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RESEARCH ARTICLE

A MATERIAL REQUIREMENTS PLANNING (MRP), GOODS REPLENISHMENT APPLICATION FOR DEMAND & INVENTORY PLANNING USING DATA AND ANALYTIC

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ABSTRACT

Replenishment for Demand & Inventory Planning is a way to efficiently manage flow of the goods as they move throughout the entire supply chain from the manufacturer to the supplier to warehouse and shipment location. It constantly check stock vs. demand. A good replenishment system help to avoid human errors, for instance missing to place an order in the system, or enter wrong information. An intelligent replenishment system can be configured to automate triggers to order/re-ordering the goods, suggest alternative approaches to get the goods (e.g. Transfer of goods from Distribution center or location instead of purchasing from the supplier), it also factors in forecast changes in demand and adjusts the replenishment orders. The tool can overall improve service levels, gain efficiency, leads to reduce cost and improves customer satisfaction.The perseverance of this study is to recognize the elements of Materials Requirement Planning (MRP) and implement to our selected problem. Main objective of MRP is to manage dependent demand items, high inventory turnover and low payable cost. A common and effective problem which rise in Manufacturing and small, medium-Sized Firms and industries was taken for understand and all possible factors are taken and discussed after that the solution procedure is applied and result is presented. This paper describes the importance and features of goods replenishment tool for Demand & Inventory Planning categorized as Material requirements planning MRP using Data and Analytic. We are going to introduce entire list of the key features that are designed specific as per the requirement of the Supply chain in the Oil and gas industry.

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INTRODUCTION

Inventory and demand planning is multi-step operational supply chain management process used to create reliable forecasts. Effective demand planning can guide users to improve the accuracy of stock orders, align inventory levels with peaks and troughs in demand, and enhance profitability for given channel or product. As described in Supply chain management (SCM) systems, 1"SCM is the management of the flow of goods and services. It involves the movement and storage of raw materials, of work-in-process inventory, and of finished goods as well as end to end order fulfillment"1.Supply chain involves five major stages: 1) The plan or strategy 2) The source (of raw materials or services),3) Manufacturing (focused on productivity and efficiency),4) Delivery and logistics and 5) The return system (for defective or unwanted products). The first and second stage is where the Goods replenishment planning will be applied.

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Our focus is to procure goods when required, with no defects, and at the lowest total cost of ownership to prevent costly inventory overstock. A cross business perspective is taken as well to highlight the opportunities. Having accurate location stock of goods on time is one of the critical key of a successful scheduled job delivery in an oil and gas organization. Better replenishment planning can be acquired as accurate as possible and it is highly depending on the efficiency of internal process of the organization. In some situations Company's forecast can be uncertain and fluctuated due to unconfirmed demand, asset management is not up to data, warehouse space is not optimized and sometimes end-to-end visibility is not clear. However by improving the process of effective stocking level strategies can be formulated and desired result of replenishment planning can be achieved. As described above, when it comes to replenishment, several of the challenges concern e.g. communication, organization and competent forecasting. The replenishment planning categorized under Material requirements planning (MRP) tool is a computer-based inventory management system designed to improve

productivity for businesses, specifically build for the Oil field users (e.g. Field users, Store Keeper, Segment Planners, distribution center Analyst, Material Control Tower analyst), Business system Managers and Supply chain Managers). One of the Key and essential features of Replenishment planning tool is to have the ability to connect live data and gather accurate information to calculate and propose replenishment. As described in Figure 1 below, suggested Material requirements planning (MRP) tool is integrated with company's various Enterprise data warehouses to collect data with live connection. The other main features are using a single configurator for all the data, consuming robust rules and algorithm, automated notification and triggers with the ability ofproducing Graphical visualization and reports with various analytics.

