

Inventory management and ERP at the University of Pretoria

Investigation, Optimization and Implementation

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Executive Summary

Information integration in a large business is a critical factor for achieving a competitive advantage and the importance of ERP (Enterprise Resource Planning) and the implementation of the appropriate system cannot be stressed enough; however, the success rests in the approach to and research into the implementation process.

Since the University of Pretoria has procured Oracle PeopleSoft, the successful Phase II implementation of the PeopleSoft SCM Inventory module is the main focus of this project. This will be done through gaining a thorough understanding of the PeopleSoft SCM Inventory module and a meticulous investigation of one of the typical inventory environments at UP, the stationary store.

After complete investigation of the current policies and procedures, an appropriate optimization process regarding the inventory practices is followed in order to populate PeopleSoft with the best possible information. Subsequently the unique configurations on PeopleSoft SCM Inventory will be designed.

Finally a revised inventory model will be delivered for the purpose of the Phase 2 implementation of Oracle PeopleSoft at UP.

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Abbreviations

EOQ – Economic Order Quantity

ERP – Enterprise Resource Planning

HOD – Head of Department

IT – Information Technology

MAD – Mean Absolute Deviation

MCIC – Multiple Criteria Inventory Classification

MRP – Material Requirement Planning

SCM – Supply Chain Management

UOM – Unit Of Measure

UP – University of Pretoria

VMI – Vendor Managed Inventory

Chapter 1

A problem well stated is a problem half solved – Charles F. Kettering

1.1 General background on the problem

1.1.1 University of Pretoria's system renewal

The University of Pretoria's (UP) information systems evolved over many years. Regrettably these systems were run separately, leading to numerous fragmented systems carrying related or similar data with little or no integration between the systems, thus developing the need for systems renewal. The legacy financial system (Unikom) was introduced to UP in 1996 and has been running to the present. Unikom is a main frame system written in Natural Adabas – a programming language which in this day and age, has become almost obsolete. Since 2005 UP has been planning to introduce an integrated platform for all IT systems. In 2007 UP decided to procure Oracle PeopleSoft.

As UP is a large institution, and an entire implementation of PeopleSoft in one go is merely impossible, a phased approach is followed.

The Phase 1 implementation of PeopleSoft at UP includes the Financial and Procurement Management functions and will be running in parallel with Unikom for some time before the old system is switched off. During the phase 2 implementation in 2011, the Inventory Module will be incorporated, hence developing the need for this project.

1.1.2 A brief history on PeopleSoft

Oracle is a software company; it is the first to develop 100 percent internet-enabled enterprise software across its entire product line (Oracle, 2010). In earlier years PeopleSoft primarily developed human resource management (HRMS) and customer relations management (CRM) software. PeopleSoft was obtained by Oracle Corporation in 2005. PeopleSoft is an ERP (Enterprise Resource Planning) software product for the purpose of business management. The typical ERP system consists of sets of customisable software, that when implemented fruitfully, integrates all business functions within an organisation.

PeopleSoft, Inc. designs, develops, markets and supports enterprise application software products for use throughout large and medium-sized organizations worldwide. These organizations include corporations, educational institutions and national, state, provincial and local government agencies. The Company provides enterprise application software for customer relationship management, human capital management, financial management and supply chain management, each with a range of industry-specific features and functions. (Yahoo Finance, 2004)

PeopleSoft Campus Solutions is a product specifically designed for universities and other higher education institutions and thus the ideal product for the renewal of UP's system.

1.1.3 PeopleSoft Supply Chain Management (SCM) Inventory

PeopleSoft SCM Inventory is an extensive inventory management system that enables users with a competitive advantage. It improves accuracy and customer service along with multiple decision making tools for support in complex inventory management environments. This is moreover the chosen module for the phase 2 implementation of PeopleSoft at UP. *Figure 1.1* from the PeopleSoft demonstration database

represents the interface of PeopleSoft Supply Chain Management (SCM) Inventory with the end user (PeopleBooks, 2010):

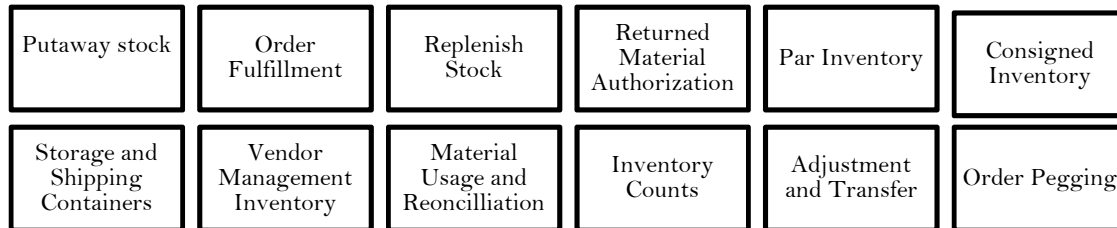


Figure 1.1 (PeopleSoft SCM Inventory user interface)

The main goal of ERP implementation is the integration of business units and information; therefore the inventory module integrates with the Set-up financials and Supply chain, SCM Integrations and Inventory Policy Planning user interfaces. *Figure 1.2*, *Figure 1.3* and *Figure 1.4* represent these interfaces:

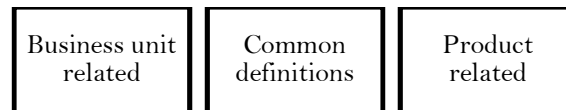


Figure 1.2 (Set-up Financials and Supply Chain user interface)

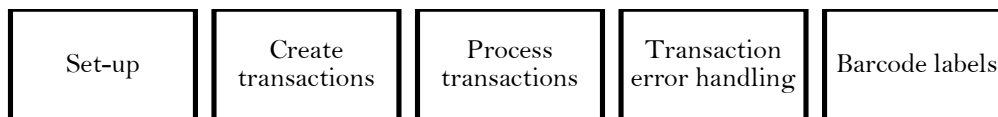


Figure 1.3 (Supply Chain Management (SCM) integration user interface)

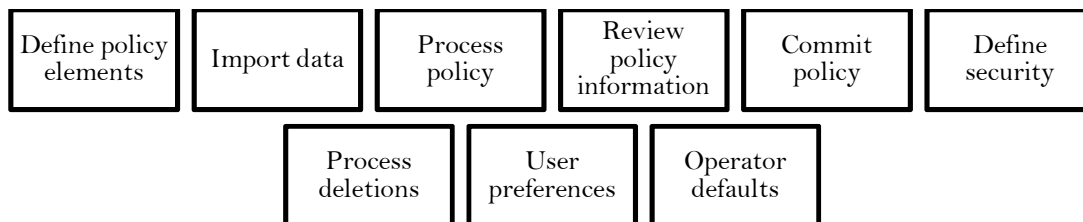


Figure 1.4 (Inventory Policy Planning user interface)

1.1.4 The stationary store

The UP stationary store is situated on the main Hatfield campus and is the sole supplier of general use stationary equipment to the main campus and all other UP campuses. All inventories in the store are non-asset items and under control of the manager of store services. The project is based on this store which is an ideal case study in preparation of the phase 2 implementation of PeopleSoft at UP.

1.2 Quantifying the need for a solution

The main objective of UP is not to make a profit; therefore a relaxed culture towards the financial well-being of the institution has developed across campus. The stationary store shows multiple signs of poor inventory management, thus before the system is renewed, system improvement is required.

1.2.1 Project purpose

The project aim is to deliver a revised inventory model representing the processes and procedures at the stationary store to pilot the second stage ERP implementation regarding the Inventory module of Oracle PeopleSoft at UP.

An investigation of the current inventory management practices is conducted at the stationary store on main campus, as well as a comprehensive study of the Inventory module on PeopleSoft in order to present an optimized inventory management model to employ in all other inventory environments at UP. Subjects such as re-order points, shelf life, item mix, forecasting, item value and classification, amount of vendors and utilization is addressed and optimized.

Figure 1.5 represents the “big picture” of the project and clearly indicates the different aspects under consideration.

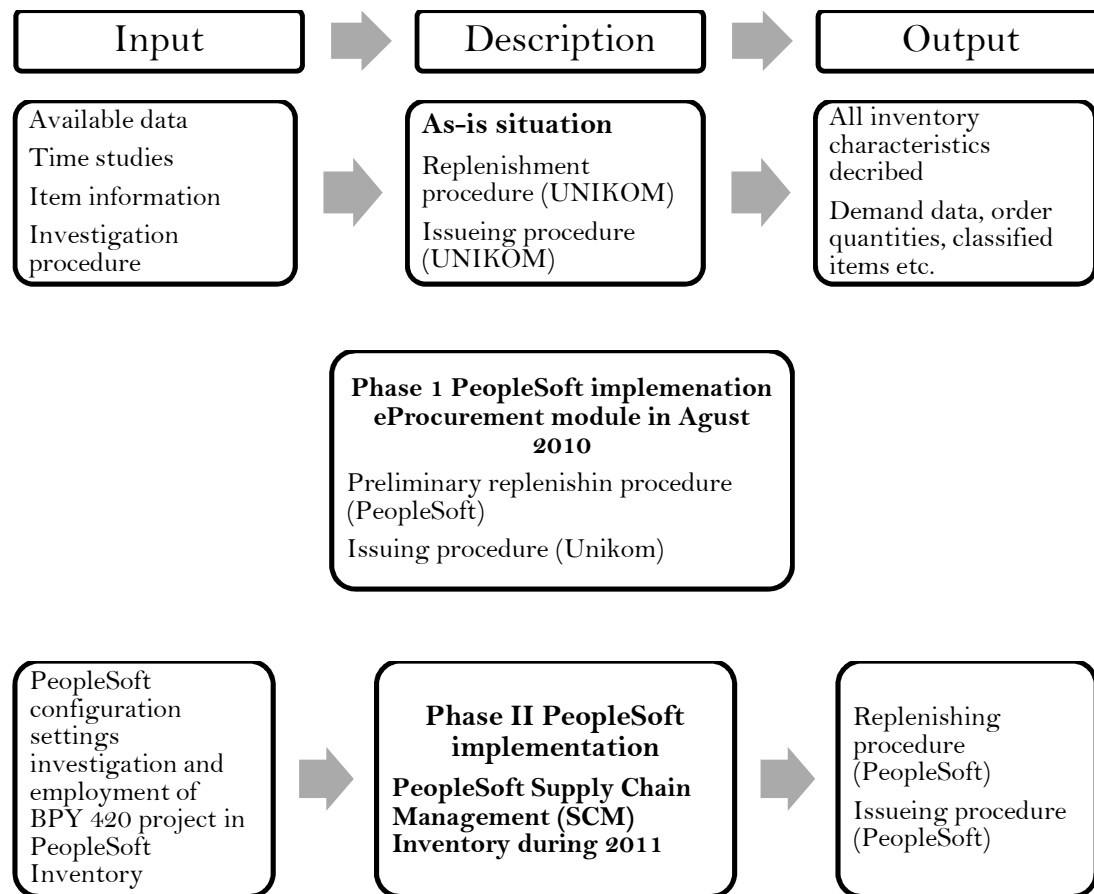


Figure 1.5 (“Big picture” view of the project)

