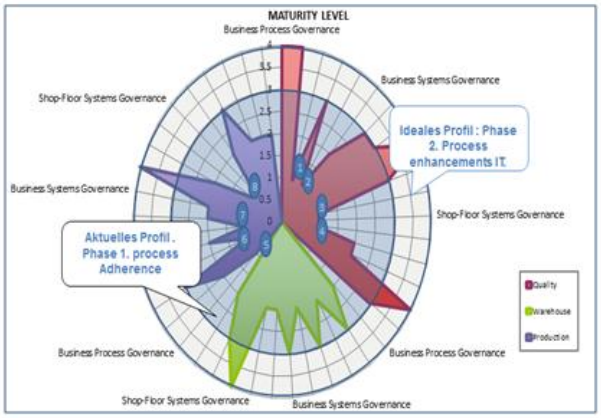


Figure 12: Implementation strategy reference plants

- Phase 1

The first target is to achieve a linked maturity level, this phase is the basis for guarantee a sustainable growth. Fast implementation is desirable as benefits are quickly realized and integration of acquired companies will be facilitated, administrative efforts will be reduced and core processes are treated. In terms of benefits this phase will deal with two types of benefits:

Quick wins:[26] This area includes the use of transaction tools, automation of batch number handing and implementation of booking and confirmation. For these benefits no big implementation efforts are considered but instead it is required a complete training and suitable information.

Process Harmonization: The benefits included in this area are: labelling, value chain integration, master date, QM process integration, process for corrections. Here, some changes in processes are needed as well as making existing solutions available for the plants.

- Phase 2

Once that the plant has a linked level of maturity is convenient to enhance some solutions that include the implementation of systems and the increase of the maturity level already reach by the site.

The benefit covered in this phase are the implementation of Mobil devices, barcoding and scanners, shop floor integration, QM process integration, WL/EM implementation the interphase planning to production and M2I production[27].

- Phase 3

After the implementation of the project, the maturity of the plant should be assessed again. This will ensure the sustainability of the project and will be helpful to identify new improvements and further gaps in the supply chain.

4.3 Change Management

Within BASF the senior project GSS/E has identified a methodology for the implementation and execution of projects. This structure is divided in success

[26] Camelot. Make to Inventory strategy V18. Ludwigshafen 2012.
[27] *Ibid.* Pag 55.

factors that are essential to ensure the transference of knowledge and involve all the actors that will take part in the implementation of the strategy.

4.3.1 Training

The transference of knowledge is essential to implement a global process such as the strategy of M2I.

The process should start by the Global process experts with an analysis gap to identify the existing material against the need of new material, In this phase the collaboration of experts is also recommendable to identify the process variants and the regional requirements.

In the next stage the collaboration between regional experts and business experts is needed to identify process improvements, some documentation must specify the training requirements and contain the information that needs to be transmitted to the end user. All the specifications related to transactions, language, processes, tasks, time, rolls must be written to create the required material.

In BASF SE, GSS/ET is the department that has responsibility for the production of new material and all the activities related to change management, a close cooperation with this department needs to be established to support the pilots and implementation projects.

4.3.2 Communications

Early engagement activities have the purpose to reach out the affected employees and inform the changes within the community. Gather feedback and identify the information needs.

Conclusions

- The management of inventory at BASF SE is not a global process but local strategy. A local decision determines if the count of stock is made manually or in the system.

- The strategy of GSS/TI includes all transactional processes in the area of production, quality management, warehouse management and site logistics. It aims to optimize and harmonize the processes that will have a positive impact in the level of stock and will reduce the logistic costs.

- This paper analysed the strategy formulated in Make to Inventory at BASF SE. The analysis shows that the strategy is consistent based on two evaluations: The alignment with the mission of BASF and the coverage of the areas in scope of Make to Inventory. Furthermore, it is shown that the project will support the harmonization and integration of processes in the field of production. It will establish global processes and complete the aim of Accelerator project.
- The definition of a global process is based on capabilities of the supply chain that follows the strategy of BASF SE, considers the conditions of the market establishes a model of processes and installs a network of systems and community.
- In terms of methodology it is shown that the strategy is well supported and well defined. Nevertheless the survey for the visits in the plants shows some gaps, as it does not contain all the relevant information needed by Make to Inventory for the identification of improvement potential and the identification of the situation As- Is.