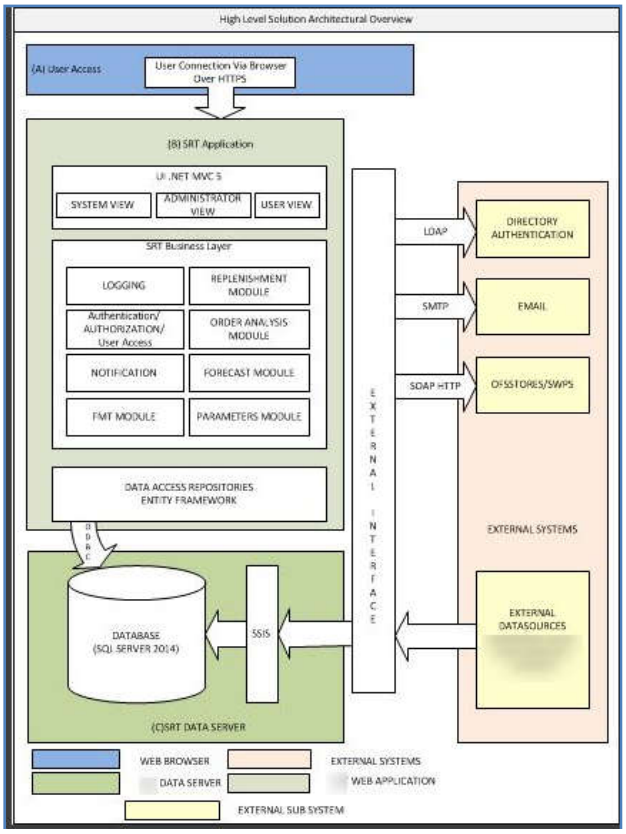

Figure 1. Architecture diagram of the good replenishment tool

BACKGROUND AND CONCEPT

According to Orickly (1) "Material Requirements Planning (MRP) consists of a set of ,data-notes, the related tools &techniques and all procedures are reasonable, and decisions relating to the explanation ofthe Master Production planning and there schedule of the final product. The sub-assemblies or final item in the net requirements and a number of requirements that must be ordered from each of the components needed to implement the Master Production Schedule. Understanding of MRP by Gaspersz (2),"Material Requirements Planning (MRP) is a planning and control of orders and inventory for dependent demand items, where demand is likely discontinuous and Uneven." Some ofMRP above, it can be concluded that Material Requirements Planning (MRP) is an information system designed with computer-based inventory is intended to control the raw materials / components that are dependent demand or request derivatives. There is enormous amount ofliterature available on Materials Management and Material Requirements Planning (MRP) in the form of research papers, books and articles in research Journals etc. Some important methods which are, Material Requirements Planning (MRP) needs for Make-to-Order Company By J Hoey et al (4), Scheduling and order Release, James R. Ashby (5) for determining the role of inventory safety stock on MRP: Optimal positioning of safety stock in MRP, A.G. Lagodimoset al (6), product Structure Complexity W.C. Benton and R.

Infrastructure: Application has two main components. Frontend and backend. Front end has been designed using .Net Framework and backend has been developed using relational database.NET (pronounced as dot net) is a framework that offers a programming procedures that can be used to develop a wide range of applications. However, relational database (Relational Database Management System, RDBMS) is the basis for SQL, and for all modern database systems including Microsoft SQL Server. As described below, Figure 2 provides the infrastructure resources to embrace the MRP application with one environment for Quality Assurance and second environment for Production as per the requirement of standard IT (Information technology) practices. Defining the standard of IT (Information technology) is out ofthe scope ofour paper. Hardware related specification and definitions are also not in the scope. Entity Relationship Diagram, also known as ERD, as described in Figure 3, is a structural diagram for use in database design. It is used to analyze the developed databases logically. Below diagram has been provided just to emphasize the complexity ofthe data flow and logics behind the MRP application, which is the essence of the MRP application.

Main Features: Major functionalities of the Material requirements planning (MRP) application, are listed as below

Field Replenishment - This feature allows business planner or purchase decision maker, to determine the replenishment quantities, based on 12 month historical consumption, manual forecast, lead time, target Days Stock on Hand) DSoH & safety stock.

Excess Offer - Location material manager can check excess quantities for his/her location, based on the MRP calculations and send excess stock related emails to other locations using the MRP tool itself. So that, locations in need, can create Field Material transfer (FMTs) to the locations having stock in excess.

FMT Management - Supplying & receiving location Point of Contact can check all FMTs and take actions on open FMTs.