On commencement of the project, the “as-is” situation of UP was that replenishing and issuing activities were done using Unikom. Therefore, data required for this project is extracted from Unikom. This is represented by the top section of Figure 1.5. The middle section represents the implementation of the Financial and Procurement modules of PeopleSoft at UP and does not concern this project. The bottom section represents the inputs configured in this project to ultimately achieve complete PeopleSoft procurement operation when implementation set off in 2011.

1.2.2 The role of PeopleSoft in this project

PeopleSoft performs the role of enabler in this project. PeopleSoft enables the implementation team to utilize the techniques used and results found in this project during the phase 2 implementation in 2011.

PeopleSoft consist of various built-in technologies and business processes that may be customised in order to achieve the unique requirements of UP. PeopleSoft Inventory has the capacity to optimize inventory procedures given the correct input. The built-in functionality of PeopleSoft will be evaluated in terms of best policies for UP to finally present a complete list of configurations for the PeopleSoft consultants to implement into the distinctive UP PeopleSoft inventory management system.

Figure 1.6 represents the enabling role of PeopleSoft in this project. PeopleSoft offers certain built-in functionality to customers and decisions regarding the relevance, need and employability of this functionality requires managerial and expert decision making. Facets of this project are dedicated to acquiring the necessary configurations for set-up in PeopleSoft. Furthermore, customization of PeopleSoft software is required to be minimal and a last resort due to software upgrades and incompatibility issues.

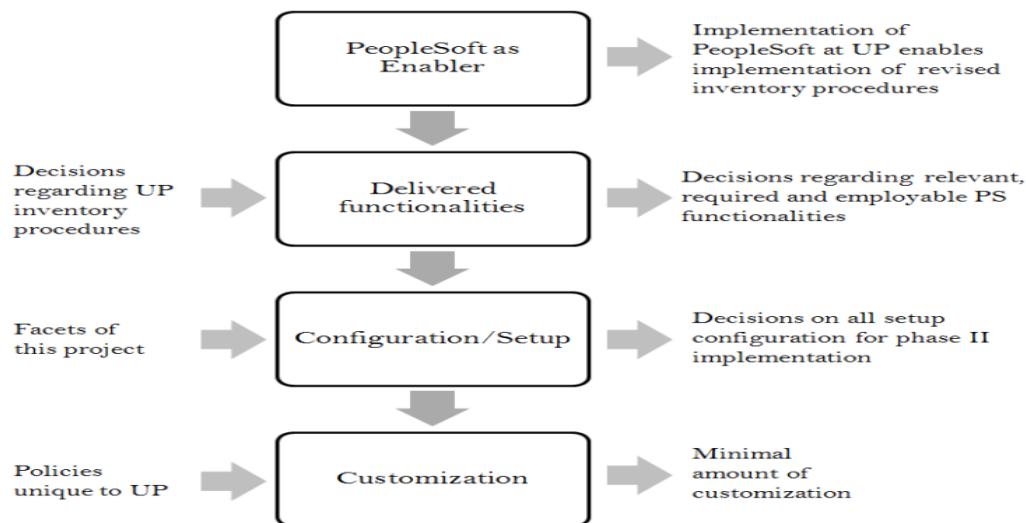


Figure 1.6 (The role of PeopleSoft as enabler)

1.3 Current processes and procedures

Over the years employees developed a sense for the inventory environment at the stationary store. This resulted in current business processes and decision making methods at the store.

1.3.1 Description of items

The stationary store currently stock roughly 473 items and carries an approximate inventory value of R 2.4 million at any given stage. After analyzing available data, it is apparent that in the year 1 July 2009 to 30 June 2010 there was movement on only 434 items. Items are categorized in groups and listed in Table 1.1 where each group has an identifying ID number in Unikom:

Books	Computer consumables	Paper
General	Exam pads	Files
Envelopes	Exam books	Slides
Video tape	Audio cassettes	Diverse
Pens	Labels	Staplers and staples
Record cards	Pencils	Tape
Office glue	Post-it notes and flags	Ink
Chalk	Paper binders	Ribbon
Marketing service	Transparencies	Batteries

Table 1.1 (Current item categories)

1.3.2 Inventory replenishing

The first aspect in inventory replenishing is the acquisition cost. A set-up cost of R 350 per order has been determined by the managers at the stationary store and includes all costs and processes from the point where the order is placed to the point where the invoice is sent to the creditors department for payment. The analysis of replenishment data for one year revealed that there are 1 – 15 different items per official order; therefore an average amount of items per order could be calculated. There is an average of 7.9 items per order, thus the average order cost per item is R 44.

The stationary store employs a 95-98% availability of stock rule and inventory is replenished according to customer usage and available space. The store does not make emergency orders when a stock out occurs.

Predetermined minimum and maximum stock levels may be viewed on the Unikom financial system by using the EAS 507 P program, the replenishing procedure is triggered when the minimum stock level is reached. *Figure 1.7* below represents the process flow after the requirement for replenishment has been established.

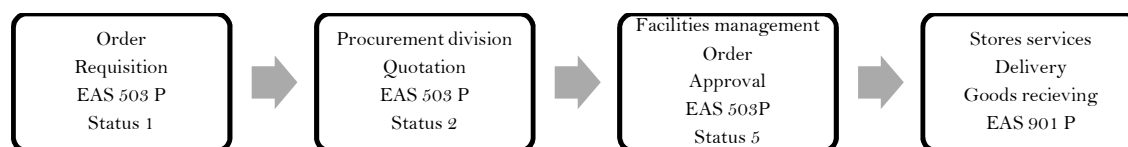


Figure 1.7 (Current replenishing procedure)

Requisitions are raised on the EAS 503 P program on Unikom and receive a Status 1 in the approval procedure. This is where item descriptions and specifications are made. The requisition is then sent to the procurement division where university buyers acquire quotations from different vendors and send the quotations back to the requestor where a status 2 is assigned to the requisition. On receipt of the quotations, the manager of the stationary store approves or denies the request. If denied, the request is sent back to the requestor in order to fix the problem, alternatively a status 5 is assigned to the requisition and a purchase order may be dispatched.

On receipt of ordered goods, the inventory supervisor verifies item descriptions, amounts, prices etc. to be correct and signs off the invoice, however, if the invoice exceeds R 10 000, the store manager is required to sign the document. Proof of goods received is done in the EAS 901 P program in Unikom directly after receipt.

Items are counted and controlled during storage and the inventory process is completed. Inventory is stored on shelves with the following dimensions: Length 10.65 m, Width 2.20 m and Height 45.0 cm. Hereafter, the invoice is sent to the financial department for payment.

UP has an extensive list of active vendors to facilitate the supply of necessary items; a catalogue is uploaded in PeopleSoft with suppliers and products available from these suppliers for the use of buyers and requestors.

1.3.3 Inventory issuing

The stationary store is the sole supplier of general use stationary materials to all UP campuses. These include the Groenkloof, Mamelodi, Onderstepoort, Medical and Hatfield campuses. Specialized items are acquired by the departments and users themselves. The store does not have lead time as customers collect their own items and rarely require a delivery service. *Figure 1.8* below depicts the issuing procedure as currently followed by the stationary store:

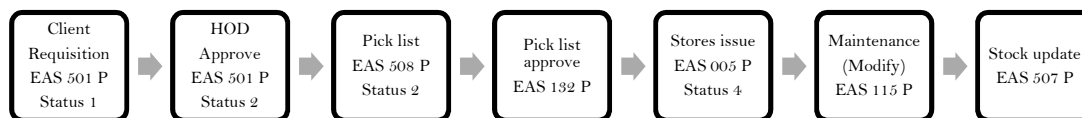


Figure 1.8 (Current issuing procedure)

In the stationary store's case, users across all UP campuses fulfil the role of the customer. A request is raised by the customer in the EAS 501 P program in Unikom and assigned a status 1. The requisition is sent to the Head of Department (HOD) pending approval. The inventory process is triggered when the HOD approves the request and assigns a status 2. The picking process is initiated in the EAS 508 P program in Unikom.

The issuing clerk approves the pick list in the EAS 132 P program in Unikom and releases the required inventory from the store to the waiting area. In the waiting area the stock is validated for correct item, quantity, damage etc. before it is exported. In the EAS 005 P program in Unikom a stores issue is made and a status 4 is assigned. The last two boxes in the process represent the case where inventory is returned.

Returns of inventory from customers are done in the EAS 115 P program in Unikom where stock is placed back in the system. In the case of broken or damaged goods, the item/s is sent back to the original supplier accompanied by the invoice. A stock update is done in the EAS 507 P program in Unikom.

1.3.4 Inventory counts

Complete inventory counts are done twice yearly in June and November using the EAS 015 P program in Unikom for comparison of actual and system inventory amounts. Test counts of 5% of items are held monthly, if the test count deviates more than 2.5% in rand value, an additional 5% is counted, if again the deviation is more than 2.5% the entire store is counted to determine the cause of the deviation. A current business rule is to manage inventory with 97.5% accuracy.

