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IMPROVEMENT OF THE MATERIALS MANAGEMENT FUNCTION IN A SHARED SERVICE CENTRE

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Executive summary

Improvement of the materials management function of a shared services centre by

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Key words

Shared services, procurement and supply, materials management, inventory investment, customer satisfaction, evaporating cloud, business process re-engineering, process thinking tools, cause-effect analysis.

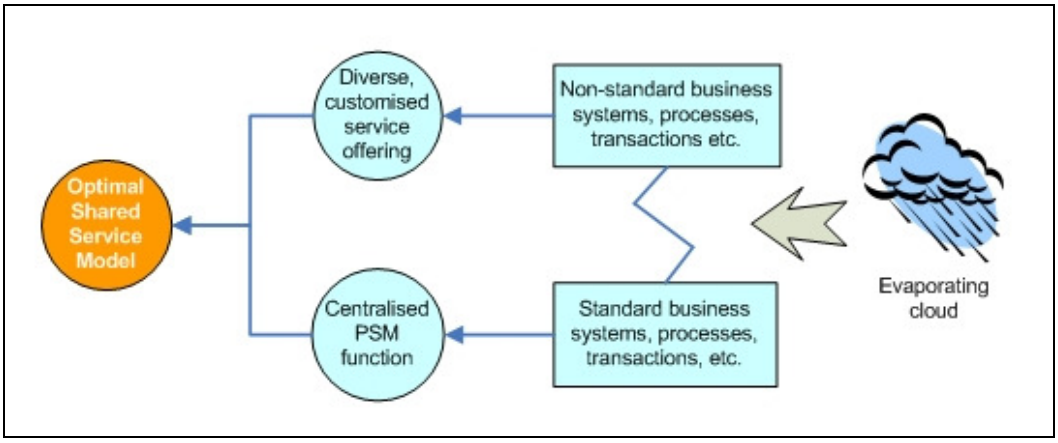
The procurement and supply functions for the Sasol Sasolburg business units are performed at a shared service centre, namely Infrachem P&SM. Since the adoption of the shared service model, business units have experienced a downward spiral of service levels and incredible escalations in expenses (as great as 25-30% per annum), until recently, top management demanded a 20% saving from Infrachem P&SM. Amongst the services offered, the maintenance materials management function was identified as the function in which most undesirable effects were being experienced and most cost cuts could be made. For example, inventory holding cost can be decreased by R240.5 million annually if the Sasol benchmark for inventory investment is attained.

The study addressed the following problem statement:

Infrachem P&SM is currently experiencing low customer satisfaction levels and inventory investment levels above accepted standards.

The aim of the study was to identify the root cause of high inventory investment and the correlated low customer satisfaction levels by applying Eli Goldratt's TOC process thinking tools; a current reality tree is compiled, from which an evaporating cloud can be identified. Finally the future reality tree forecasts the effects of the elimination of the cloud. Furthermore, the dissertation contains the design of a solution that will eliminate the root cause and a pilot run application of this solution in an Infrachem P&SM MM (materials management) process.

One of the outcomes of the application of the TOC methodology was the evaporating cloud, which highlighted the root cause; a conflict between a move towards standardization and a drive in the opposite direction.



The assumptions in the top leg state that, in order to achieve the customer satisfaction needed for an optimal shared service centre, diverse customized service offerings must be available to match the unique set of needs of each customer. In contrast to this, the author argues that each customer does not have unique needs and client needs can be grouped into a finite set of needs. Furthermore, all customers are not created equal and only valued customers need be satisfied. This can be achieved, and the cloud evaporated (root cause eliminated), by following the steps outlining the solution:

1. Determine the actual needs of the customers. If 'preferred needs' are detected, market the actual needs
2. Determine the most valued customers
3. Design a set of standard configurations, processes and transactions in a finite number of standard service offerings to satisfy a percentage of the most valued customers.
4. Increase mark-ups for non-standard requests (add-ons)
5. Put in place a strict acceptance procedure if non-standard services are to be recognised as standard.

Furthermore, the author discovered that "simply pulling processes together in a central hub is unlikely to deliver a more streamlined, customer-driven service. Moving to a shared service provision requires a fundamental re-engineering of processes." (CIPD, 2004). In other words, the above-summarised solution could only be implemented through the use of a BPR methodology.

During the pilot run, the existence of the evaporating cloud was confirmed and eliminated. During the redesign of the processes bottom up empowerment was enabled and the importance of customer input emphasised.

This study has lead to a design in which various theoretical models were consolidated to form a methodology that is innovative, effective and practical for companies aiming to optimize their shared service centres.