Order Analysis - This feature allows users to check open shopping carts (using direct interface to Purchase Order requisition system) and find pending for approval shopping carts. Shopping cart approver can make approval/rejection decision. Other important information like forecast, open orders and excess stock is displayed, to help approver make conscious decision on shopping cart approval.

Global Parts - User can search one or many parts to determine the locations holding that part. This feature can help user know FMT opportunities. Also can find "Globally Dead" (if there has been no consumption of that part at a global level)

TCC Checks: - Check the order shipping and receiving location along with the parts. Check classification of part against master data if it is permissible to process the order.

METHODOLOGY

As described in Figure 4, there are 3 application layers. First layer is named Data Access is the key of the application that makes sure that data input is accurate and up-to-date. 2nd layer is the business logic layer where it calculate the algorithm as per defined rules from the supply chain organization in the company. Third and last layer is presentation layer where it displays the graphic visualization, export the data for further analysis and feed to external system for further action like placing a purchase order for the required part and quantity as proposed by the MRP.

Sequence Diagram

Below are module based sequence diagrams

Administrator: As described in Figure 5; In order for the MRP system to be properly run and setup, some basic parameters would need to be defined by user or Regional planning function. These parameters would then be used in the calculations as per system defined logic. Only Administrator can access this page, other users can access this page in read only mode.

Replenishment: As described in Figure 6; The MRP planning application would determine the demand classification for all the different parts by performing back-end calculations.

The criteria above would then be used to filter the parts that are to be displayed for replenishment, and the level of aggregation to be used. For instance, it could be used to just select one warehouse location (and the parts within that location) or for all warehouse locations in one Geomarket (GMK), or multiple locations in a Geomarket (GMK) (not necessarily all). The parts in these latter cases, would then be aggregated across multiple warehouse locations.

Order Analysis: As described in Figure 7; all the orders that the field users place are reviewed and validated by the Area Segment Planners. The Segment Planners would leverage the same application to review the orders placed by the locations in the Geo markets. They would evaluate if the location did not miss out on any excess opportunity and that the orders being placed are aligned with the proposal from application based on (Days Stock on Hand) DSOH target and the processes of Inventory standard.

Field Material Transfer (FMT) Management

As described in Figure 8; FMT management screen consist of two parts –FMT IN and FMT OUT. In FMT OUT section, User can verify generated FMT request for Supplying Location. In FMT IN section, user can verify generated FMT request

FOR RECEIVING LOCATION

Manual Forecast: Forecasting goods for impending requirement is an essential part of the delivery process because undesirable long lead times may associate too many products. Forecasting allows the field to compose, prioritize, approve, and publish forecasts, and therefore allows field staff to commit to capacity to meet the needs. The forecast is the expression of the field for capital equipment to fulfil a business need. When duly reviewed and approved by the chain of command (GeoMarket -> Area -> Segment) the forecast is the basis to procure long lead time items and start manufacturing. In essence manufacturing is based on approved forecast and not purchase order. Forecasting provide capability to do analysis based on Past consumption, can Create/Update/Delete Forecast on the goods level. As described in Figure 9; The Manual forecast used by the user to provide the forecast by month for specific parts and the associated technology for the parts for Distribution center and/or for location field. The application record the user alias and the update date for audit trail.

Excess Redistribution: As described in Figure 10; Excess Offer would provide the view on all the available Excess worldwide when doing replenishment planning. This would include the parts in Excess stores as well as the system calculated excess.

Constraint and Limitations: MRP systems offer a number of potential benefits to manufacturing firms. Some of the main benefits include helping production managers to minimize inventory levels and the associated carrying costs, track material requirements, determine the most economical lot sizes for orders, compute quantities needed as safety stock, allocate production time among various products, and plan for future capacity needs. The information generated by MRP systems is useful in other areas as well. There is a large range of people in a manufacturing company that may find the use of information provided by an MRP system very helpful. Production planners are obvious users of MRP, as are production managers, who must balance workloads across departments and make decisions about scheduling work. Plant foremen, responsible for issuing work orders and maintaining production schedules, also rely heavily on MRP output.