1.3.5 Obsolete, damaged and slow moving inventory

Items are classified obsolete when no movement has occurred on them in 2 years. Items with no usage value are disregarded with the approval of the vice director of facilities and services and removed from the store.

1.3.6 Holding cost

The current expenses at the stationary store that may be considered for calculating holding cost is listed in *Table 1.2*:

	Monthly (R)	Yearly (R)
Rent of equipment	3300	39600
Telephone	800	9600
Protective element	1200	14400
Clerk salaries	65272.42	783269
Damage and obsolescence cost	14171	170052
Total cost (R)		1016921

Table 1.2 (Current holding cost elements)

1.4 Scope and limitations of the project

This project concerns the phase II implementation of PeopleSoft SCM Inventory at UP. For the period of preliminary research this objective is essential to take into account. As it is time-consuming and nearly impossible to review all warehousing at UP, only the stationary inventory environment will be investigated. Further decisions and customizations will be based on the findings at the stationary store and adjusted and employed in all other inventory environments at UP.

Although PeopleSoft is able to fit most of the unique procedures and requirements at UP, not all built-in functions could be re-programmed, and customizations requires minimization due to software upgrades and compatibility issues. This raises the constraint on the optimization approaches that will be employed in the PeopleSoft environment.

The study is limited to one inventory environment at the UP, where due to unrefined procedures at the stationary store, the accuracy of the available data is doubtful. However doubtful this data might be, it will be utilised as initial input for the project.

The final outcome regarding an optimized inventory system for PeopleSoft employment gives substance and value to the project. In an ever more competing world it is advisable for entities to remain at the forefront.

Chapter 2

Literature review

The answers you get from literature depend upon the questions you pose – Margaret Atwood

2.1 Characteristics of an inventory system

According to Naddor (1982:3), a typical inventory system is a system where the following three costs are considerable and subject to control:

- Carrying cost
- Shortage cost
- Replenishment cost

2.1.1 Carrying cost

The costs associated with the amount of inventory stored at a given stage are called inventory holding costs or inventory carrying costs. This commonly represents one of the elevated costs of logistics. The need for proper assessment of these costs is due to the magnitude of them (Stock & Lambert, 2001). Problems associated with these costs are that many company's costs are not calculated according to their own unique situations however include only the current interest rate, taxes and insurance paid on inventory. Some managers find it appropriate to apply textbook or industry percentages for calculation of these costs (Stock & Lambert, 2001).

Inventory holding fixes money where it could be applied in other investments on which interest could be earned. Douglas and Lambert (2001) suggests inventory carrying costs should only include costs varying with the amount of inventory and categorize them in 4 groups: (1) capital costs, (2) inventory service costs, (3) storage space costs, and (4) inventory risk costs. Atkinson (2005) state that the estimated holding cost for an item is roughly 15-35% of the items actual value per year. According to REM Associates a "rule of thumb" to determine inventory carrying costs is 25% of on-hand inventory.

Naddor (1982:37) declares the following costs included in unit carrying cost: the costs of money tied up in inventory, storage, taxes payable on stock, obsolescence, insuring inventory and more. Richardson (1995) suggests the percentages in *Table 2.1* a basis for calculating inventory carrying cost:

Cost element	Percentage range
Cost of money	6% - 12%
Taxes	2% - 6%
Insurance	1% - 3%
Warehouse expense	2% - %5
Physical handling	2% - 5%
Clerical and inventory control	3% - 6%
Obsolescence	6% - 12%
Deterioration and pilferage	3% - 6%

Table 2.1 (Suggested percentages to calculate inventory carrying cost)

Douglas and Lambert (2001:203-212) explains an industry example for calculating inventory holding cost. In the example, 11 cost categories, each with the source, explanation and amount is described. According to Douglas and Lambert (2001:205), the value of average system inventory should be calculated and all other inventory costs should be calculated as a percentage of average variable cost of total inventory and added to

the capital cost. Assumptions to the method are that variable costs are 80% of full cost and the cost of money is 30% before taxes and 15% after taxes (Douglas & Lambert, 2001:205).

2.1.2 Shortage cost

According to Naddor (1982:38), shortage cost is the most difficult cost to quantify. In other words, shortage cost is the penalty for not having demanded stock available.

The following costs may be included when calculating the shortage cost: overtime costs, extra administration and clerical costs, sales loss, goodwill loss, customer loss and other costs (Naddor, 1982:38). Shortage costs not only depend on the quantities that are short but the time the stock is unavailable as well.

2.1.3 Replenishment cost

Replenishment cost includes ordering and set-up cost as well as unit purchasing cost. Ordering and set-up cost does not depend on the size of the order, unlike unit purchasing cost which is the variable cost of purchasing one unit of the item (Winston, 2004:103-104). In general, replenishment refers to the amounts that are put back in stock, decisions regarding ordering these amounts and the time ordered items are refilled in stock (Naddor, 1982:26).

When calculating the replenishment cost, the following costs may be considered: administration cost, delivery cost, and labour cost for storage etc.

2.1.4 Customer demand

The purpose of keeping inventory is to have items available on demand. Demand from the customers may be considered as an initializing feature of the inventory policies and procedures that an organization will employ. Wild (2002:19) defined availability:

$$Availability = \frac{Demand\ satisfied}{Total\ demand}$$

This criterion should be employed as a measure of investment performance made in inventory management.

Wild (2002) suggests that when demand is evaluated, historical data for each period should be collected for each item. The most common type of demand follows a normal distribution where the majority of the demand falls close to the average and is sometimes much higher or lower.

The mean represents the average demand for the item. When calculating minimum and maximum levels of inventory, the outliers should be disregarded.

2.1.5 Safety stock

Safety stock is the amount of inventory of each item carried in addition to cycle stock to cover calculated variations in demand (Stock & Lambert, 2001:232). The carrying of safety stock is a direct result of uncertainties in demand i.e. errors in forecasting (Grant et al., 2006:163).

Reasons for having safety stock may include the convenience of buying in bulk or because supply time exceeds the time in which items are required. The amount of safety stock held by a company depends on the variability of demand, reliability of suppliers or dependability of transportation (Wild, 2002).

By gathering valid statistical data of sales and replenishments, the safety stock may be computed. Stock and Lambert (2001) suggests the following equation:

$$\sigma_c = \sqrt{\bar{R}(\sigma_S^2) + \bar{S}^2(\sigma_R^2)}$$

where:

σ_c = Units of safety stock required to satisfy 68 percent of all probabilities

\bar{R} = Average replenishments

σ_S = Standard deviation of sales

\bar{S} = Average sales

σ_R = Standard deviation of replenishment cycle

2.1.6 Lead time

The lead time of an item is the time between the occurrence of a shortage and the point where items are available for supply again. Lead time may be organized into different components according to Wild (2002), depending on the businesses practice preferred. The following are examples of times that may be included in total lead time:

- Order review time
- Order processing time
- Lead time of supplier
- Transportation time
- Receiving, storage and update time

The consequence of long lead time creates difficulty in inventory replenishment to cover a supply period.

2.1.7 Obsolete items

Obsolete items are those items that are damaged, expired or lost i.e. items that cannot be accounted for. This introduces a hidden cost when calculating holding cost as the amount of inventory stocked may be related to the amount of obsolete items.

A tool that may be used for the calculation of cost that is variable with inventory levels is simple linear regression. A calculation for damaged inventory related to the level of inventory follows (Stock & Lambert, 2001):

1. Find dollar observations for as many possible events where stocks are damaged, expired, lost etc. and the dollar value at which total inventory was in each instance.
2. The relationship between damage (D) and inventory level (I) is then graphed and a straight line is drawn through the plotted points whilst minimizing the distance of each plotted point from the graph.
3. Two points may now be selected on the regression line and the change from one to the other is expressed as a percentage. In mathematical terms:

$$(\Delta D / \Delta I) \times 100\%$$

This concept may be employed for calculating the cost of expired goods, damaged goods, lost goods, generally items that cannot be summoned up.

Many of the elements of a typical inventory environment are graphically represented in Figure 2.1 from Wild (2002:113).

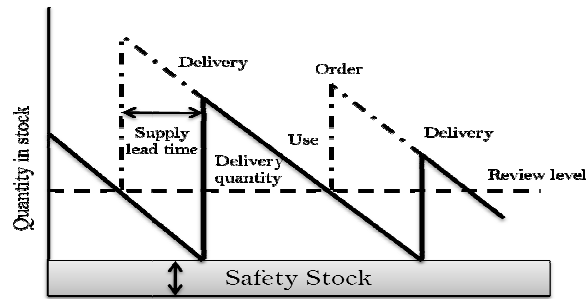


Figure 2.1 (Inventory control)

2.2 Tools and techniques

This section is dedicated to a comprehensive description of the tools and techniques generally applied to inventory systems.

2.2.1 The Pareto principle

A study of wealth distribution in Milan during the 18th century by Vilefredo Pareto revealed that 80 percent of the wealth was controlled by 20 percent of the people. The logic of many with little importance and a few with great importance has come to be the Pareto Principle (Stock & Lambert, 2001).

2.2.2 ABC analysis

The principle of ABC analysis has been around for many years, more specifically since the Pareto Principle of imbalance was developed. In the 1950's ABC classification was devised by General Electric and identifies a small amount of items which constitute a large amount of annual dollar value of sales (Winston, 2004).