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List of abbreviations

CCR: Capacity Constraint Resource

BOM: Bill of Material

BPM: Business Process Management

BPR: Business Process Re-engineering

CIPD: Chartered Institute of Personnel and Development

CSF: Critical Success Factors

DITR: Dynamic Inventory Turnover Rate

ERP: Enterprise Resource Planning

ERV: Economic Replacement Value

FIS: Focussed Improvement Systems

IP: Infrachem / Polymers

ITR: Inventory Turnover Rate

KPI: Key Performance Indicators

MAD: Mean Actual Deviation

MM: Material Management

MRO: Maintenance, Repair and Operational

MRP: Manufacturing Resource Planning

P&SM: Procurement and Supply Management

PI: Product Inquiry

PITR: Projected Inventory Turnover Rate

PO: Planned Order

PR: Purchase Requisition

QA: Quality Control

SAP: Systems, Applications and Programmes

SCI: Sasol Chemical Industries

SI: Stock inquiry

SLA: Service Level Agreement

SPIR: Spare Part Interchangeable Record

SWOT: Strengths, Weaknesses, Opportunities, Threats

TO: Transport Order

TOC: Theory of Constraints

VHS: Vendor Held Stock

WO: Works Order

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1 Background and approach

1.1 Introduction / background

Sasol Limited is a global energy company. Headquartered in Johannesburg, South Africa it is engaged in the commercial production and marketing of chemicals and liquid fuels; with a growing interest in oil and gas exploration (Explore Sasol – business overview, 2003).

The scope of the study covers the SAP IP (Systems, Applications and Programs Infrachem/Polymers) cluster of the SASOL businesses located in Sasolburg. This cluster includes the business units listed in table 1.

Table 1: IP cluster business units

Infrachem	Infrachem affiliates	Polymers
Synthesis gas	SASOL wax	Monomers
Utilities	SASOL solvents	Mining reagents
Midland	Merisol	Poly-propylene
SCI main	Carbo tar	Polythene
Infrastructure		Vinyls
Infrachem other		

Documented in a SASOL Infrachem report (2004) and according to Boyce (2005), Infrachem affiliates and Polymer businesses can choose from the following SASOL Infrachem shared services:

- Redundant material and scrap sales
- Materials management
- Demand management
- Performance enablement
- Procurement management (Infrachem SASOL, 2004 & Boyce, 2005)

This dissertation will focus on the *Materials management* side of the services. Although all units in the IP cluster make use of this particular service, Polymers, Solvents and Nitro (one of the Infrachem affiliate business units) do their own MRP (Material Requirements Planning) for plant specific (unique) stock (Visser, 2005).

The services of Infrachem for affiliate business units include only the planning and holding of stock, and not the ownership of the stock. Only common stock (generic stock utilised by two or more divisions) and stock used by Infrachem departments appear on Infrachem books (Visser, 2005).

The ERP (Enterprise Resource Planning) system employed is SAP R3 (Visser, 2005).

The material items managed by the cluster are classified as either:

- Process material items, or
- Maintenance material items

Since the process material items include only a fraction of the stock volume, the focus of this dissertation will be on *Maintenance material items* – "the material items used to maintain installed assets. This includes all MRO (Maintenance, Repair and Operational) items. Examples are spares, pipes, equipment and consumables." (Inventory Strategy for SASOL Group of Companies, May 2003).

Prioritising of stock is done under the following headings:

- Insurance stock – stock purchased against capital, which is not included in the calculations of percentage of the ERV (Economic Replacement Value) of the plant.
- Critical stock – items that could cause a production breakdown in the case of a stock-out. These material items have a 100% service level.
- Non-critical stock – items with a minimal effect on production in the case of a stock-out. These material items have a 75% service level.
- Consumables – units that have no impact on production. These stock units

also have a 75% service level.

Organizations need to continuously manage the trade-off between inventory investment and service level. For the SAP IP cluster an in-depth study of the materials management environment was called for to pinpoint possible causes of, and generate feasible solutions for high stock levels and low customer satisfaction. The study commences with a more detailed description of the problem in the following paragraph.

1.2 Problem description

High stock levels and low customer satisfaction are two undesirable effects currently experienced by Infrachem P&SM (Procurement and Supply Management). Both quantitative and qualitative proof of this exists: Firstly, table 2 contains quantitative data evident of high inventory investment. The table shows the current and target inventory investments for the SAP IP cluster in terms of percentage ERV, as well as inventory investment in relation to Infrachem.

Table 2: Inventory investment targets and benchmarks (Boyce, 2005)

Business Unit	Current % ERV June 2005	Target % ERV June 2006	Inventory investment
Infrachem	0.52%	0.52%	100.00%
Polymers	1.67%	1.50%	185.00%
Infrachem Affiliates: Solvents	6.66%	5.66%	161.00%
Merisol	1.06%	1.01%	9.90%
Other	0.92%	0.87%	134.00%

The international standard accepted by SASOL dictates an inventory investment of 0.65% ERV (Boyce, 2005). Two of the largest contributors of inventory investment – Polymers and Solvents – have inventory investments well above

the benchmark.