Other users include customer service representatives, who need to be able to provide projected delivery dates, purchasing managers, and inventory managers. MRP systems also have several potential drawbacks. First, MRP relies upon accurate input information. If a small business has not maintained good inventory records or has not updated its bills of materials with all relevant changes, it may encounter serious problems with the outputs of its MRP system. The problems could range from missing parts and excessive order quantities to schedule delays and missed delivery dates. At a minimum, an MRP system must have an accurate master production schedule, good lead-time estimates, and current inventory records in order to function effectively and produce useful information.

Another potential drawback associated with MRP is that the systems can be difficult, time consuming, and costly to implement. Many businesses encounter resistance from employees when they try to implement MRP. For example, employees who once got by with sloppy record keeping may

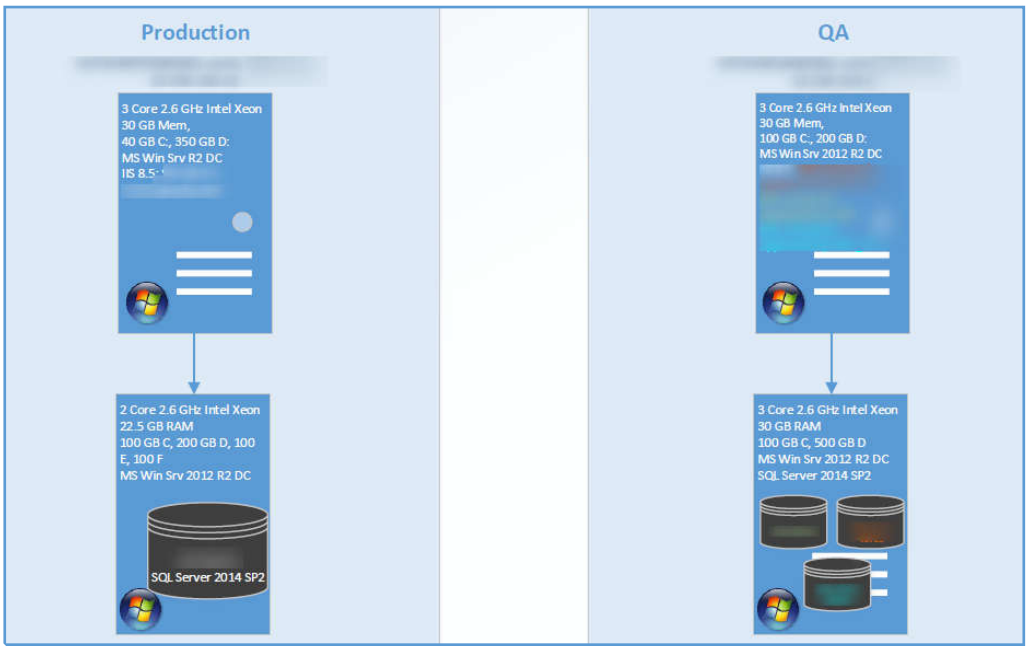

Figure 2. Infrastructure diagram

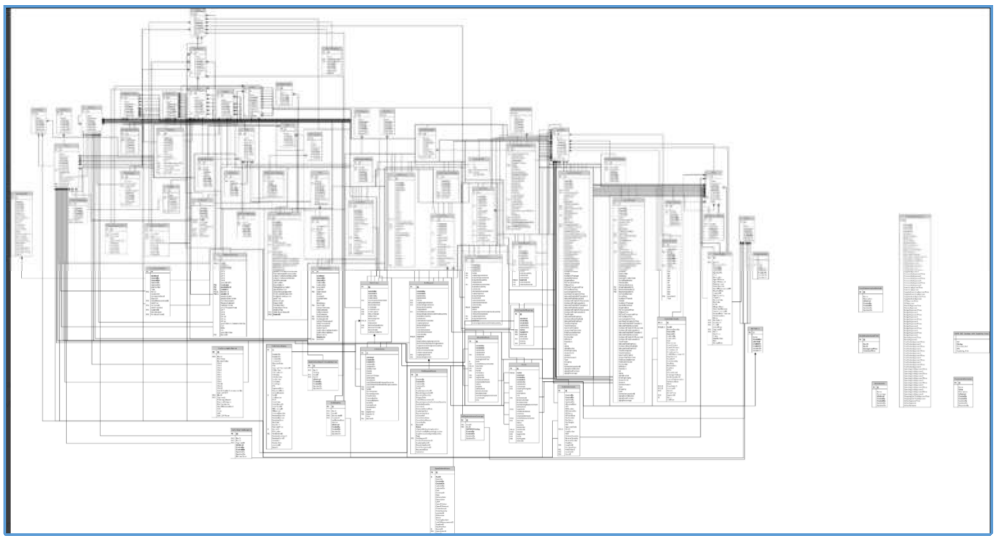

Figure 3. Entity relationship diagram (ERD) for the application

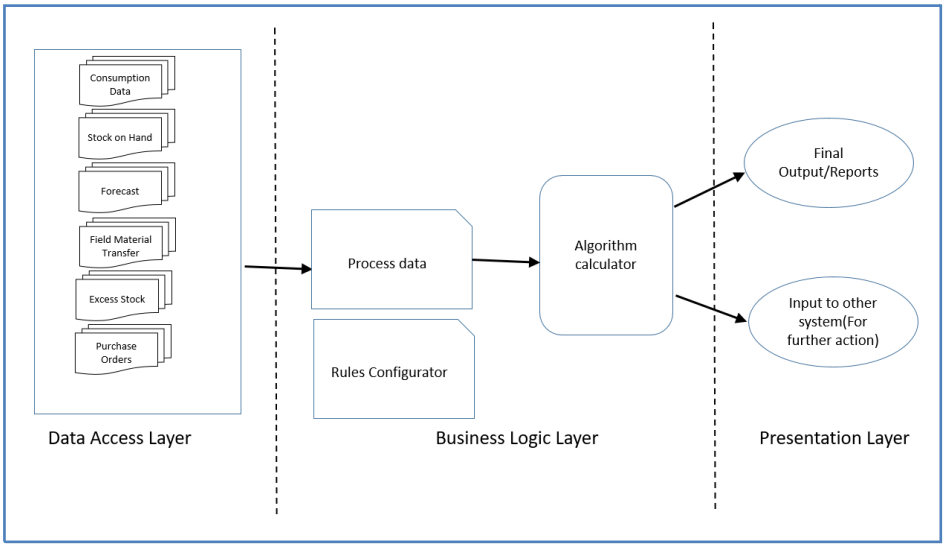

Figure 4.Application layers for the goods replenishment planning tool