In an organization there may be thousands of different inventory items with multiple units of measure. A traditional approach to inventory is to classify the items into different classes according to annual dollar usage i.e. ABC analysis. Wild (2002) summarizes the essence of ABC analysis in *Table 2.2*:

Item Category	% of Company Business	Amount in Inventory
A	70%	10%
B	20%	20%
C	10%	70%

Table 2.2 (Essence of ABC analysis)

Flores and Whybark (1987) states that little guidance is given on what to do after completing the ABC analysis and general advice such as “manage the A items more closely” and “spend less time on the C items” are given which does not necessitate the need to improve managerial performance. The annual turnover of stock items may be expressed as:

$$\text{Annual usage} * \text{Unit cost}$$

which is the traditional measurement criteria in ABC analysis. The assumption may be made that unit cost represent average cost of units, latest cost or standard cost provided that the same cost is applied to all items. *Table 2.3* from Wild (2002) summarizes approaches and methods concerning the different classes of items:

Class	Characteristics	Policy	Method
A items	Few items	Tight control	Frequent monitoring
	Most of the turnover	Personal Supervision	Accurate records
		Communication	Sophisticated forecasting
		Balanced safety stock	Service-level policy
B items	Important items	Lean stock policy	Rely on sophisticated method
	Significant turnover	Use classic stock control	Calculated safety stocks
		Fast appraisal method	Limit order value
		Manage by exception	Exception reporting
C items	Many items	Minimum supervision	Simple system
	Low turnover value	Supply to order where possible	Avoid stock outs and excess
		Large orders	Infrequent ordering
		Zero or high safety stock	Automatic system

Table 2.3 (Possible approaches to different item classes (Wild, 2002))

2.2.3 Traditional ABC analysis vs. multiple criteria ABC analysis

Traditional ABC analysis is based only on annual dollar usage, however this appear insufficient and reports using a multiple classifying method to group inventory items are rare (Flores & Whybark, 1987). According to Lung (2007), other criteria listed in Table 2.4 are also important in inventory classification.

Inventory Cost	Substitutability	Order Size Requirement
Part Criticality	Number of request per year	Stock-ability
Lead Time	Scarcity	Demand Distribution
Commonality	Durability	Stock-out Penalty
Obsolescence	Repair ability	Expiry dates

Table 2.4 (Important criteria for classifying items, (Lung, 2007))

Lung (2007) proposes an alternative weight linear optimization model for multi-criteria inventory classification (MCIC) problems. The formulation of the problem is described below where I number of inventory items are classified using J number of criteria. The following is assumed in the model:

- Criteria measures are positive related to scope of an item
- If negatively related, reciprocals may be applied for conversion
- The decision maker has to rank the importance of each criterion
- A non-negative weight contribution is defined
- Criteria is ranked in descending order
- Score of each item is expressed as a weighted sum of performance measures under multiple criteria
- Value of the weight of a particular criterion is equal to the proportion of the importance of such criterion out of a total importance
- All partial scores are in a comparable base, thus normalization of weights and measurements are required

The performance measures must first be transformed to a 0-1 scale in order to compare them using (Lung, 2007):

$$\frac{y_{ij} - \min_{i=1,2,\dots,I}\{y_{ij}\}}{\max_{i=1,2,\dots,I}\{y_{ij}\} - \min_{i=1,2,\dots,I}\{y_{ij}\}}$$

y_{ij} = *ith item measured under the jth criterion*

w_{ij} = *weight contribution of performance of the ith item under the jth criterion*

where $w_{1j} \geq w_{2j} \geq \dots \geq w_{ij}$ for all items i

S_i = *score of the ith item*

The weighted linear optimization model is shown for each item i :

$$\begin{aligned} \max S_i &= \sum_{j=1}^J w_{ij} y_{ij} \\ \text{s. t. } \sum_{j=1}^J w_{ij} &= 1 \\ w_{ij} - w_{i(j+1)} &\geq 0 \quad j = 1, 2, \dots, J \\ w_{ij} &\geq 0 \quad j = 1, 2, \dots, J \end{aligned}$$

The second equation is a normalization constraint, where the values of the weights allocated are always within 0 and 1. The third equation drives the assumption that criteria are ranked in descending order. Furthermore, the sum of all weights should equal 1. All scores S_i are always within a scale of 0-1 which is the result of all measures y_{ij} are in 0-1.

This is a linear optimization model and consequently requires a linear optimizer for solving. For environments consisting of many inventory items this might be a tedious process. Lung (2007) however developed a transformation procedure to simplify the model to ultimately solve without a linear optimizer. After a sequence of calculations and manipulations, the following linear program is retrieved:

$$\begin{aligned} \max S_i &= \sum_{j=1}^J u_{ij} x_{ij} \\ \text{s. t. } \sum_{j=1}^J j u_{ij} &= 1 \\ u_{ij} &\geq 0 \quad j = 1, 2, \dots, J \end{aligned}$$

where:

$$u_{ij} = w_{ij} - w_{i(j+1)} \quad i = 1, 2, \dots, I \text{ and } j = 1, 2, \dots, (J - 1)$$

$$x_{ij} = \sum_{k=1}^j y_{ik} \quad i = 1, 2, \dots, I$$

The following are advantages of the derived model:

- The form of the new equation is Canonical with one equality constraint
- There is only one optimal solution u_{ij} that is non-zero
- The only non-zero decision variable must be equal to $\frac{1}{j}$ due to the constraint
- There is no need for a linear optimizer
- Decision makers requires no special training

The score of the i th inventory item may now be obtained by:

$$\max_{j=1,2,\dots,J} \left(\frac{1}{j} \sum_{k=1}^j y_{ik} \right)$$

The procedure, according to Lung (2007), following the transformation is done on a spreadsheet package and consists of the following steps:

- Calculate all partial averages, $\frac{1}{j} \sum_{k=1}^j x_{ik} \quad j=1,2,\dots,J$
- Compare and locate the maximum among these partial averages. The corresponding value is the score S_i of the i th item
- Sort all the scores S_i in descending order
- Group all inventory items according to standard ABC analysis principles

Lung (2007) performed a case study to represent the model where the three criteria chosen are annual dollar usage, average unit cost and lead time. For the purpose of this project, all chosen criteria should be positive related to the score of inventory items. As stated in the assumptions above, it should be assumed that the importance of the criteria is in descending order. For simplicity in explaining, only the first 3 items will be explained as in *Table 2.5*. The complete spreadsheet with the 47 items investigated by Lung (2007) will not be explained.

Item no.	Annual dollar usage	Average unit cost	Lead time	Transformed Values		
				Annual dollar usage	Average unit cost	Lead time
1	5840.64	49.92	2	1.00	0.22	0.17
2	5670.00	210.00	5	0.97	1.00	0.67
3	5037.12	23.76	4	0.86	0.09	0.50
Min	25.38	5.12	1			
Max	5840.64	210	7			

Table 2.5 (Spreadsheet sample (Lung, 2007))

Items are arranged in descending order according to the values of annual dollar usage as this is the most important criterion. Applying $\frac{y_{ij} - \min_{i=1,2,\dots,I}\{y_{ij}\}}{\max_{i=1,2,\dots,I}\{y_{ij}\} - \min_{i=1,2,\dots,I}\{y_{ij}\}}$ the transformed criteria is computed in the same manner for all criteria. Actual computations may be viewed in Appendix A.

After transformation, the first step is performed. Calculate partial averages of the transformed measures of each item and identify the maximum partial average of each item. *Table 2.6* represents this step in the model:

Item no.	Transformed Values			Partial Average		
	Annual dollar usage	Average unit cost	Lead time	1	2	3
1	1.00	0.22	0.17	1.00	0.61	0.46
2	0.97	1.00	0.67	0.97	0.99	0.88
3	0.86	0.09	0.50	0.86	0.48	0.48

Table 2.6 (Calculation of partial averages sample (Lung, 2007))

The computations of partial averages of item 1, 2 and 3 are shown in Appendix A. The score S_i of each item may now be obtained by locating the maximum among these partial averages. This is illustrated in bold in *Table 2.6* above.

The scores are now sorted in descending order and inventory items are grouped by means of the ABC principle. When comparing the traditional method and the 3 criteria classification method by Lung (2007), only 28 out of 47 items remained in the same class. Thus, almost half of the items were classified in another group using the multi-criteria method. For comparison, items were grouped in the following manner: 10 A class items, 14 B class items and 23 C class items and established the following:

- Eight out of ten items remained in the A group after applying the multi-criteria method.
- Two are re-classified as group B items using the multi-criteria method.
- Only 5 group B items remained in group B comparing to the traditional method, eight is re-classified as group C items and one as group A.
- 15 of the 23 group C items are kept in group C, whilst seven are moved to group B and one is moved to group A.

The model is simple and inventory managers will find it easy to use. There is no need for a linear optimizer as the simple calculations may be performed on any spreadsheet package. Although this model has shortages and requires further investigation, in the case were a small amount of criteria is considered, the ranking process is not too difficult.

2.2.4 Economic Order Quantity (EOQ)

According to Ballentine et al. (1976) the economic order quantity (EOQ) concept has references that may be traced back to 1904 and has been used in the American industry for extended periods of time. EOQ is generally defined as the re-order quantity that will result in the lowest annual cost for that specific item.

Lee and Dobler (1965) group incremental costs in two categories as the optimal re-order quantity depend on these. The two categories are as follows: (1) inventory carrying costs and (2) inventory acquisition costs. Cargal et al. (1963) too support this policy as optimal. The preferred point in EOQ is where (1) = (2), which result in lowest annual total cost. The following is a standard formula for EOQ:

$$EOQ = \sqrt{\frac{2DA}{HC}}$$

D = Annual usage/demand - The demand for items per year

C = Per unit cost - Independent of EOQ

H = Inventory carrying cost or Holding cost - Cost of holding per unit per time

A = Aquisition cost – Flat fee for placing an order, independent of EOQ

There are a number of assumptions to be made when employing EOQ formulas. Winston (2004) suggests the following:

- Repetitive ordering
- Constant demand
- Constant lead time
- Continuous ordering

Orders are placed on a regular basis as inventory is depleted and replenishing is required and orders may be placed at any point in time, this is called continuous review models. Demand remains constant throughout certain periods. The lead time for each order is a known constant i.e. the institution is familiar with the lead time from all suppliers (Winston, 2004:104–105).