In the third column investment for each unit is shown in relation to that held by Infrachem - if Infrachem has 100 units, then Polymers has 185 units and Solvents has 161. These then are the main contributors of inventory. Two of the units that hold the most stock also have the highest investment as a percentage of ERV.

If inventory can be cut, SASOL can save on capital caught up in inventory and apply it elsewhere. If each unit reaches its target, savings amount to R 26.5 million. If the benchmark target is reached, savings escalate to R 133.6 million. This is a significant opportunity cost for the SASOL group (Boyce, 2005).

Although savings already seem significant, the cut in holding cost is in fact the major saving to be made because the above-mentioned savings are once off, while holding cost savings are made monthly. SASOL calculates holding cost as 15% (refer to 2.1.2 *Inventory costs* for the components of carrying costs) of the inventory monetary value. According to this, an annual saving of R 47.6 million will be made if targets are met, while an incredible R 240.5 million can be saved if the benchmark of 0.65% ERV is attained.

The quantitative data discussed above proves that P&SM is suffering from unacceptably high inventory levels. Secondly and in addition to this, quantitative data exists that proves low customer satisfaction levels. The current satisfaction score is 44.3%. The SASOL benchmark accepts a score of below 50% as unsatisfactory (Goolam, 2006). Qualitative data exists that strengthens the above-mentioned quantitative data with regard to satisfaction. Through various interviews (Boyce, C., Steyl, K., Auret, S., Vermaak, H.,Hughes, K., Vermaak, P., Oosthuizen, E., *Problem areas in the IP cluster environment*, 2005) the author discovered symptoms that pointed to low customer satisfaction:

- Service level measurements are unreliable and give management and employees distorted views of actual performance.
- Supplier lead times are captured incorrectly. This reflects poorly on

suppliers even if they are performing as agreed in SLA's (Service Level Agreements). Inaccurate appraisals of supplier performance result in damaged supplier relationships. Poor relations will affect Infrachem performance and consequently customer satisfaction.

- Plant personnel schedule maintenance tasks, but do not inform Infrachem of stock requirements in time. This scheduled maintenance then appears as unscheduled stock requirements on the MRP records resulting in the MRP system not performing as agreed in SLA's and ultimately unsatisfied customers.
- Redundant stock is not timeously or routinely removed from stores. This results in unnecessary high inventory investment for customers and low satisfaction levels.
- Employees are currently unmotivated and not sufficiently empowered to enable bottom-up inputs. Clients perceive employees as unfriendly and service as unprofessional, which in turn lowers satisfaction levels.
- Various shared-service related problems were detected:
  - A lack of trust from Infrachem clients.
  - Terminology discrepancies.
  - Business unit politics and narrow mindedness.
  - Responsibility discrepancies, for example, is Infrachem or the Maintenance Division responsible for the BOM (Bill of Material) record updating?
  - Governance discrepancies: each division has its own hierarchy of control. Infrachem does not have absolute hierarchical control over Infrachem Affiliates.
  - Unique maintenance and materials management strategies of clients and affiliates.
  - Unique ERP configurations for different divisions due to the independence of the business units within the IP cluster.

- With regard to the ERP system configuration, the following symptoms of non-optimality were identified:
  - Underutilization of MRP functionality.
  - Poor choice of ERP system for the IP cluster environment.
  - SAP is perceived as a controlling system instead of an operating system. For example, electronic firewalls are continuously installed to enforce strict adherence to set procedures and prevent criminal activities by employees. This slows employees down in the execution of their tasks and inhibits the empowerment of the workforce.
  - Unique ERP configurations for different divisions.
- Master data is currently very unreliable and outdated. Unreliable data leads to poor MRP and eventually to non-optimal inventory levels and unhappy clients.

These signs of underlying problems point to certain main areas in which a concentration of undesirable effects exist, which lead to high inventory investment and low service levels:

A. Performance measurement
B. Suppliers management
C. Co-ordination of maintenance execution with MRP
D. Redundant stock management
E. Employee management
F. Overcoming shared-service challenges
G. ERP system configuration management
H. Master data optimization

These concentrated areas of symptoms can be plotted on the value chain of the service centre as depicted in figure 1.

