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From a Corporate Product Specification to a Control Recipe: It's not a Transatlantic Trip…

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ABSTRACT

Corporate Product Specification Management is fairly new in batch processing industries. Up to now, it lived a low profile life in the form of spreadsheets, word docs and paper, but with the increasing supply chain dynamics specifications become more than ever the focal point as the indispensable backbone. Automotive, electronics and assembly businesses have known the theme for a number of years as PDM (Product Data Management). AMR defines its variant for the process industries as PLM: Product Lifecycle Management. Welcome to the world of acronyms!

A product specification describes a particular material in all its aspects such as chemical, physical and microbiological characteristics, logistic specifications, production specifications, labeling guidelines, etc. Product specifications within an enterprise can exist for procured materials, intermediate and finished goods, packaging materials etc. When such a specification deals with production aspects, it enters the S88 zone, where we tend to call them general and site recipes.

During the paper presentation, we'll follow a product from a general recipe definition down to its executable form: the control recipe. Illustrated by examples from real implementations in multi-national enterprises, we'll experience that this is not necessarily a transatlantic journey, but on the other hand, it's not a simple bus trip either…

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PLM

In AMR's definition, the scope of PLM goes beyond the traditional PDM (Product Data Management). PDM lives its relatively solitary life in engineering/R&D departments and this not sufficient in an e-business context where new products have to be delivered faster and customers have to be supported better. PLM adds the capability of collaboration between enterprise departments, but also collaboration with suppliers, co-manufacturers and customers. PLM is a new vitally important backbone in the supply chain: the product backbone responsible for managing intellectual property of the enterprise.

The focal object in PLM is the product. PLM systems store and manage product information during the entire product lifecycle. We define a product specification (a product spec) as a structured set of information related to a product. Product spec information goes beyond manufacturing. The information in product specs has to support each and every business process in the enterprise. E.g. a typical specification in Unilever contains following sections:

- Header
- Microbiological properties
- Chemical properties
- Nutritional Properties
- Allergens, free-from specs
- Packaging specs
- Storage and transportation
- Process instructions
- …

Product specifications are shared among different organizational entities such as plants, divisions, business units, R&D centers, distribution centers, … In order to facilitate electronic collaboration, it is essential that the different organizational entities agree on the way the information is structured. We define **harmonization** as the process of agreeing on the product specification structure, naming conventions, approval processes, etc.

Figure 1. shows a typical conceptual framework that supports the harmonization process.