According to Winston (2004:113) other elements may also be derived from the basic EOQ formula. These include calculations using the formulas in *Table 2.7*:

Orders per year	D/EOQ
Annual holding cost	$\frac{1}{2} * EOQ * H$
Total annual cost	$H + A$
Re-order point	$L * D/EOQ$

Table 2.7 (Formulas derived from basic EOQ model)

2.3 Enterprise Resource Planning (ERP)

2.3.1 A brief history on enterprise resource planning

The following definition for ERP is by Blackstone and Cox (2005:38) and states that ERP is a “*framework for organising, defining and standardizing the business processes necessary to effectively plan and control an organization so the organization can use its internal knowledge to seek external advantage*”.

Joining in effort, J.I Case and IBM developed MRP (Material Requirements Planning) in the late 1960’s which was a state of the art method for scheduling and planning. In the 1970’s MRP rapidly became a fundamental part in production control and planning (Jacobs & Weston, 2006).

In 1972 SAP (Systemanalyse und Programmentwicklung) was started by 5 engineers and Oracle Corporation was established in 1977 (Jacobs & Weston, 2006). From there multiple enthusiasts and companies started developing software, mainly focussed on manufacturing companies, for the purpose of planning and control.

In the 1980’s the term MRP was being referred to as *Manufacturing Resource Planning* rather than Material Requirements Planning and in due course MRP II came to pass (Jacobs & Weston, 2006). Dave Duffield and Ken Morris found PeopleSoft Company in 1987 at which stage all of the main ERP companies (Oracle, SAP, PeopleSoft, IBM, J.D Edwards and Baan) were already in position (Jacobs & Weston, 2006). In the late 1980’s the question “What is not included in MRP II?” started to arise.

In the early 1990’s the term Enterprise Resource Planning was introduced by Gartner Group (Wylie, 1990). Customers and new development of the major ERP companies escalated during this era where the most significant growth was depicted in the year 2000 (Jacobs & Weston, 2006).

In August 2003 PeopleSoft and J.D Edwards merged companies and in 2005 PeopleSoft were taken over by Oracle leaving only two major competitors, SAP and Oracle (Jacobs & Weston, 2006). ERP systems have since reached maturity. Current ERP developed into an environment that is ready for intelligent planning and logic execution as not much regarding the logic of these systems has changed since the 1970’s (Jacobs & Weston, 2006).

2.3.2 ERP implementation

The pilot point for ERP implementation is determining the steps required to reach the goal. Edwin (2006) believes there are seven steps defining the best path for implementation of a new ERP system. The steps are shown in *Figure 2.2* below:

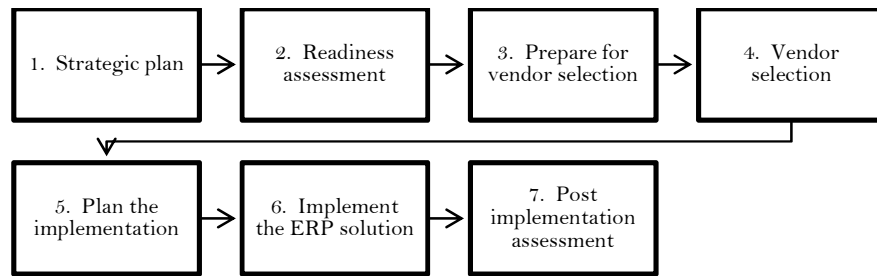


Figure 2.2 (ERP implementation steps (Edwin, 2006))

The implementation steps in Figure 2.3 below have been compiled by Umble et al. (2003) who integrated numerous works:

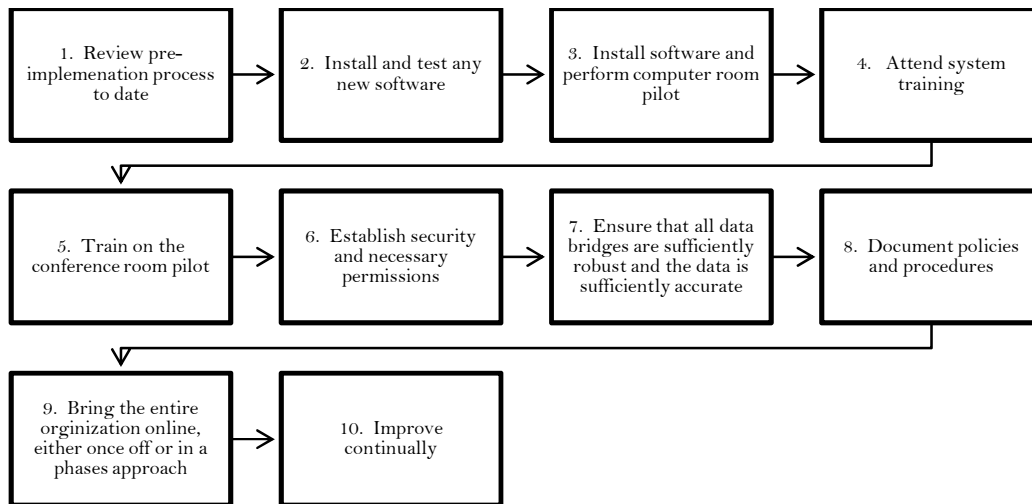


Figure 2.3 (ERP implementation steps (Umble et al., 2003))

Umble et al. (2003) states that various authors have defined critical success factors for the implementation of an ERP system, of these, the most prominent are:

- a understanding of strategic goals
- commitment of top management
- effective project management
- organizational change management
- an immense implementation team
- accurate data
- extensive education and training
- focussed performance measures
- multi-site issues

Umble et al. (2003) concludes that ERP systems are highly complex and implementation of these is difficult and cost a lot of money, time and corporate resources. Therefore the correct implementation procedure is critical to the success of the venture.

Chapter 3

Solution Design

It isn't that they can't see the solution; it's that they can't see the problem – G.K. Chesterson

3.1 Design regarding inventory environment

When considering the “*solution of an inventory system*” it is solving a set of controllable variables in order to minimize the total cost of inventory (Naddor, 1982:11). *Table 3.1* below is a summary of all inputs that may be obtained from UP, and the techniques used in order to obtain the deliverables required for PeopleSoft upload.

Tools and techniques used for configuration of PeopleSoft SCM Inventory		
Inventory Classification (Multiple criteria ABC Analysis)		
Item Classification	Techniques Used	Deliverables
A Items	EOQ formula	Current status
Unit Cost	Safety stock formula	Inventory item
Annual Usage(Rand)	Tight control	Default average cost
Lead Time	Personal supervision	Re-order level (minimum quantity)
Holding cost elements	Communication	Re-order quantity (EOQ)
Item ID	Balanced safety stock	Safety stock
Item description		Average replenishment amount
Standard UOM		Standard deviation of replenishment amount
Item group		Average issuing amount
Maximum quantity		Standard deviation of issuing amount
Shelf life		
Set-up cost		
B Items	EOQ formula	Current status
Unit Cost	Safety stock formula	Inventory item
Annual Usage(Rand)	Classic stock control	Default average cost
Lead time	Lean stock policy	Re-order level (minimum quantity)
Holding cost elements	Fast appraisal method	Re-order quantity (EOQ)
Item ID	Manage by exception	Safety stock
Item description		Average replenishment amount
Standard UOM		Standard deviation of replenishment amount
Item group		Average issuing amount
Maximum quantity		Standard deviation of issuing amount

		amount
Shelf life		
Set-up cost		
C Items	EOQ formula	Current status
Unit Cost	Safety stock formula	Inventory item
Annual Usage(Rand)	Minimum supervision	Default average cost
Lead time	Supply to order where possible	Re-order level (minimum quantity)
Holding cost elements	Large orders	Re-order quantity (EOQ)
Item ID		Safety stock
Item description		Average replenishment amount
Standard UOM		Standard deviation of replenishment amount
Item group		Average issuing amount
Maximum quantity		Standard deviation of issuing amount
Shelf life		
Set-up cost		
Other considerations		
	EOQ derivations	Total ordering cost
	EOQ derivations	Total cost

Table 3.1 (Summary of inputs, techniques and deliverables)

3.2 Design regarding PeopleSoft environment

PeopleSoft provides numerous methods to enhance understanding and implementation of the ERP system and literature makes provision for numerous step-by-step guides for implementing an ERP system. The phases, tools and technologies for implementation suggested by PeopleSoft are portrayed in *Table 3.2* below and serve as the guideline for implementing the inventory module in 2011:

Phase	Description	Tools and technologies used
Installation	Involves installation of PeopleSoft CD's and demonstration environment which include application servers, process scheduler servers, web servers and a PeopleSoft database	Data mover Configuration manager PeopleSoft application designer PeopleTools security Data integrity tools
Application configuration	Configuration of PeopleSoft applications to fit organisation processes. The activities include security access, customising pages, creating batch programs etc.	PeopleTools security PeopleSoft application designer Global technology PeopleCode PeopleSoft application engine PeopleSoft set-up manager
System configuration	Configuration of the infrastructure that supports the deployment of application configuration. This is the phase where necessary effects are set in place for users to be able to complete business transactions.	Internet technology (portal) PeopleTools security PeopleSoft application server PeopleSoft process scheduler PeopleSoft MultiChannel framework PeopleSoft set-up manager

		PeopleSoft mobile agent PeopleSoft application engine
Decision support configuration	Activities involved with setting up support system for decision makers to gather business information. Development of predefined queries and reports, set-up a system to generate scheduled reports, access to OLAP cubes etc.	PeopleSoft process scheduler PeopleSoft query PeopleSoft analytic calculation engine PeopleSoft tree manager Crystal reports for PeopleSoft S/n vision PeopleSoft cube manager QR for PeopleSoft PeopleCode
Business process integration	Set-up of systems that enables business processes to span multiple business areas. Includes setting up XML-driven integration technology that enables disparate systems to exchange data. This step includes set-up of PeopleSoft workflow which enable multiple users to route data and notifications	PeopleSoft integration broker Workflow technology PeopleSoft component interfaces PeopleSoft application designer PeopleCode PeopleSoft application engine
Maintenance	Maintenance of the PeopleSoft system once used by the end-users. This include monitoring of system performance, new release upgrades, applying patches etc.	PeopleSoft performance manager Diagnostic framework PeopleSoft data archive manager PeopleSoft change assistant PeopleSoft tools utilities

Table 3.2 (PeopleSoft implementation phases and the tools and technologies required)

The PeopleSoft implementation team should be familiar with the tools and applications mentioned above. All tools and technologies described for each implementation phase should direct the team in the correct direction throughout implementation during 2011.

