BPM Design Patterns – Collaborative Replenishment Process in Retail

Applies to:
SAP NetWeaver 7.3 (WDJ, BPM, BRM), SAP NetWeaver CE 7.2. For more information, visit the Business Process Modeling homepage.

Summary
Retail industry is among the largest industries in the world. It is also among the most competitive. Retailers achieve differentiation by frequently optimizing their supply chain, keeping their inventory levels low and reducing lost sales. To keep their inventory levels at an optimum, various demand forecasting models are employed to predict procurement needs.

The article deals with a BPM process where push-pull strategy is employed in predicting sales outlet demands by buyers. Buyers can collaborate with store managers in different locations, collect their individual store demands and employ this data along with demand forecast models to build a more efficient procurement process thus optimizing inventory levels.

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# Table of Contents

Introduction ........................................................................................................................................... 3
Target Audience ..................................................................................................................................... 3
Replenishment and SAP .......................................................................................................................... 4
  Why is a Replenishment Strategy Important ...................................................................................... 4
  Push, Pull Strategy in Retail .................................................................................................................. 4
SAP in Retail ........................................................................................................................................... 4
Collaborative Replenishment in Retail ...................................................................................................... 5
Use Case ................................................................................................................................................ 5
Solution Architecture ............................................................................................................................... 6
  What Features Do We Need? ................................................................................................................ 6
  How Do We Incorporate these Features? ............................................................................................ 6
Technology Components ....................................................................................................................... 7
  Process Model – SAP NetWeaver BPM ................................................................................................ 7
    Browsing Your Task List ...................................................................................................................... 8
  Persistence and Service Layer ............................................................................................................... 8
    Entities and Relationships .................................................................................................................. 8
    EJB Services ..................................................................................................................................... 9
User Interface .......................................................................................................................................... 9
  WebDynpro Java ................................................................................................................................. 9
  Native / non – Native Mobile Applications ......................................................................................... 11
Process Analytics .................................................................................................................................... 13
  Business Process Analytics Format .................................................................................................... 13
  Power of Analytics .............................................................................................................................. 13
Conclusion ............................................................................................................................................. 14
Acknowledgements ............................................................................................................................... 14
Related Content ..................................................................................................................................... 15
Copyright ............................................................................................................................................... 16
Introduction

An efficient and appropriate replenishment strategy in retail leads to low inventories and ensures a better quality of customer service. Employing a hybrid push-pull strategy which uses accurate information from the retail outlets, moves us a step closer to this objective.

While there are many ad-hoc ways to obtain this information, we will discuss about a process driven collaborative approach to collect sales demand. The approach will also help us as a framework that can track sales metrics, analyze demand trends and hopefully improve the supply chain in the longer run.

By incorporating best practices in the solution, we will ensure that the process is scalable and flexible.

Target Audience

The article is most suitable for business process consultants, technical architects, BPM developers and retail consultants.

The section below provides an introduction to retail and replenishment. Consultants and architects who are keen on the BPM implementation can skip this section.
Replenishment and SAP
“Retail consists of the sale of goods or merchandise from a fixed location, such as a department store, boutique or kiosk, or by mail, in small or individual lots for direct consumption by the purchaser.”

Replenishment involves adding new stocks or supplies to address sales demands.

We understand what replenishment is, but opportunities does it provide a business?

Why is a Replenishment Strategy Important
Firms these days frequently reassess their business process and explore new areas for cost reduction. With the last decade seeing higher levels of product variety, shorter product life cycles, shorter response times and outsourcing of manufacturing operations, supply chains have become more complex and cumbersome. An inefficient replenishment strategy here can hinder growth and reduce competitiveness. The right replenishment will not only bring you savings in inventory and process, improving bottom line, but also provide as feedback system to improve the overall supply chain.

Push, Pull Strategy in Retail
There are two common replenishment strategies push and pull.

A push strategy refers to supply driven replenishment where the company which manufactures goods decide the frequency and quantity of the product released. This works well for new product releases like an Apple IPAD 2 release.

A pull strategy refers to demand driven replenishment where goods are replenished once the stock reduces to a certain limit.

There is also a hybrid strategy which works where distribution networks employ a push strategy but use a pull strategy to estimate the consumer demand.

We can assume that we are discussing about a strategy more aligned towards this hybrid model.

SAP in Retail
SAP for Retail supports multiple dimensions of retail including supply chain management, shopper insight analysis, merchandise life cycle management, warehouse management, PoS and analytics.

We have covered the basics of retail and addressed the basic necessities of replenishment, and can now move on to the use case and implementation of this process in the next few sections.

The implementation incorporates some of the best practices and learning’s I have seen and learnt over time.
Collaborative Replenishment in Retail

Use Case

The use case deals with a retail replenishment scenario where a buyer needs to collect product needs from store managers in different locations and use this information along with demand forecasts, lead time forecasts and other SLAs to estimate replenishment needs accurately.