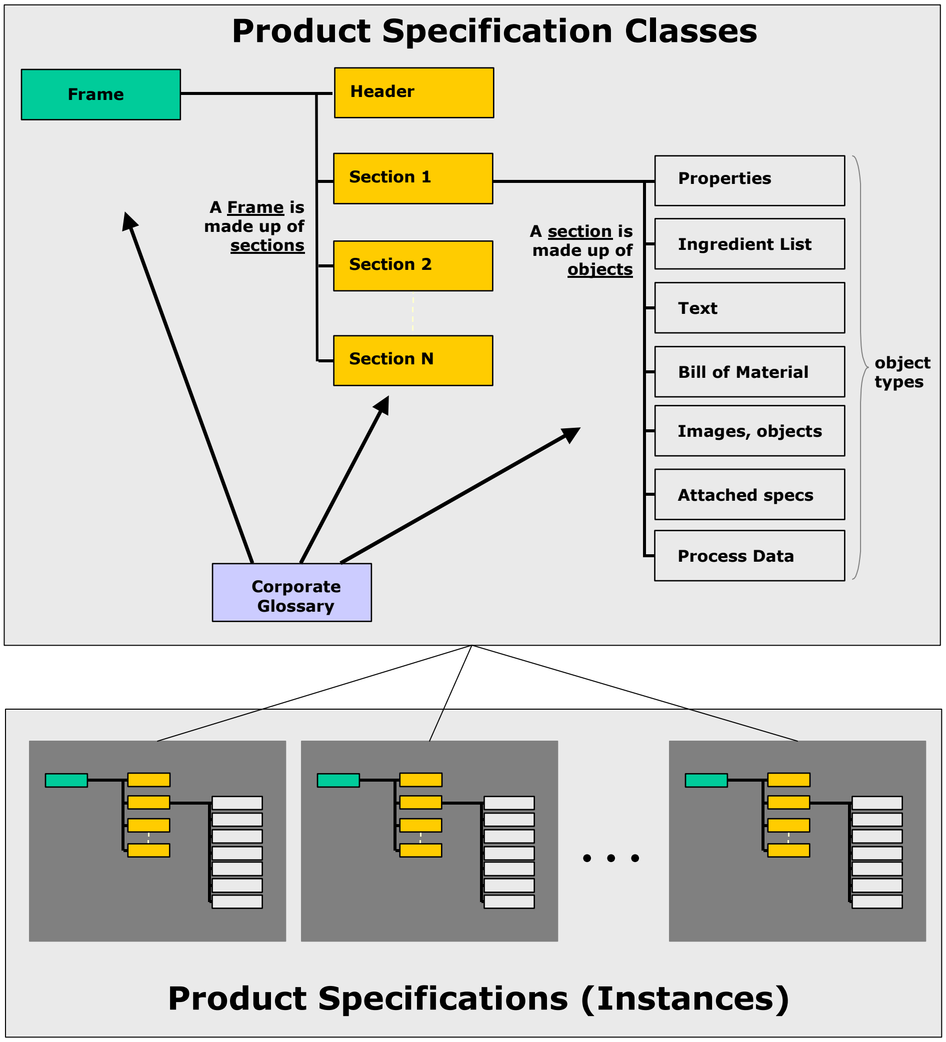

Figure 1 An example of a concept supporting the harmonization process

GLOBAL Vs. LOCAL PRODUCT SPECIFICATIONS

Next to improving an enterprise's capability to introduce new products faster, PLM is also intended to optimize the procurement and fulfillment process. At the procurement side, large corporations are interested in cutting costs by purchasing raw materials from a limited set of closely evaluated suppliers (Global Buying). At the fulfillment side they are interested in maximizing the flexibility and transparency to manufacture products at different production units (multi-sourcing).

This requirement results in a concept of distinguishing global and local specifications. A global specification is valid for the entire enterprise. Local specifications are derived from the global specification and might add or overrule information. It's definitely not only the plant setup that motivates the existence of a local derivate of a global specification. In many more cases it is driven by procurement (local presence and characteristics of raw materials) or marketing/R&D (localized versions of brands with different packaging, language, label declaration, taste, texture or shape).

An essential functionality in PLM is the capability to maintain the relation between the global spec versions and the local spec versions. What happens if the global spec changes? What happens if changes to a local spec are applied to global spec or other local specs? For paper-based systems, such questions were often the cause of chaos, which grew exponentially over time. So, it's exactly at this point where one of the big challenges of PLM can be found. A business that handles this problem properly creates huge potential through agility and supply chain responsiveness.

Figure 2 shows a typical architecture supporting the harmonization process across different geographically spread locations, across different databases and across different organizational entities.