Chapter 4

Solutions and recommendations

It so happens that the world is undergoing a transformation to which no change that has yet occurred can be compared, either in scope or in rapidity – Charles de Gaulle

Prior to the discussion on solutions and recommendations a few notes regarding this report is necessary. There is a CD at the end of the report containing all data concerning the project. As UP is undergoing a system renewal procedure, many of the required information and data is not readily retrievable. This poses some constraints on the solutions presented as there is insufficient and inaccurate data that had to be used.

4.1 ABC Analysis

The inputs required for completing the ABC analysis includes the annual usage, average unit cost and lead time for each item. The Pareto Principle is apparent during this project and is used to gain the supplier lead times. 16 vendors are responsible for the supply of 80% of the stationary stores inventory, for these the lead times are exact. For the remaining 20% a lead time of 2 days is used as the university buyer responsible for purchasing stationary suggests. Data for the annual usage is from the EAS 062 P program in Unikom. A list of all store issues from 1 July 2009 to 30 June 2010 was compiled from which the annual usage and average unit cost was determined.

PeopleSoft comprise of built-in functionality regarding categorized items i.e. ABC classified items. Settings regarding this built-in functionality may be altered in order to reflect UP's unique needs.

The literature from Lung (2007) was utilized to execute the multiple-criteria ABC classification. The calculation sequence includes the transformation of criteria, calculation of partial averages, acquiring of all maximum row partial averages and sorting of items according to this maximum partial average.

The outcome portrays the classification of items according to Lung's (2007) method and the traditional ABC approach. Spreadsheets of item data and the classification procedure may be viewed on the CD (file Data.xls). The final comparison of classified items is as follows:

- 21 out of 43 items remained in class A
- 13 items in class A are now in class B
- 30 items in class B are now in class C
- 4 items in class B are now in class A
- 13 items in class C are now in class A
- 24 items in class C are now in class B

There is a total of 42 items in class A, 87 items in class B and 304 items in class C. This is in order with the Pareto Principle and the essence of ABC analysis in *Table 2.2*. These items may now be appropriately prioritised according to correct item and class procedures as a more accurate approach to inventory items is MCIC.

4.2 EOQ Computations

4.2.1 Cost elements in equation

There are four cost elements required to compute the EOQ and other EOQ related elements of each item, these include:

1. The set-up cost previously determined by managers to be R 350. After revision of this cost, the assumption could be made that the average cost for ordering each item is R 44 as explained in Chapter 1.
2. Holding cost - the cost for carrying one item for one year. The computation of holding cost may be viewed in *Table 4.1* below. As the stationary department does not deal with taxes, 15% should be used for the cost of money according to Douglas and Lambert (2001). The annual salaries for store clerks are disregarded as this expense does not vary with the amount of inventory in the store. Therefore, 25% of unit cost would represent the cost of carrying one unit of inventory for one year.

Step no	Cost Category	Explanation	Amount	% of holding cost
1	Cost of money	Cost of having money in inventory and the return should be comparable to other investment opportunities	2400000	0.15
2	Rent of equipment	Cost of renting equipment to handle inventory. This is variable as the amount of required equipment depends on the inventory level.	39600	0.0165
3	Telephone	Telephone costs associated with making orders, issuing stock or attending to inventory	9600	0.004
4	Protective element	Cost for protecting certain amounts of inventory in the store against breakage, theft, damage etc.	14400	0.006
5	Damage and obsolescence	Cost of holding inventory beyond its useful life or cost of damaged stock. This is variable with the amount of inventory.	170052	0.070855
6	Total carrying cost			0.247355

Table 4.1 (Holding cost calculation)

3. The average unit cost for each item, this may be viewed on the CD (file Data.xls)
4. The annual demand for each item. This may be viewed on the CD (file Data.xls)

The results obtained are in MS Excel format where the methods used and all the results obtained may be viewed on the CD (file Data.xls). However, for each of the 434 active items in the store, the elements in *Table 4.2* are determined:

Item no.	4686
Set-up cost	R 44
Annual holding cost per unit	0.25% of unit cost
Annual demand	1988 items
Average unit cost	R 5.52
EOQ	356 items
Orders per year	6
Total order cost	R 245.61
Annual holding cost	R 245.61
Total cost	R 491.23
Lead time	6 days
Re-order point	175

Table 4.2 (Description of EOQ computations for each item)

4.3 Safety stock computations

4.3.1 Elements in equation

Calculations are based on demand and replenishment data for one year. A current rule at UP is that no movement on items are allowed for two years after which the items become obsolete. In the available data there are many such items and zero values are assumed for these items. The following four elements are required for calculating of the amount of safety stock to be kept in inventory:

1. Average amount each item was replenished with for the year 1 May 2009 – 30 April 2010. This represents R in the safety stock equation in Chapter 2.1.5
2. Standard deviation of the replenishment amount for each item. This represents σ_R in the safety stock equation in Chapter 2.1.5
3. Average amount of each item issued for the year 1 July 2009 to 30 June 2010. This represents S in the safety stock equation in Chapter 2.1.5
4. Standard deviation of the amounts issued for each item. This represents σ_S in the safety stock equation in Chapter 2.1.5

The amount of safety stock that should be kept in inventory for each item and all calculation requirements may be viewed on the CD (file Data.xls). Keeping the amount as suggested on the CD (file Data.xls) of safety stock in inventory would cover 68% of variation probabilities.

4.4 PeopleSoft Input

4.4.1 Current renewed replenishing method

During the phase 1 implementation of PeopleSoft FSCM Financial and Procurement at UP, a preliminary replenishing procedure was employed as portrayed in *Figure 1.5* in Chapter 1. The procedure as currently running at UP may be viewed in Appendix B, *Figure B1*. In PeopleSoft, stationary or any other inventory replenishment would follow the same procedure; however certain attributes are given to inventory items which pilot the PeopleSoft inventory management procedure that operates in the “background”.

4.4.2 PeopleSoft Set-up requirements

PeopleSoft workflow technology - Workflow capabilities enable efficient automated information flow throughout the enterprise. The application tools automate business processes that are time consuming in which activities of multiple users are merged. The term *workflow* refers to the larger process involved with doing business tasks.

A step-by-step guide of business processes and rules is required for the implementation of PeopleSoft workflow. These business processes are defined and approved by UP stakeholders, managers and applicable staff. Designing a workflow enables the automation of paper-based business processes, increase employee, customer and supplier collaboration and system integration. Some of the main elements of PeopleSoft workflow are listed below:

- Process definitions for the business
- Sets of logically ordered steps in a process called activities
- Worklists, which are automated “to-do” lists
- Rules determining the activities required to process business data
- Roles describing where people fit into the workflow
- Routings specifying where information goes and the form it takes, e.g. email, message or worklist entry

The above mentioned elements are decisions for stakeholders to agree upon before implementation of phase 2 PeopleSoft starts. *Figure 4.1* below describes the steps for designing a workflow application in PeopleSoft:

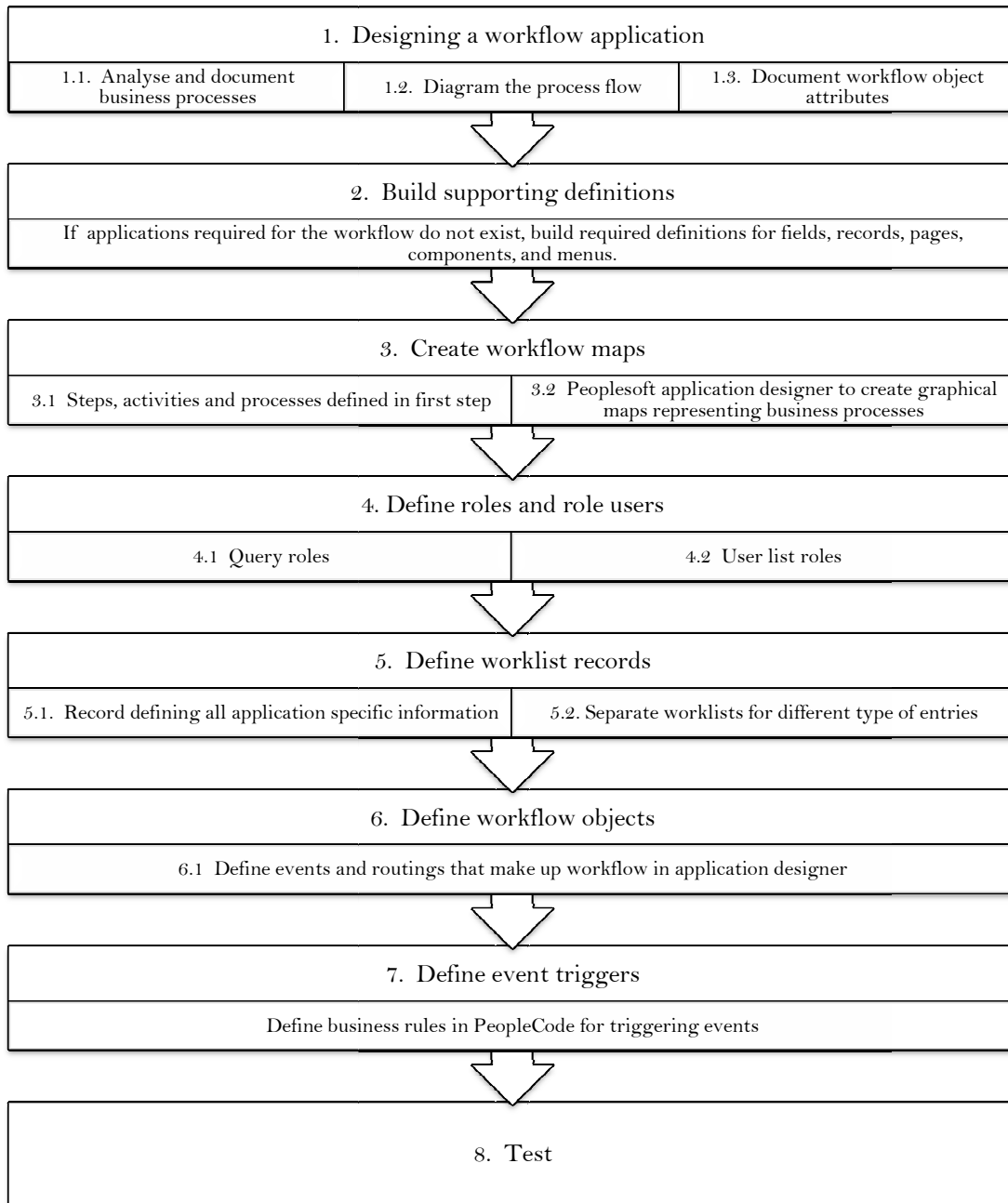


Figure 4.1 (Steps when designing a workflow application)