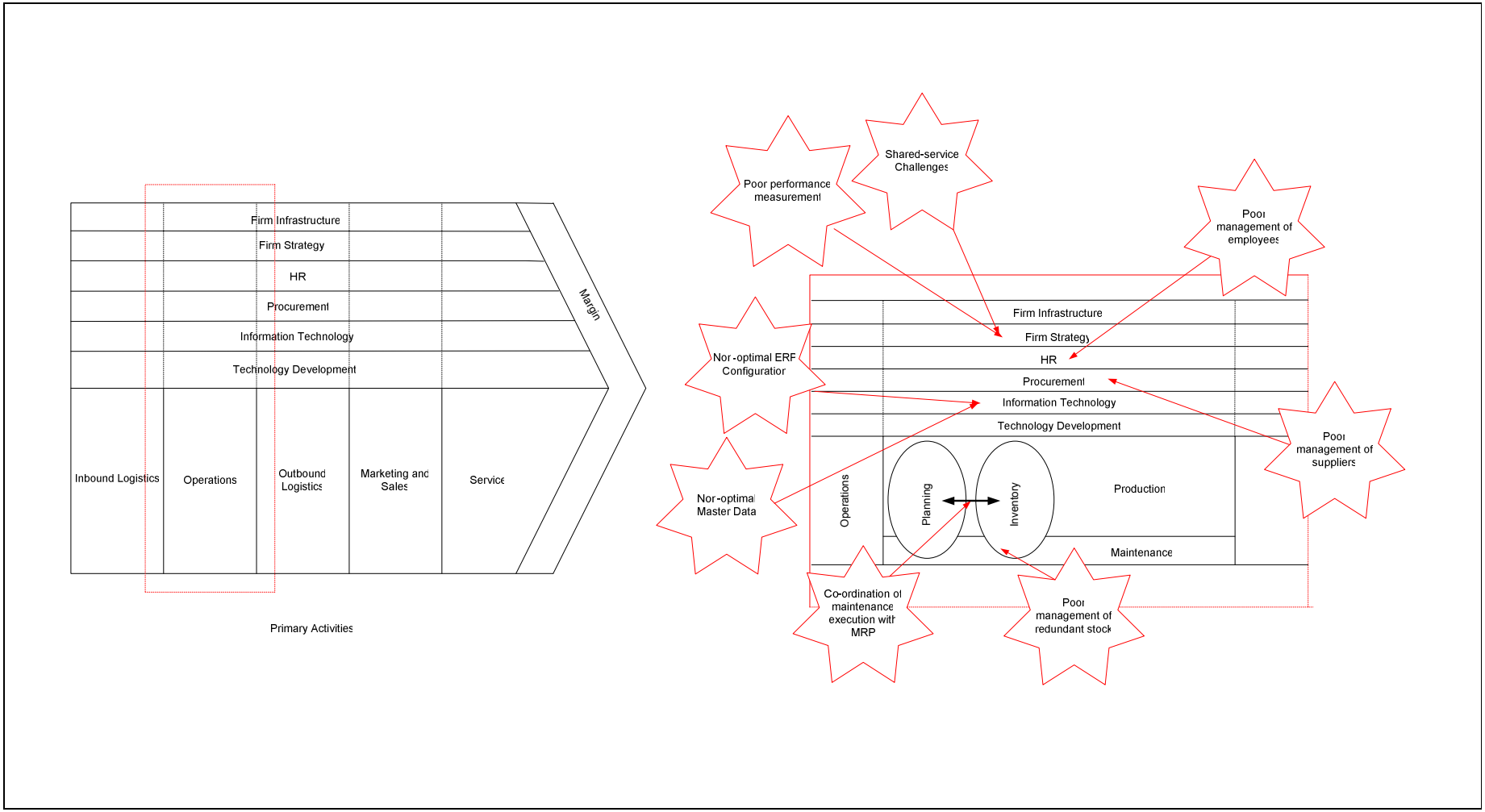

Figure 1: Problem areas on the value chain (adapted from Narayanan, 2001)

The quantitative data given in table 2, along with the qualitative data discussed, prompt the problem statement given in the following paragraph.

1.3 Problem statement

Infrachem P&SM is currently experiencing inventory investment levels above, and customer satisfaction levels below accepted standards.

In order to solve the above outlined problem certain objectives have to be reached. These are stipulated in the following paragraph.

1.4 Research objectives

1 Find the root cause of high inventory investment and the correlating low customer satisfaction levels.

2 Design a solution that will eliminate the root cause and resultantly enable:

- Each business unit serviced by Infrachem to reach their inventory investment targets, and eventually the international benchmark of 0.65% accepted by SASOL.
- Infrachem P&SM to drastically improve client satisfaction.

The research methodologies applied during the study are described in the following paragraph.

1.5 Research Approach

The experimental research has a strong qualitative approach, which is strengthened with quantitative data where appropriate. According to Page and Meyer (2000), experimental research "seeks to establish a direct cause-effect relation between elements". This is evident in the study at hand where a direct cause / direct causes of high inventory investment and low customer satisfaction is/are sought.

According to Page and Meyer (2000), qualitative data is crucial to a study. They emphasise that every attempt should be made to include both qualitative and quantitative forms of data in a study.

Page and Meyer further states that the purpose of research can be defined by means of a research strategy. In the case of the current study, an applied research strategy is followed since its aim is to solve a specific problem. A pure research strategy is done for the sole purpose of adding to a body of knowledge. Page and Meyer suggests that action research is a popular way of guiding applied research. Figure 2 illustrates what data collection procedures were applied in the action research model.