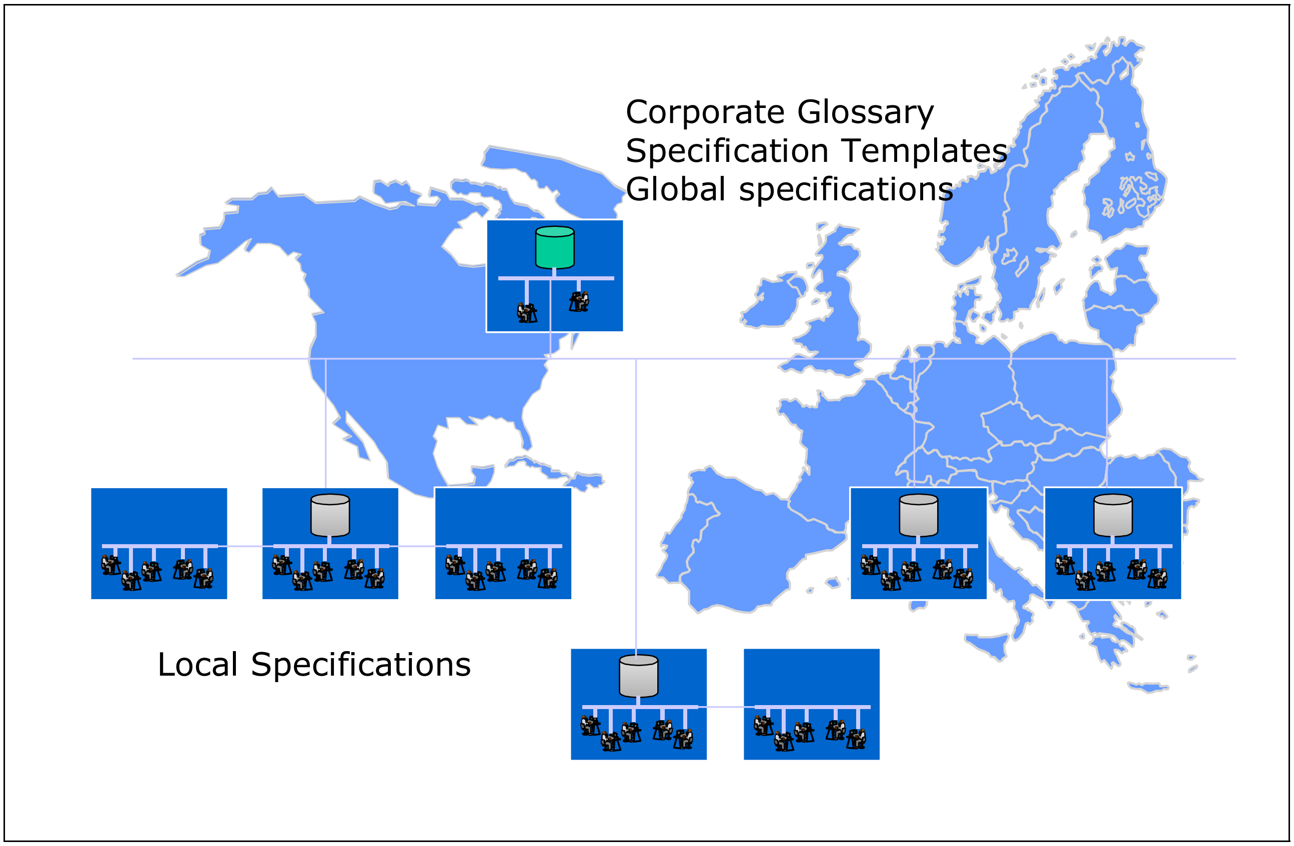

Figure 2 A typical architecture of PLM in a multi-national company

PLM and ERP

PLM, as the intellectual property backbone, is the single point of reference for product information and consequently, this information must be shared with a lot of other systems. The interaction with ERP is important because just like PLM, ERP is also a vital vein in the organization. If both fail to synchronize, a lot of depending business processes will fail as well.

ERP and PLM have 2 important overlapping objects: the product (item, article, …) and the BOM (Bill of Material). After a number of discussions between manufacturers, system vendors, consultants and industry watchers, we have reached a consensus based on 2 rules:

1. ERP owns the product

2. PLM owns the BOM

Rule 1 indicates that an integrated plant or enterprise system can only work with products that are defined in ERP.

Rule 2 indicates that PLM is responsible for maintaining the BOM as a part of the product specification, and that this BOM will be created or updated in the ERP system by the PLM system. In accordance with rule 1, the BOM can only be composed of products that exist in ERP.

Rule 1 was pretty obvious. Rule 2, however, is at least paradigm shifting for many users that were raised in the IT-world with the slogan 'ERP is the Almighty, does it all and owns it all'. There are 3 good arguments for rule 2:

- The BOM information as a section in a product spec is usually more detailed than its version needed in ERP.

- ERP is one of the users of BOM information. However, the usage of BOM information goes beyond costing and back-flushing. Supply Chain Management systems (SCM), Plant systems (MES, process automation, batch systems), Warehouse Management Systems (WMS), distribution and transportation are just a few other examples. Each application needs its particular level of detail.

- In collaborative manufacturing, the BOM information of a particular product is definitely not static. E.g. use of alternative raw materials (changed characteristics) or seasonal/regional aspects might result in new BOM versions for the new product that are planned over time. PLM systems are capable of planning BOM versions and manage the fade-over process between versions. PLM also keeps track of these changes in order to guarantee traceability (e.g. relate a lot to the specification that was valid at the time of manufacturing).

Translating specifications into plant centric operations

Up to now we considered specifications from a broad perspective. But let's have a look at specifications that describe products that are manufactured by the enterprise (or controlled by the enterprise like contract manufacturing, co-packers, …).

It is at this point that corporate specifications management in an PLM context meets the recipe model in an S88 context.

We can define a general recipe as a global product specification containing sections that describe the bill of resource (BOR), basic processing conditions and the bill of material (BOM). Similarly we can define the relation between the S88 site recipe and the local specifications.

Figure 3 shows how the S88 recipe model is positioned in a PLM context.