Inventory facility structure - PeopleSoft may reflect different storage levels within an inventory business unit. A business unit consist of storage areas which may be divided in storage levels. At UP, each store has a unique store code, for the stationary store the code is 8211, this code represents Level 2 in PeopleSoft storage levels. The campus in question represents Level 1 storage space in PeopleSoft. Each store has a certain amount of shelves with corresponding BIN numbers in Unikom, these BIN numbers represent Level 3 storage in PeopleSoft. For each store the shelf dimensions should be uploaded in PeopleSoft.

Inventory items - PeopleSoft defines items as goods that an organization order, stock and issue to customers. Before making use of items in PeopleSoft Inventory, some set-up is required. These include names, descriptions, dimensions and attributes. Items are shared by multiple PeopleSoft applications which include inventory, purchasing, manufacturing and customer relationship management. A MS Excel sheet (Item req) is available on the CD (file Data.xls) and resembles the required input for PeopleSoft upload.

Defining put-away options - On receipt of goods, stock is inspected and put-away in a storage location from which it may be retrieved when required. Adding inventory to a storage location is known as put-away. PeopleSoft inventory enables definition of rules that administer the put-away locations in inventory facilities. Therefore, all campus codes, store codes and shelf BIN numbers should be uploaded before defining put-away rules in PeopleSoft.

Demand fulfilment setup - PeopleSoft is flexible in setting up the system for fulfilment of orders. Fulfilment options may be set up at business unit level as well as item level. At business unit level, options regarding reservations, backorders, inter-unit transfers and shipping may be defined. These options are normally set-up during implementation and remain as default setting for stock fulfilment. Fulfilment on item level may be set up when replenishment for certain items are different than for the majority of items. These settings take precedence over setup on business unit level. PeopleSoft performs and monitors the fulfilment process which include stock reservations, material picking, shipping, and post-shipment processing. The above mentioned are business rules unique to each enterprise and stakeholders is to make the decisions.

Creating material stock requests - Stock orders are material stock requests for inventory from internal or external customers. This procedure is currently referred to as “raising requisitions” and is fully operative. The same requisition method should be applied by customers of the stores. This is possible as the set-up and attributes for inventory items is different than other items and the PeopleSoft built-in functionality recognizes the process to follow when an item is set up as an inventory item.

Reserving inventory - Reservation of inventory serves two purposes. It moves demand orders from a demand interface table to a demand management table for it to be picked and shipped and secondly, allows users to be updated on the quantity of the item in storage.

Managing stock shortages - The shortage workbench is an online component that enables users to monitor and control stock shortages and order fulfilment issues.

Picking Inventory - Inventory picking is the process in which inventory requests are fulfilled in preparation for shipment. PeopleSoft Inventory guides the process by creating picking plans based on picking methods and criteria defined in the system. Designing the most efficient picking process possible, exceptions may be minimized and quantities kept consistent with actual picking activity in the stockroom. UP employs a 95-98% availability rule, this rule is set-up as a picking plan and ensures that if less items are available it is not shipped.

Shipping inventory - When inventory is shipped, items are picked for shipment and placed in an area close to the shipping department and loading dock where appropriate documents are printed. The shipment person signs the documents before dispatching them to the appropriate destinations.

Replenishing inventory - Inventory levels require maintenance to meet demand. In addition, stocking and overhead cost should be kept at a minimum. Currently the replenishing procedure requires minimal alterations for the phase 2 implementation. Items should be uploaded as inventory items accompanied by delivered attributes as on the CD (file Data.xls).

Managing consigned inventory purchasing - Consignment inventory is a supply chain management strategy in which goods are stored in a business unit without paying the vendor until the goods are consumed. As the vendor owns consigned stock until it is consumed, warehouse stocking with consignment items enables reduction in carrying costs and defers payment of liabilities. However, for implementing this strategy consignment vendors should first be identified in PeopleSoft payables. This application will be utilized after the phase 2 implementation as the set-up for this strategy is not a necessity for successful operation of the inventory module.

Vendor managed inventory - Vendor managed inventory is a supply chain management strategy in which a vendor manages inventory located in a customer's warehouse. The goods may be consigned or non-consigned. As the vendor, a Vendor Managed Inventory (VMI) business unit will be created which represents customer inventory. This includes items, quantities and storage space. Proper management and synchronization is required to use this functionality and will only be employed after the phase 2 implementation.

Counting inventory stock - To ensure sufficient available stock for order fulfilment, regular inventory counts is required. The process includes physical counting of stock and system updates. UP stakeholders define parameters or calculation rules for a combination of a business unit and a utilization group to calculate utilization rules. For each rule, a specification regarding static or percent values is made. Various types of rules include:

- Forecasted amount
- Forecasted quantity
- Historical amount of transactions
- Historical adjustment amount
- Historical adjustment quantity
- Historical usage amount
- Lead-time (days)
- On hand quantity
- Unit cost

Currently complete inventory counts are done twice yearly in June and November for comparison of actual and system inventory amounts. Test counts of 5% of items are held monthly, if the test count deviates more than 2.5% in rand value, an additional 5% is counted, if again the deviation is more than 2.5% the entire store is counted to determine the cause of the deviation. A current business rule is to manage inventory with 97.5% accuracy. These unique rules may now be set-up as utilization rules connected to certain inventory items.

PeopleSoft Inventory calculates the minimum permitted value for all utilization rules. In PeopleSoft Inventory, ABC classification primarily drives the cycle count frequency. PeopleSoft Inventory allows for cycle counts and physical counts. When the count type is confirmed, a counting event is generated by the system. Periodic checks on inventory quantities may be performed using the physical inventory process which involves the recording of hand item quantities, reconciling the system and updating the system to reflect accurate physical inventory.

Maintaining inventory - another purpose of inventory maintenance is to know the location and quantities of stock. PeopleSoft Inventory enables users to maintain inventory by tracking and updating quantities during material movement transactions such as put-away, transfers and shipping.

An illustration of all the PeopleSoft input requirements may be viewed in *Table 4.3* below. *Table 4.3* includes the attributes that PeopleSoft requires for inventory items, the relevant source for acquiring the data and a description of what the attribute entails.

Attribute	Source	Description
Item no	Unikom	Each item is assigned an individual code in Unikom.
Item description	Unikom	In Unikom, each item receives a description when creating the item
Current status	Active	All of the current items are <i>active</i> , when no movement has occurred in 2 years the status becomes <i>inactive</i> or if the item is awaiting approval the status is <i>pending</i> .
Inventory item	Report	All of the items are inventory type items
Standard UOM	Unikom	The standard unit of measure in which items are issued to customers
Default category	Report	In this report each item is classified as A, B or C. PeopleSoft applies different rules to each category.
Item group	Unikom	All items are assembled in similar groups with unique identifying codes
Default average cost	Report	The default average cost is determined by averaging purchasing data for one year. In PeopleSoft, this value automatically updates.
Standard pack UOM	Unikom	Standard unit of measure in which items are purchased from suppliers
Max quantity	Unikom	Maximum allowable quantity in storage for each item
Shelf life	Report	Conducted study reveals certain stationary items have shelf life or expiry dates
Re-order point	Report	The level of inventory at which an order should be placed i.e. minimum allowable amount of stock for each item
Re-order quantity	Report	The optimal amount to purchase with each order
Safety stock	Report	Amount of stock to keep in inventory to cover for variations in demand
Annual demand	Report	Determined by analysis of demand data for one year

Table 4.3 (Item requirements for PeopleSoft upload)

The current standard issuing method in PeopleSoft is illustrated in *Figure 4.2* below. It pilots the execution of business, however customizations to this method is required to portray the unique processes and procedures of UP.

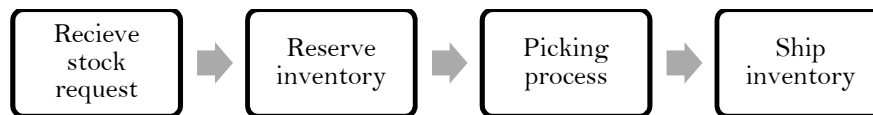


Figure 4.2 (Issuing process model)

A suggested preliminary issuing procedure may be viewed in Appendix B, *Figure B2*. The figure provides minimal detail on the elements required however, places the above mentioned requirements in context with the set-up requirements. The phase 2 implementation team may build on the basic process illustrated in *Figure B2*.

Chapter 5

Conclusion

5.1 Objectives revised

As stated in Chapter 1, the main objective of the project is to develop a revised inventory model to pilot the phase 2 implementation of PeopleSoft Inventory at UP. The elements which forms the project are issues such as re-order points, re-order quantities, shelf life, item mix etc. and the employment of the unique processes and procedures of UP into a new ERP system.