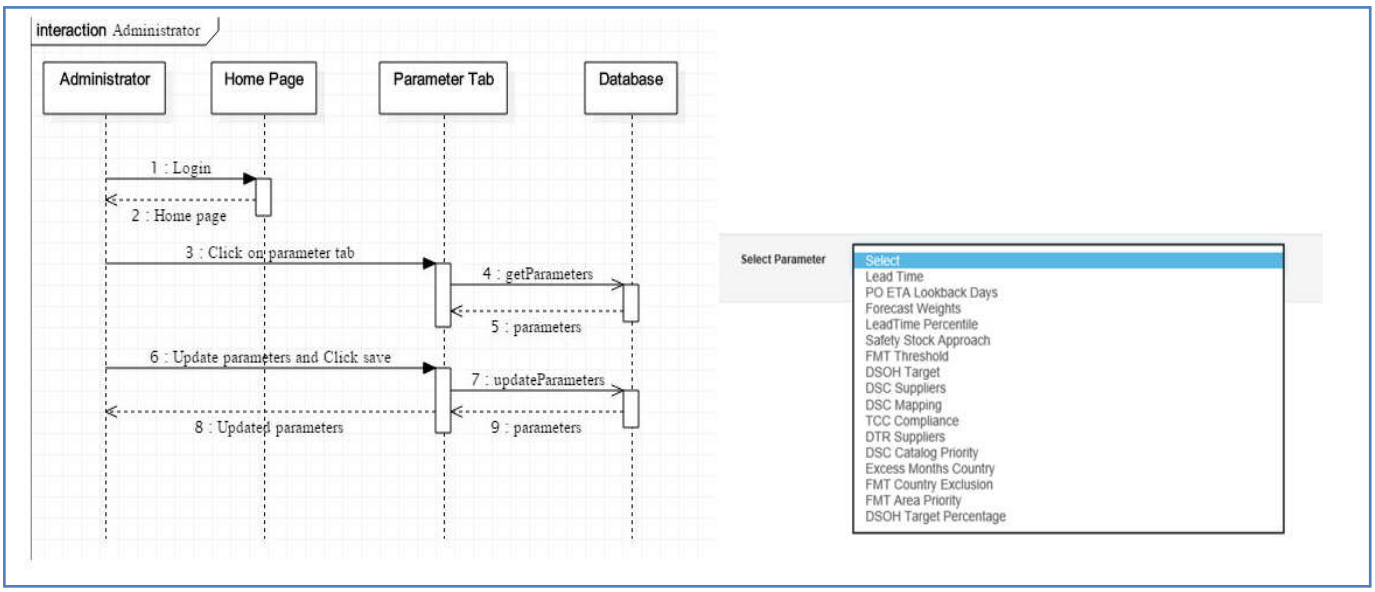

Figure 5: Admin control for the goods replenishment planning tool

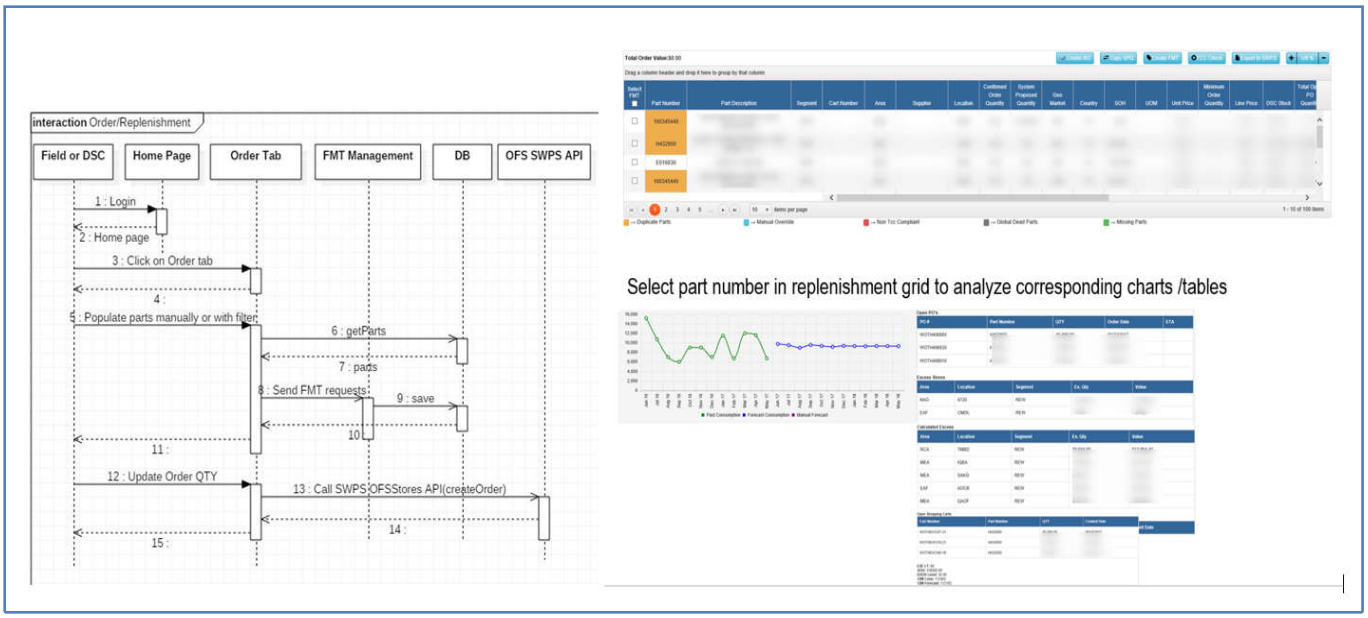

Figure 6: Replenishment area for the goods replenishment planning tool

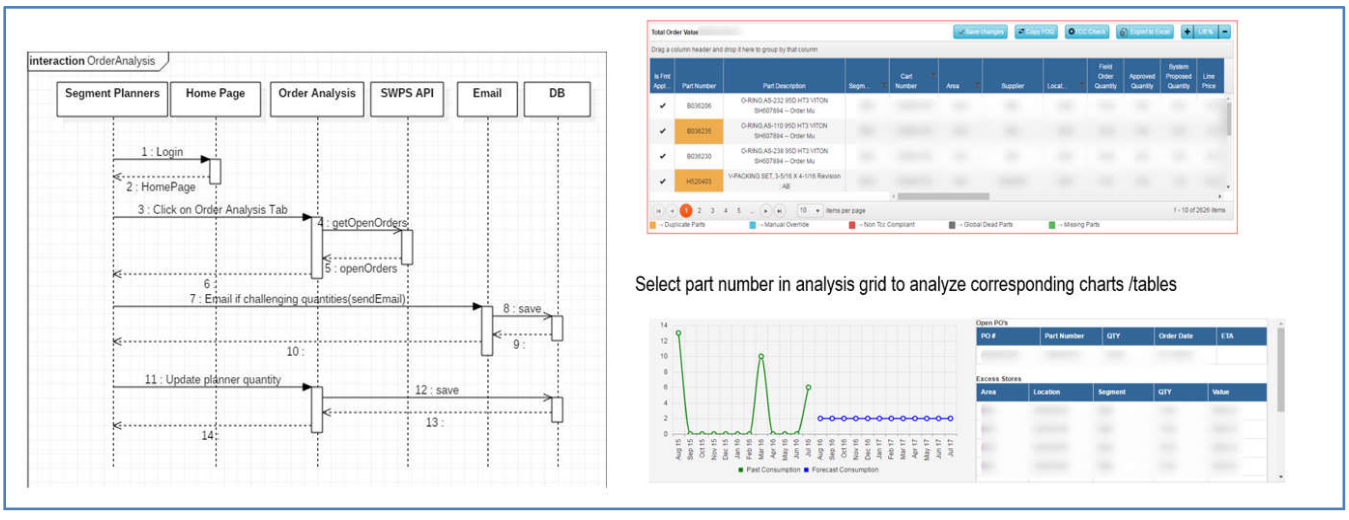

Figure 7: Order Analysis for the goods replenishment planning tool

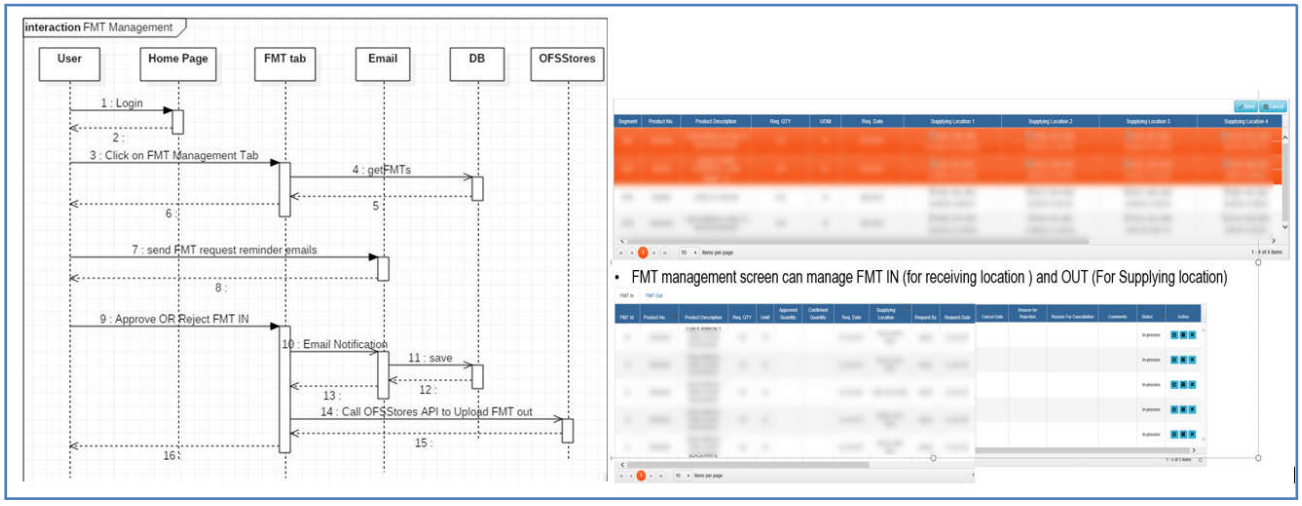

Figure 8. Field Material Transfer management for the goods replenishment planning tool