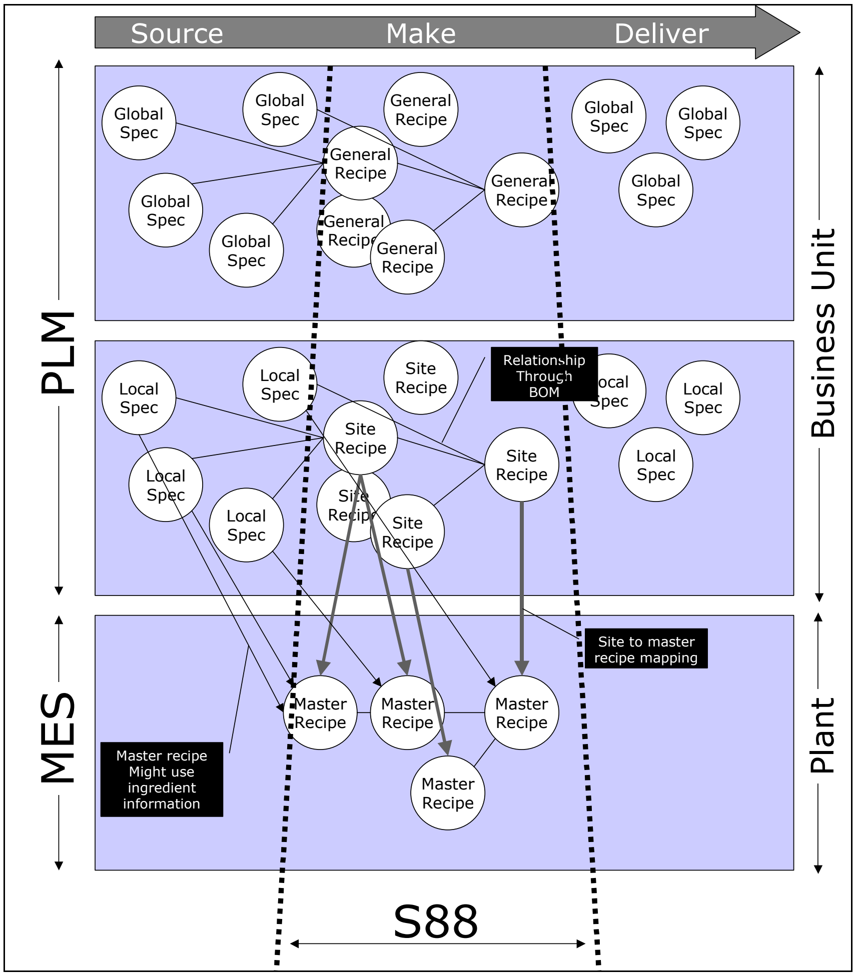

Figure 3 The S88 general and site recipes are a sub-set of PLM product specifications

In accordance with S88, a site recipe serves as a basis for master recipes. Re-positioned in the broader context, we can say that a local specification serves as a basis for any plant or supply chain operation (manufacturing, distribution, storage, …).

But let's focus on the manufacturing side of it. In a typical implementation scenario (see figure 4) we have seen how a site recipe becomes the common source for ERP, manufacturing and quality execution:

1. The BOM section of the site recipe creates the ERP BOM
2. The manufacturing sections of the site recipe form a basis for the master recipe.
3. The quality section of the site recipe creates lab sample types for QA/QC evaluation (note: a Sample Type in LIMS-world defines how, where when and on what a sample is taken, what is to be analyzed, how it is validated, etc).