The buyer initiates a process listing the products he is planning to buy and includes the managers involved in his zone or region. Different buyers deal with different zones and hence with different number of store managers. The process needs to dynamically route to a different number of personnel based on the number of store managers involved. [How so? Refer solution architecture]

Each store manager feed in his/her product needs based on their internal forecasting or sometimes just by previous experience, and submits the inputs. The buyer then consolidates these inputs, computes safety stock based on seasonal trends and adds other variants like lead time forecasts, order cycle durations and even general statistical variance based on yearly trends.

The buyer then finalizes the order and triggers the logistics execution the completing the process.

He can also define an SLA of when he is expecting the inputs to be available and can choose to ignore the inputs from store managers who missed their deadline. At each step of the process, the data is being staged thus providing valuable data on which product based analytics can be built.

Fig 1. The simplified retail replenishment process
Solution Architecture

A good way to begin architecting a solution is to identify the critical features it needs to offer and the pain points it needs to tackle. This can vary based on the industry, budget, system landscape, skills etc.,

*Personally I would skip the budget and other restrictive details during the initial design. It makes better sense to design an optimal solution and if absolutely necessary take in the other factors and tweak the solution.*

What Features Do We Need?

1. Multi-channel based user access
2. Ability to track metrics and build analytics
3. Dynamic and flexible process
4. Ability to apply real life SLA’s, business assumptions, rules etc.,

How Do We Incorporate these Features?

There are two user access channels available for this solution. A web based portal with UWL (Universal work list) to view, launch and perform BPM tasks. A mobile based user interface solution (native) for approvals.

The process layer is SAP NetWeaver BPM running on 7.3.

BPM uses WebDynpro Java UI for tasks. Tasks receive critical data via BPM runtime and refer to the persistence store for retrieving the complete process data.

The persistence store is accessed via web services and enterprise Java beans. Certain EJBs provide business operations, while other EJBs operate on JPA objects and provide CRUD operations only. This is another way to ensure we adhere to the dependency inversion principle.

Validity checks, process flow control etc are performed against the BRM framework. For ease of use, BRM is also consumed via web services.

Process flexibility is achieved by dynamic routing based on users selected by the buyer. Process data is staged at every point in the process, thus addressing the compliance and tracking requirements. This data also provides a valuable store for performing analytics and build reports. We use JPA to provide persistence and caching. At a later stage, since we use ORM, query building for analytics becomes a lot easier.

Application of rules and SLA’s is achieved by BRM. For instance to estimate the appropriate safety stock level for a product we can use BRM.
Technology Components

A top down approach is taken to implement this replenishment process. Top down approach works best for processes that have few entities with simpler relationships between them. Process owner designs the process, typically in ARIS or in SAP NW BPM.

Using the ARIS model as a reference model, a technical process model for the replenishment scenario is built in SAP NW BPM. The data context containing user data, process data and the product data is defined. After context definition, we can generate the UI for human activities.

The buyer uses different screens for initiation and confirmation. All the store managers will be using a similar user interface. After user interface integration, this process skeleton can be independently tested for process flow.

The persistence layer is then modeled and implemented based on the data context defined in BPM. Each data object is transformed into an “Entity” in JPA and business operations are implemented over these objects. Finally the user interface can consume the services exposed by the persistence layer.

Process Model – SAP NetWeaver BPM

The replenishment process can be initiated by either the buyer or by a scheduled service which uses the pre-defined templates. Scheduled launch is suitable for mature products.

The buyer enters the product details and store managers and triggers the process.

The store manager id is used in “Parallel for Each” human activity. Each store manager is assigned his own instance of the “Add replenishment task”. This behaves as set of parallel tasks. Once all the store managers submit the data, it is sent for approval.

For critical products or for orders exceeding regional managers need to approve the details. Critical products and order limits are defined in BRM.

Keep the model complexity to a maximum of 10 – 15 steps. If the process grows beyond this number explore the option of sub processes.
Browsing Your Task List

The tasks in BPM are accessed via an UWL. While this is the most common approach, there could be requirements where users are interested only in viewing their BPM tasks.

Process list viewer displays all the BPM tasks a portal user is involved in. It also provides more metadata on each task like deadlines, attachments, notes etc.

Persistence and Service Layer

Why is a persistence layer required, when BPM has the ability to store data as a part of its context?

A large amount of data in the process context reduces the performance of a BPM process. There can be significant delays in process loading and task generation. Building analytics also becomes tricky.

Hence the general principle is to divide your process data into primary and secondary data. Primary data is usually a key or id in a particular entity. Use this primary data to retrieve secondary data when required.

As a rule of thumb when process attributes exceeds 25, staging should be used.

Entities and Relationships

Replenishment model deals with a simple set of JPA entities. JPA is used as it simplifies database operations. It also requires lower maintenance and is database independent. The entities are modeled specifically to suit the process.