The final model regarding all inventory aspects will be employed in PeopleSoft in order to optimize UP's inventory environments.

As pointed out in Chapter 1, studies are based on a single inventory environment at UP and proved that industrial engineering concepts may be engaged in an inventory and ERP implementation environment. The introduction of optimum strategies poses many benefits and in a competitive world institutions should remain at the forefront.

5.2 Future research

According to Edwin there are numerous documents required when planning for ERP implementation. Some considerations for the future are a change impact analysis and a training plan. The first is used to facilitate and overcome the aspect of resistance to change which follows the implementation of the new software. The second is a necessity when implementing, and include technical training, functional training, end-user training, management training and many more (Edwin, 2006). The post-implementation sequence described by Edwin has the purpose of ensuring that objectives were met and to analyse the extent to which the software is being used.

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Appendix

Appendix A

Transformation calculations

Annual dollar usage	Item1: $(5840.64-25.38)/(5840.64-25.38) = 1.00$ Item2: $(5670-25.38)/(5840.64-25.38) = 0.97$ Item3: $(5037.12-25.38)/(5840.64-25.38) = 0.86$
Average unit cost	Item1: $(49.92-5.12)/(210-5.12) = 0.22$ Item2: $(210-5.12)/(210-5.12) = 1.00$ Item3: $(23.76-5.12)/(210-5.12) = 0.09$
Lead time	Item1: $(2-1)/(7-1) = 0.17$ Item2: $(5-1)/(7-1) = 0.67$ Item3: $(4-1)/(7-1) = 0.50$

Table A1 (Transformation calculations)

Calculations of partial averages

Item1	$1.00/1 = \mathbf{1.00}$ $(1.00/2 + 0.22/2) = 0.61$ $(1.00/3 + 0.22/3 + 0.17/3) = 0.46$
Item2	$0.97/1 = 0.97$ $(0.97/2 + 1.00/2) = \mathbf{0.99}$ $(0.97/3 + 1.00/3 + 0.67/3) = 0.88$
Item3	$0.86/1 = \mathbf{0.86}$ $(0.86/2 + 0.09/2) = 0.48$ $(0.86/3 + 0.09/3 + 0.50/3) = 0.48$

Table A2 (Calculation of partial average)

Appendix B

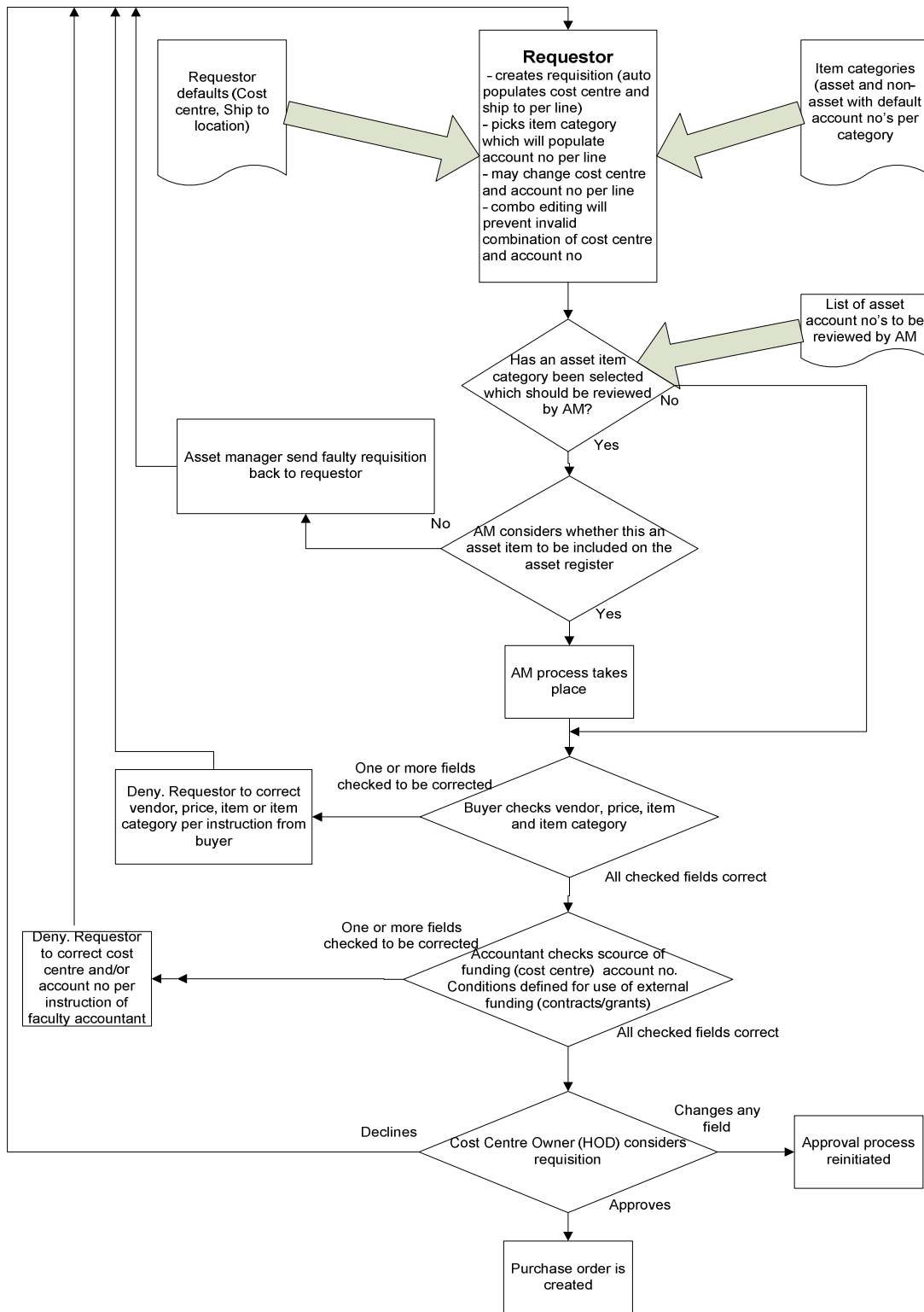


Figure B1 (Current preliminary replenishing procedure)

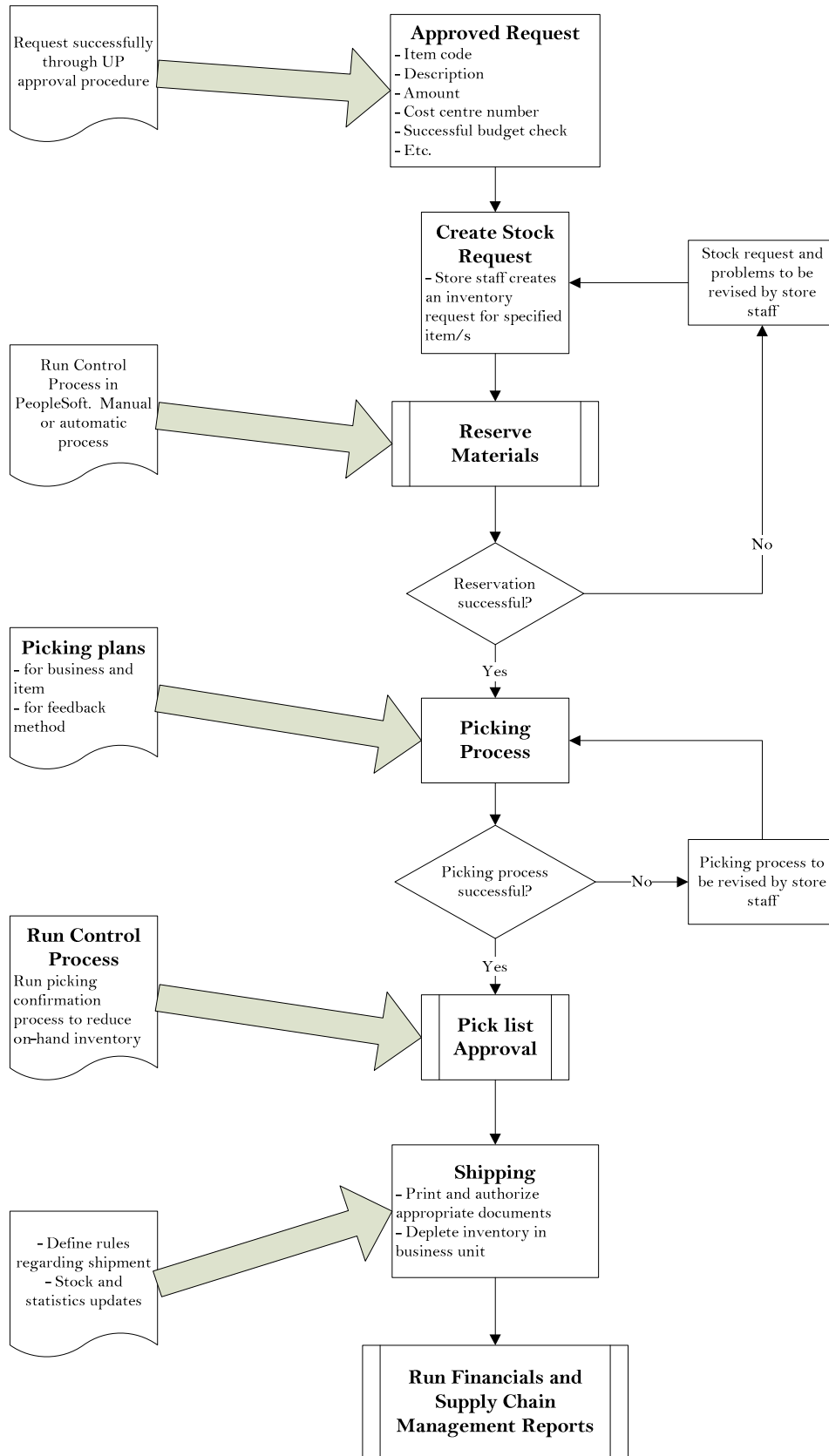


Figure B2 (Suggested preliminary issuing procedure)