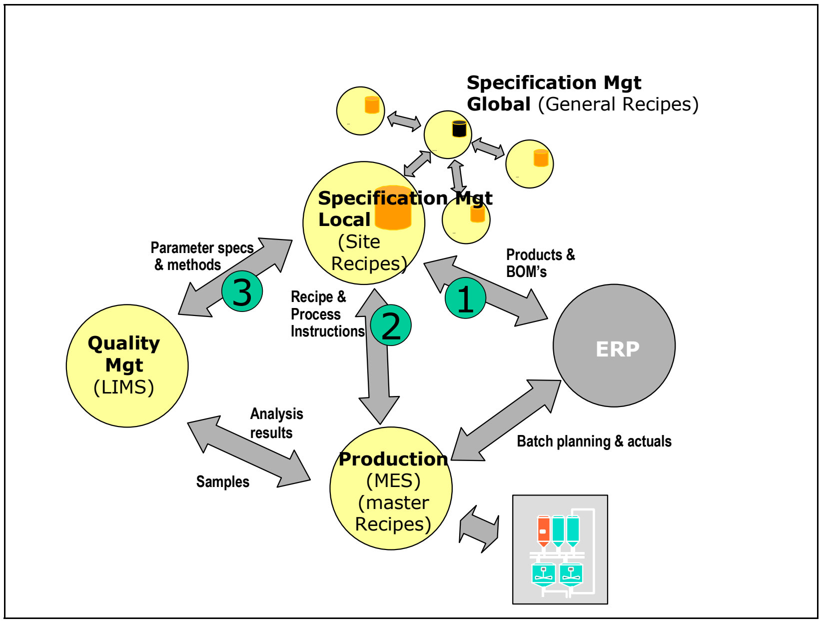

Figure 4 PLM enabler: integrated business and plant operations

Interface 1 and 2 are relatively simple, both from the technical/functional point of view and from the organizational point of view. This is because it stays focused around the same object: the product.

Interface 3 is more complicated because it involves more organizational entities (production, R&D, QA, …). Technically this is not a simple interface because it contains a transition from product to product/process. In the next section we will have a closer look at this.

Once we've solved the above interfaces, the operational integration (interaction between systems during the production execution) becomes much simpler:

- The interface between ERP and production does not need to carry all product/production details. Basically, a quantity, a due date and a product ID is sufficient. The other details come via the site recipe.

- The interface between production and quality (LIMS) is also simple. In the master recipe it is sufficient to specify a sample type (typically a product/sample location combination). The quality system identifies, through this sample type, the quality parameters against which the sample has to be evaluated.

From site to master recipe

In S88.01, a master recipe is defined as a type of recipe that accounts for equipment capabilities and may include process cell-specific information. And with these simple words we have addressed a fairly complex topic. The phrase '…that accounts for equipment capabilities…' is the culprit. It indicates that we are confronted with the translation of a product centric site recipe into a product/equipment centric master recipe.

Before diving into functional concepts, let's have a look at ownerships and responsibilities.

General and site recipes originate as a result of a collaboration where R&D plays a central role, but finally the business unit will own the global and/or local spec.

The translation of a local spec into plant operations is also the result of collaboration between the plant, the business unit and R&D, but in this case it is the plant that owns the output of this collaboration. E.g. within a plant context, quality management ('the lab') will own the sample types that are generated from the local spec/site recipe and production will own the master recipes.

Figure 5 explains the functional approach for the site to master recipe translation. Note that the structured approach in PLM is the key for mapping site recipes to master recipes in a generic way.

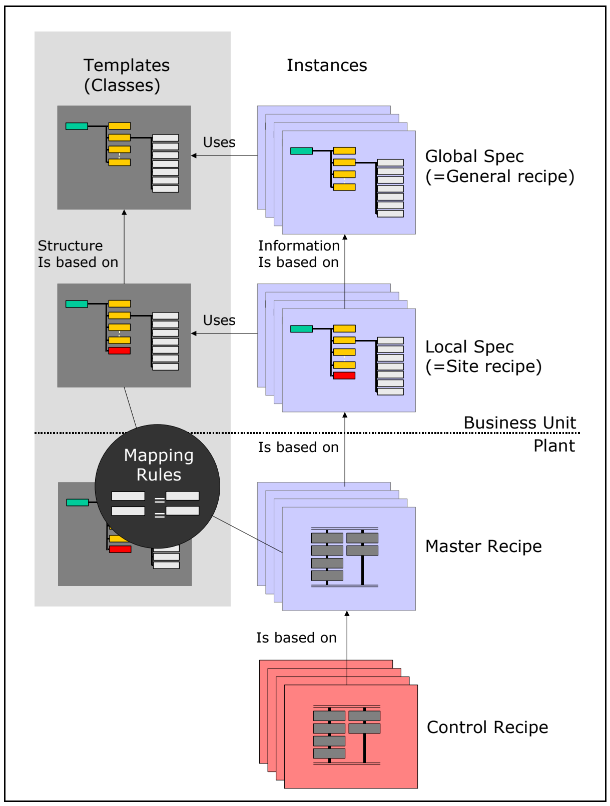

Figure 5 Mapping product specifications in the S88 recipes model.

In our experience, the plant owns the mapping rules and it is also the plant –and not the business unit- that initiates the translation to a master recipe. This includes that plants might develop new master recipes for a particular product or product family concurrently with the business unit defining specifications. The plant will e.g. initiate the mapping between the master and the site recipe as the last step in the parallel development process.