Hence “Process” entity acts as the parent. The store managers involved in the process form the “User” entity. Each user updates his sales outlet demand per product. This forms the final “Product” entity.
EJB Services

Process data is modeled as JPA entities. During each task in the process, the process state is persisted in the database using EJB services.

User Interface

A combination of WebDynpro Java based UI and mobile applications are used for the replenishment process.

WebDynpro Java

WebDynpro Java is the primary UI used in BPM developments. While the latest version of BPM 7.3 provides API for triggering processes and consuming tasks, it is still cumbersome as UI needs to be built.

However with WebDynpro java, UI can be generated based on the data objects defined in BPM.

I find it quite useful to generate the UI and test the process. Finally based on the requirement we can tweak the UI and build business logic in it.

The collaborative retail replenishment process involves three UI components. The first component for initiation, second for adding product quantities and the third component for approval.

The buyer initiates the replenishment process using the initiation screen. Once he adds the products, he searches the sales outlets involved and adds their respective managers. Finally the process is triggered.

Two store managers are added in this process.
Each store manager received a task in his UWL.

On launch of the task, the store manager can add the demand in their respective sales outlet. Both store managers submit their request independently.
The task is available in the buyer’s task list for consolidation and approval.

The buyer finally needs to consolidate the demand and add other variances (which can be retrieved from BRM using WS) before triggering the downstream logistics. When the buyer submits the data is cross checked against BRM to verify if an regional manager approval is required.

Native / non – Native Mobile Applications

With mobility coming of age, everyone wants to build mobile applications. Building mobile apps for the enterprise is different from building them for consumers.

Device management, security, data protection etc add another dimension to the use of mobile apps in enterprise. Adding to this we have an option of either developing a native app or a browser based device.

When to and how to?

Native applications are best suited for use cases which require native device features, for apps which can operate offline or cannot afford continuous connectivity.
And have you heard about “fragmentation”? That’s a native application developer’s nightmare. In fact enterprises see this as one of the biggest hurdle.

When you can control the devices in a landscape try native apps. In all other cases, it makes more sense to go with mobile web apps. Mobile apps are well suited for form based applications plain data entry / data view applications. And when we do not know the target devices in a landscape, it is a safe bet to deploy a particular app as a mobile web application

**Retail approval for regional managers**

In retail replenishment scenarios, for exception cases where new products are involved or if orders exceed certain threshold, an approval from regional managers is required.

The number of regional managers involved is generally limited and they usually carry a phone provided by their company. When we are aware of the target devices, it is easier to deploy native apps to these consumers. The manager views the task which needs his approval verifies the products, views the cost involved and approves the same.

A prototype android application (themed similar to Iphone), used for approval.

Finally for mobile development, an app developer has the option of using SUP or REST based services. Use SUP when the data sources are not REST enabled. SUP supports a variety of data sources and abstracts them as mobile business objects. Native mobile applications can consume these MBOs to build device specific content.

When applications are simple, have REST based services and deployed only to a limited target devices, development without using SUP seems more prudent.
Process Analytics

Automating of retail replenishment scenario requires a significant amount of time. There are some obvious advantages in automating this process. Significant reduction in costs, collaboration between store managers, faster turn-around times and not to mention reduction in the number of personnel required.

But if we cannot use this information to improve the retail business, we might as well use pen and paper to collect information.

A key takeaway in implementing business process is process analytics. The ability to understand how a business process behaves in real time conditions, ability to visualize trends, ability to identify strengths and weaknesses makes a BPM implementation worthwhile.

Business Process Analytics Format

Effective analytics requires useful data. The foundation for useful data is a well designed data format built in the context of BPM.

A process context, in addition to storing its task data, should have the ability to store state of objects and how these objects transform in each step of the business process.

With that in mind, we need to design our process context.

A suggested method to design a process context and store data object states is mentioned below. Storing the state of data object before and after will provide significant advantages beyond analytics. This data will be particularly useful in audit and compliance requirements.

Power of Analytics

It is no secret that retail businesses will benefit from analytical approach. SAP provides standard data sources to build administrative reports for BPM.

The simplest away to build analytics on process data is to use custom data sources in BPM and consume them in visual composer. As the data in the replenishment scenario is staged, richer analytics can be built by leveraging this information.
An interesting way is to use this data to build a text–query based analytic engine. This would be a unique way to gain user acceptance for usage of process analytics.

![Text based query engine](image)

*Fig. An idea of text based query engine for process analytics*

But that’s probably for some other day.

**Conclusion**

We have seen how to implement a collaborative retail replenishment scenario using SAP NetWeaver BPM. The various technology components required to implement this retail process and the best practices for each of these components were also discussed.

Future enhancements that can be added to this implementation are building a task list for mobile interfaces, a text query based analytics engine and integrating with BRM in estimating other variances for sales outlet demand.

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