Figure 9: manual Forecast for the goods replenishment planning tool

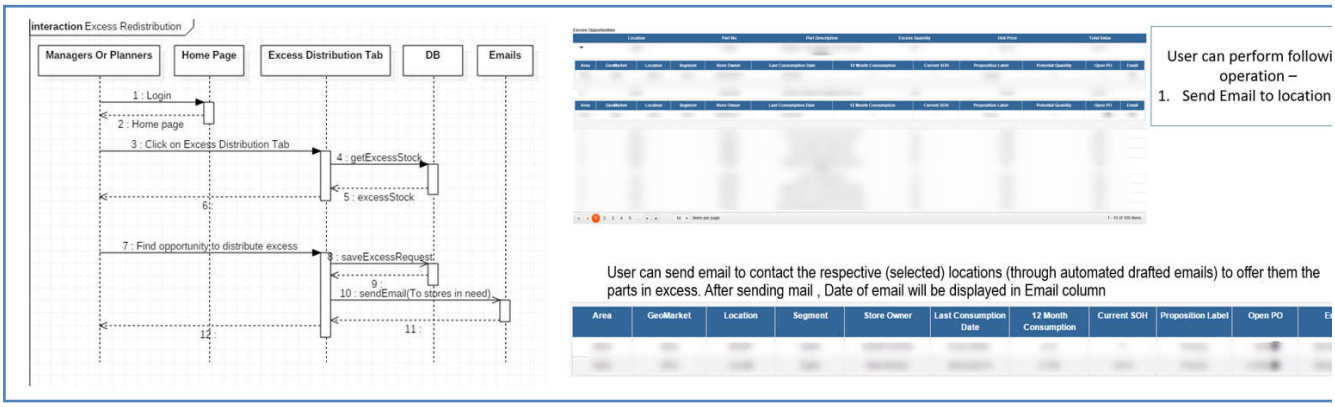

Figure 10. Excess Redistribution Analysis for the goods replenishment planning tool

resent the discipline MRP requires. Or departments that became accustomed to hoarding parts in case of inventory shortages might find it difficult to trust the system and let go of that habit. The key to making MRP implementation work is to provide training and education for all affected employees. It is important early on to identify the key personnel whose power base will be affected by a new MRP system. These people must be among the first to be convinced of the merits of the new system so that they may buy into the plan. Key personnel must be convinced that they personally will be better served by the new system than by any alternate system. One way to improve employee acceptance of MRP systems is to adjust reward systems to reflect production and inventory management goals.

Recommendation

We recommend further experimental and theoretical studies for the Material requirement planning systems for manufacturing and Oil and gas industry. Additional research is required to overcome the impact of various external key factors to estimate the accurate production planning and replenishment.

Conclusion

In this paper, we demonstrate how demand and inventory planning and replenishment processing tool can be designed for central operations and reduced the costs of operation

overall by gaining efficiency, lower stock(overstock) levels and improved inventory turnover. By using that automated tool a higher service levels can be achieved specific to the oil and field industry. The developed application can be implemented in real time or near real time in any large organization such as Oil and gas industry. Furthermore, research is needed if the identified approach can be used for other supply chain operation, the scope of the analysis can be extended using similar approach.

Nomenclature

- MRP :Material requirement Planning
- FMT: Field Material Transfer
- SCM :Supply Chain Management
- MCT :Material Control Tower
- ERD: Entity relationship diagram
- QA: Quality Assurance
- DSOH: Days Stock on Hand
- GMK :Geo market
- Win: Windows
- SQL: Structured Query Language

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