- The process Make to Inventory is considered to be the last piece of the project Accelerator to include all the cross- functional processes within the supply chain.
- Make to Inventory will improve operational information flow between production, execution, quality management & warehouse (the main focus areas of the M2I group). It will allow BASF to contribute to the reliable, smooth, and cost-efficient worldwide flow of goods. This benefits both the regional and global business units, and therefore BASF customers.
- BASF needs to appropriate tools such as inventory management to support the continued growth of its business.
- The benefits discovered in the global strategy shows the high impact that the project might have by establishing global end- to – end processes that are supported by adequate systems.
- Accurate and standardized processes will guarantee an improvement of real-time system information, coordination of raw material purchase levels, and real-time stock transparency. Thus, it will provide optimal inventory levels ensuring that BASF adheres to its delivery promises.
- In order to determine the direction of M2I, it is necessary to understand its current position and the possible avenues through which the model to be is formulated. For this purpose a Maturity concept is assessed via a short questionnaire in order to cluster and prioritize plants.
- Maturity is defined as the level of understanding/ strategic view (Manufacturing within the supply chain) against the level of activity/ performance: what are the actions taken by the plants to accomplish their understanding when doing manufacturing processes.
- A tool to measure the maturity of the plants in the fields of Quality, production and management is developed developed to identify how far the processes are from best practices and identify variants in processes. Out of this assessment make to inventory can potentially define clusters of maturity

and define the position of the plants. This will help to identify the transferability of benefits.

- In the first phase of the implementation phase Make to Inventory should focus on plants with low process maturity to drive process improvement projects, whereas in the second phase Make to Inventory might focus on plants that require IT enhancements.
- Key performance indicators (KPIs) are essential to measure the performance of the production plants across all the regions and to develop accurate and timely processes.
- The five pillars of change management should involve the whole organization of BASF SE to ensure the success of the project.

Recommendations

- Make to Inventory has to select first pilots for the implementation phase. It is suggested to use the maturity tool to identify the position of the plants, define clusters of maturity and identify transferability of benefits.
- To implement a competitive strategy, Make to inventory has to ensure that plants have the foundations to follow end to end processes. (First levels of maturity) A general concept of training must be developed by the global experts and regional experts to identify local needs.
- The assessment of maturity should be based on best practices identified in the processes and business scenarios. Hereby, the survey might be modified to contain all the relevant information.
- Global process experts need to write a report with the global transactions that must be available for all the production plants.
- Make to Inventory needs to staff regional process experts across all the regions to extend its process experts network and to ensure the transference of knowledge. This concept should be enclosed to the development of communities and ambassadors able to spread the message of M2I.
- Cross functional collaboration and partnerships are needed to achieve the execution of the strategy Make to Inventory.
- In the short term Make to Inventory should focus on quick wins benefits that require low level of effort and higher transferability.
- The use of a single point of truth (SAP) is essential to consolidate transparent information across the supply chain. Furthermore, Make to Inventory should focus on the use of proper systems and interfaces in the area of Quality, production and warehouse.

- Cooperation with GT/P is essential to improve the activities in the shop floor systems.
- Full integration of GSS/TI in the operational processes needs to be established.
- A maturity re-assessment is recommended to measure and ensure the project success, therefore is essential to identify specific need in the production plants, and estimate potential benefits.
- A pull approach is highly recommended for the implementation phase of the global strategy of M2I.
- Global initiatives and projects with impact on M2I strategy (e. g. EWM, LIMS strategy) have to be aligned with M2I to be process model and project schedule.
- The model presented here is not finally developed and need further adjustments in the structure and content. The areas could be redefined (systems) and best practices should also be up to date.
- Further research should be follow to identify what other dimensions can have an impact in the maturity concept.

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