Data was collected in both interactive and non-interactive procedures. This data can be divided into two categories: primary data and secondary data. Primary data is newly generated data, while secondary data is existing data (Page & Meyer, 2000). During the diagnosis phase of the model, a problem statement was formulated based on primary data gathered in semi-structured interviews and re-collected existing data held in company documentation. Page and Meyer (2000) defines semi-structured interviews as an interactive data collection procedure in which "some structured questions are asked of all participants, and that these are completely open-ended questions with no limitations on how the participant can respond". Re-collecting existing data is a non-interactive data collection procedure whereby archival data or data found in published literature is

sought (Page & Meyer, 2000).

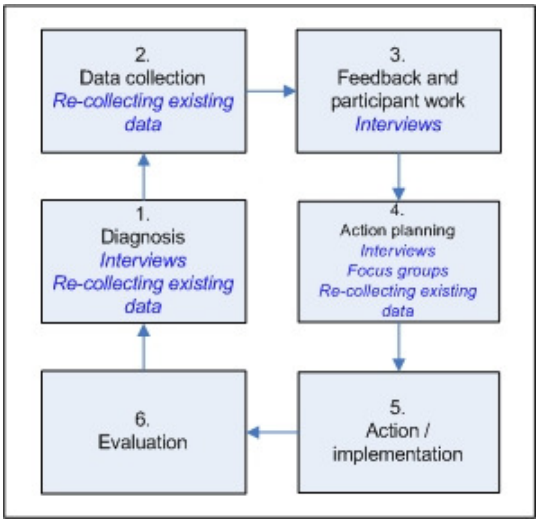

Figure 2: Action research model and data collection methods (Page & Meyer, 2000)

During the data collection phase, a literature study was performed in which the non-interactive re-collection of existing data procedure was utilized. This data was approached qualitatively through the informal content analysis method. Page and Meyer (2000) says that this method "consists of the scanning of content for recurring themes/concepts".

Feedback and participation were promoted throughout the study by means of semi-structured interviews. This primary data was applied both qualitatively and quantitatively.

During the action planning phase, data was generated through semi-structured interviews and focus groups. During focus groups, quantitative data was generated through the numerical analysis technique of Value management and the weighted average technique. Through interviews data was generated and applied qualitatively in the TOC (Theory of Constraints) process thinking tools. The TOC tools involve a very reliable, logical qualitative analysis of data. Re-collected existing data was used in this phase to arrive at a suitable solution to

the problem.

Due to certain practical implications implementation and evaluation were omitted from the study, although expected challenges are outlined.

In addition to the above research approach a clear outline of this study is given in the roadmap in the following paragraph.

1.6 Roadmap

Figure 3 is a schematic illustration of the layout of the document. The aim of the first chapter was to give the reader insight into the problem and the context in which it appears.

Chapter two is a comprehensive literature study. Two groups of concepts will be addressed, namely functional themes and problem solving themes. The functional themes include the subject matter of the study:

- Inventory
- MRP
- Shared services

The problem solving group of themes look at why problems are experienced in the functional areas. These include BPR (Business Process Re-engineering) and FIS (Focussed Improvement Systems), VM (Value Management) numerical analysis and TOC process thinking tools.

The literature study delivered inputs from which an adapted improvement methodology was compiled in chapter three. In chapter four this methodology is applied to solve the problem defined in chapter one. The TOC process tools and VM numerical analysis were applied to pinpoint the root cause of non-optimality during the analysis phases of the improvement methodology.