The S88 recipe model in a make-to-spec environment

In a leading business-to-business addable oils company, the final characteristics of a product are determined in the final process stage where a number of additives are blended with the edible oil batch before load-out in trucks occurs. The business case is almost a perfect example of a make-to-(customer)spec production in a B2B context.

This company manages global and local specifications with an PLM solution that is integrated with ERP. Blend production orders are passed from ERP to the batch system. Based on the product ID the batch system accesses PLM to find the process information in the currently approved version of the site recipe. Together with them, we came to following considerations during the design phase:

- The dynamics in global and local specifications are so high that our customers cannot afford to lose time in creating separate master recipes for each site recipe. Moreover, products that belong to the same product family (=group of similar products) have a master recipe that only differs on a limited number of recipe setpoints, inputs and outputs. The production sequence itself is not differing.

- As long as the local spec (site recipe) owner respects some pre-set constraints when defining a new product within the product family, there is no need for an additional plant validation on the master recipe.

These considerations made us question the S88 recipe model in its strictly hierarchical form. What our customer asked was in fact to use the S88 control recipe with a multiple inheritance capability. The master recipe is defined for a particular product type (product family) and forms the basis for generating the control recipe (inheritance 1) with a strong accent on the recipe procedure. The control recipe then inherits (inheritance 2) the process information from the local specification by using the mapping rules that were defined together with the product family master recipe.

Figure 6 shows how the structure of figure 5 is adapted for highly dynamic environments.

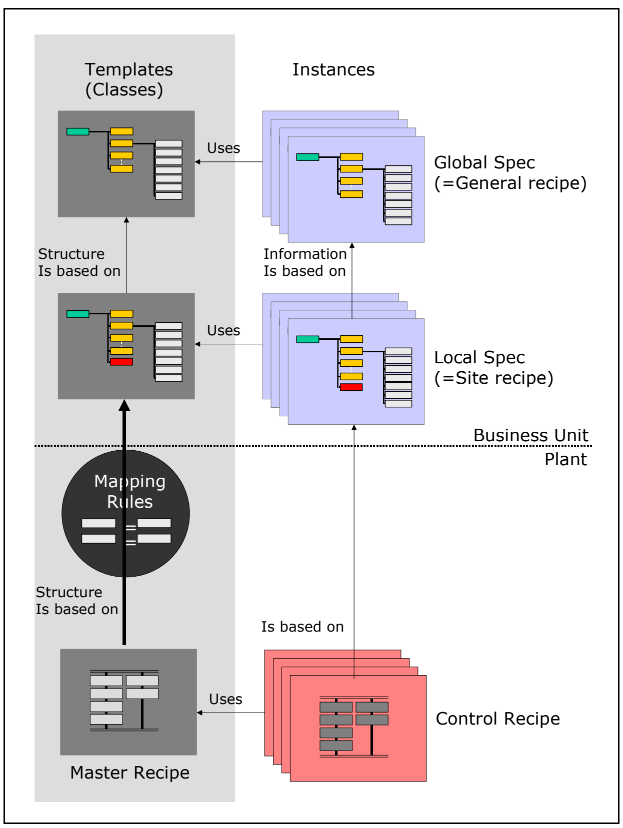

Figure 6 The master recipe re-positioned in a make-to-spec environment.

This implementation approach offered significant advantages. One of the most impressive benefits comes from the fact that new product introductions (NPI) for products that fit in a pre-defined product family are now virtually immediate. Once the local spec is defined and approved, production schedulers can create production orders that are dispatched directly into the plant. There is no addition master recipe creation process. PLM verifies that new products take into account the plant constraints.

Conclusion

The usage of master recipes like in the described case cannot be applied in all situations. As stated earlier, the complexity of the site-to-master recipe translation is the consequence of a product to product/process transition. In the described case we kept the process conditions fixed within a product family, so the integration comes back to a more simple product-to-product transition.

However, this business case is not a standalone example. It indicates a trend towards a concept of intelligent manufacturing where new executable recipes (including equipment requirements, the procedure and the formula) are created dynamically when new product spec versions are approved. Within a collaborative manufacturing environment, such agility is and will be a must. Such concepts create new challenges for us, and for members of S88, S95, WBF or other organizations. As we have experienced, from general to control recipe is not a transatlantic journey anymore, but it will definitely require some additional out-of-the-box thinking to make this a simple bus trip.