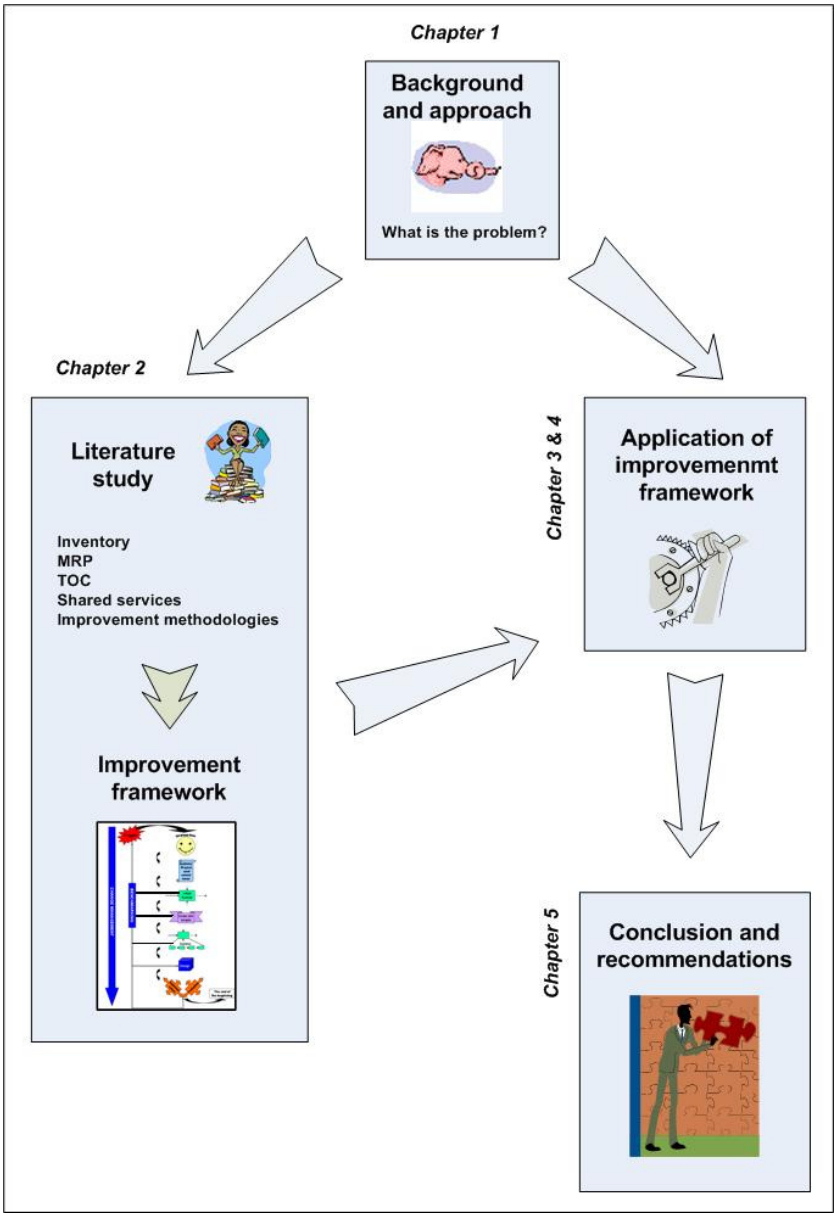

Figure 3: Roadmap

Chapter five concludes the study with a summary of findings and recommendations for the future.

2 Literature study

Before addressing the problem, a clear understanding of certain key concepts must be gained. These concepts can be divided into two groups, namely functional, discipline-related themes and problem solving themes. The functional themes include:

- Inventory
- MRP
- Shared services

The problem solving group of themes are:

- BPR and FIS
- VM numerical analysis
- TOC process thinking tools

A literature study will first address the functional themes. It will start with a section on inventory; the costs associated with it and its impact on production and customer satisfaction levels. Since SASOL makes use of MRP to optimise inventory, the next theme to be addressed is MRP. These functions are organised in a shared services centre and therefore the literature study includes a section on shared services models.

Possible solutions to the problem include FIS and BPR, well known improvement methodologies. The next section of the literature study is dedicated to the study of these concepts. Since all improvement frameworks contain a review phase, the study includes two analysis techniques, namely VM numerical analysis and TOC process thinking tools.

2.1 Inventory

In an effort to form a clear understanding of the concept 'inventory', the literature study begins with a list of the types of inventory, followed by a grouping of inventory according to the function fulfilled by it. In addition to this, the study includes the various costs incurred due to inventory and ways in which inventory should be managed to minimise these costs.

2.1.1 Inventory types

According to DNA Supply Chains (2002) and Tony Arnold (1991) the various types of inventory that can be found in a company such as SASOL include:

- Raw material
- Work in process
- Components / sub-assemblies
- Finished goods
- Maintenance, repair and operational supplies
- Transportation inventory

Fogarty *et al.* (1991) and DNA supply chains (2002) say that each of these inventory types can be grouped according to the function they perform. Functional grouping include the following:

- Anticipation inventory (Seasonal inventory)
  Additional inventory acquired above the normal required levels to cover for projected trends of increased sales, planned sales promotion programs, seasonal fluctuations, plant capacity constraints, plant shutdowns and vacations.
- Hedge inventory
  Additional inventory acquired above the normal required levels to take advantage of present costs or to avoid anticipated substantial price

increases.

- Fluctuation inventory (buffer inventory, buffer stock, inventory buffer, reserve stock or safety stock)

  Planned inventory to protect against statistical variability in demand or supply.

- Cycle inventory (lot-size inventory)

  Since it is impossible to supply inventory at the same rate at which it is consumed, inventory is replenished cyclically.

- Transportation inventory (movement inventory, pipeline inventory or pipeline stock)

  Because stages in the production process are not always physically adjacent, inventory must be kept in the pipeline between stations to assure continuity. This inventory acts as buffer for the time taken to move items to where they are needed.

A clear understanding of inventory can only be gained if the reader is aware of the different expenses brought about due to inventory. Therefore, the next paragraph will deal with inventory costs.

2.1.2 Inventory costs

According to Fogarty *et al.* (1991) & DNA Supply Chains (2002), inventory decision costs include:

- Carrying costs

  Carrying costs include the cost of

  - Pilferage, spoilage, obsolescence and damage
  - Insurance
  - Taxes
  - Handling
  - Security

- Space
- Record-keeping requirements
- Capital (based on the higher of either the actual cost of capital, or the opportunity cost)

This cost is calculated by multiplying the carrying rate with the item cost. A standard rate is determined by dividing the annual total of the carrying cost by the average rand value of stock.

- Stock-out costs

  This decision cost will depend on whether a backorder exists or not. If a backorder exists the cost will include the expense of keeping track of the backorder, the possibility of losing future sales and emergency shipment costs. If there is no backorder, the cost includes the loss of profit due to the lost sale and possible loss of future sales. Because customer goodwill is an intangible cost, the cost of stock-outs is very difficult to determine. The most popular approach is to establish a desired level of customer service where a marginal cost is assigned to each level of service, which can then be translated into a stock-out cost.

- Preparation costs

  These include the cost of all the activities required in issuing a purchasing order, in other words the cost of writing the order, preparation specifications, recording the order, order follow-up, processing of invoices, and preparation of payment.

- Capacity related costs

  These include the cost of expanding or contracting capacity. For example, when capacity is increased, new labourers must be hired and trained.

The answer to keeping these costs to a minimum is effective inventory management, as discussed in the next paragraph.

2.1.3 Inventory management

The objective of inventory management is to deliver what the customer needs, when and where he wants it, at a minimum cost. To achieve this, the trade-off must be managed between the level of customer service and the cost of providing that service.

Vollmann *et al.* (1997) argues that inventory management includes the establishment of desired targets and performance appraisal against these targets. This prompts the need for performance measures of customer service levels and the inventory investment needed to reach these levels.

Because the measure used depends on the nature of the inventory, management must class inventory into different categories. One method used to do this is the ABC analysis. The ABC analysis is based on the Pareto principle. The Pareto principle states that 20% of all causes are responsible for 80% of the effects (Kanawaty, 1992). The ABC analysis classifies items on the basis of relative importance. According to Vollmann *et al.* (1997) factors that affect the importance of units include:

- Annual Rand volume of the transaction for an item
- Unit cost
- Scarcity of material items used in producing an item
- Availability of resources, manpower, and facilities to produce an item
- Substitutability
- Lead time
- Criticality
- Storage requirements for an item
- Pilferage risks, shelf life, and other critical attributes
- Cost of a stock-out
- Engineering design volatility

The selection of the above factors will obviously be affected by the specific stock-

keeping environment. Multiple-criteria ABC analysis involves a combination of a cost and non-cost criteria from the list above. A matrix is compiled with cost elements along the one leg and non-cost criticality on the other. The matrix in table 3 shows how this procedure works.

Table 3: Multiple-criteria ABC analysis matrix (Vollmann *et al.*, 1997)

	Non-cost I (High criticality)	Non-cost II (Med criticality)	Non-cost III (Low criticality)	Total # items
Cost A (High)	2	12	1	**15**
Cost B (Medium)	1	19	5	**25**
Cost C (Low)	2	17	69	**88**
Total # items	**5**	**48**	**75**	**128**

Material items are firstly graded with regard to the cost criterion and then the non-cost criterion. The nine combinations are then combined into three broad but manageable categories, as indicated by the yellow, green and blue shading. The yellow shaded blocks are labelled AA, while the green blocks are BB and the blue ones are CC. The AA category includes high cost items with high non-cost criticality. The other two classes can be defined similarly. This leaves three classes, each with its own management policy (Vollmann *et al.*, 1997).

Once the inventory has been grouped, management can select the measure best-suited for inventory investment or apply different strategies for the different categories.

Inventory management must be complemented by an inventory investment measure which is suited to a specific company. The next paragraph looks at the different ways in which inventory investment can be calculated.

2.1.4 Inventory investment measures

Costing of inventory must be done on a regular basis. An annual evaluation of inventory investment ignores fluctuations in investment that occur during the year. Fogarty *et al.* (1997) suggests that monthly accounting evaluations must be combined with a cyclical counting program to enable an organization to spot short-term seasonal fluctuations, discern long-term trends early and avoid end-of-year inventory surprises. By measuring inventory investment, management can:

- Compare budgeted levels to actual levels and analyse differences
- Calculate the ITR (Inventory Turnover Rate). Variations on the ITR are the DITR (Dynamic Inventory Turnover Rate) and the PITR (Projected Inventory Turnover Rate). The first uses historical data, while the second is based on forecasts. The calculated ITR can then be compared with the ITR objective set by management (Fogarty *et al.*, 1997).

It is important that not only investment in inventory is measured, but also customer service levels, the next theme considered in the literature study.

2.1.5 Service level measures

Fogarty *et al.* (1991) states that customer service (service level) can be expressed quantitatively by considering the availability of items when needed by the customer. In addition to measuring delivery performance relative to delivery dates, backorder-filling performance must also be measured. Customer service can be measured in two ways that are suitable for comparison with a standard, according to Fogarty *et al.* (1991):

Percentage measures

- Orders shipped on schedule.

This could be misleading if orders contain different ratios of the total volume and profit.

- Line items shipped on schedule.

  This measure recognises the difference in the number of items in different orders, but it does not consider the differences in profit value.

  - Total units shipped on schedule.

    Once again the difference in the number of items in orders is taken into account, but the Rand volume is not.
  - Rand volume shipped on schedule.
  - Profit volume shipped on schedule.
- Operating item days not out of stock.
- Ordering periods without a stock-out.

Absolute value measures

- Order days out of stock.
- Line item days out of stock.
- Total item days out of stock.
- Rand volume days out of stock.
- Idle time due to material and component shortages.

These measures are similar to the percentage measures discussed above, but can only be evaluated if there is a basis for comparison.

Similar to service levels, backorder-filling performance can be measured in the following ways, as stated by Fogarty *et al.* (1991):

- The percentage of backorders shipped within different time periods.
- The average time and standard deviation taken to fill a backorder.
- The aging of backorders.

Furthermore, Forgarty *et al.* (1991) suggests that the selection of the specific measure to be used in a specific environment depends on the following factors:

- Is the data available?
- Can the causes of the results being measured be impacted?
- Do the elements being measured have an impact on the ROI?
- How costly is the measure?
- What is the nature of the inventory?

The management of inventory includes planning of inventory. One method of planning inventory is MRP. Since this is the materials planning procedure utilised by SASOL, the literature study includes the following section on the basics of MRP.

2.2 MRP (Material Requirements Planning)

The segment on MRP includes a brief description of the planning procedure followed, the role of MRP planners, the information contained in the system and the business decisions that affect the MRP system. A short section is included on forecasting, since MRO goods are often forecasted at SASOL.

2.2.1 MRP basics

MRP is a tool used to produce a resultant time-phased set of material requirements by combining the following inputs:

- A time-phased set of master production schedule requirements.
- A bill of materials.
- Inventory status (Vollmann *et al.*, 1997).

Table 4 provides a basic example of an MRP record.

Table 4: MRP records example (Vollmann *et al.*, 1997)

	Period (Planning horizon)					
	0	**1**	**2**	**3**	**4**	**5**
Gross Requirements			10		40	10
Scheduled Receipts		50				50
Projected Available Balance	4	54	44	44	4	44
Planned Order Release	50				50	

Lead time: Period (time bucket)
Lot size: 50

The Gross Requirements are the projected future demand for the material item during the period. The Scheduled Receipts are the existing (open) orders for the material item at the beginning of the period. The Projected Available Balance represents the current and projected available inventory balance at the end of the period. For example, the 4 items on hand will not be adequate to fill the open order for 10 in period 2. A scheduled receipt of 50 in period 1 brings inventory status to 54 in order to fill the requirement in period 2 (Vollmann *et al.*, 1997).

A Planned Order Release shows the planned orders for the material item at the beginning of the period. Whenever a projected available balance is too low to satisfy a gross requirement, a planned order is generated. Since the lead time is one period, the MRP system creates a planned order at the beginning of week 4 to meet the requirement in week 5. When a Planned Order is released (an actual order is placed with suppliers, or the order is communicated to the shop floor for production or assembly), it becomes a Scheduled Receipt (Vollmann *et al.*, 1997).

The MRP records are updated at regular intervals. Processing frequency refers to the number of times the records are updated in a period. Regeneration means that all the records are completely reconstructed every time they are processed. Net change implies that only the records affected by new or changed information are reconstructed (Vollmann *et al.*, 1997).

Note that the lot size in the MRP record example is a fixed lot size of 50. Lot sizing can either be done on a lot-for-lot basis or in fixed lot sizes. The lot-for-lot procedure involves the ordering of the exact amount required, while fixed lot sizes are used when orders are placed for a set quantity (Vollmann *et al.*, 1997).

The success of an MRP system lies in the expertise of its controllers. The following paragraph deals with the role that these MRP controllers should play in the system.

2.2.2 MRP planners

MRP planners are generally organised around logical groupings of inventory. Planners should only have to review records that require action. The primary duties of the planner are:

- Release orders.
- Reschedule due dates of existing open orders if necessary.
- Analyse and update system planning factors such as lead time and safety stock.
- Reconcile inconsistencies and pinpoint root cause/s of such errors.
- Find key problem areas requiring action.
- Use the system to solve critical stock-outs so that these actions can be captured in the system.
- Indicate whether future system enhancements will make the planner's work easier (Vollmann *et al.*, 1997).

The Pareto principle is used in MRP to separate the trivial many from the vital few. By the use of exception coding, the MRP planner only reviews 10-20% of the MRP records at each processing cycle. Exception codes can be divided into two categories:

- Control of input data accuracy.

  This would include examples such as checks for dates beyond the planning horizon, non-valid part numbers or other incongruities.
- Planning activity support.
  - Material items for which a planned order is now in a time period in which action is imperative to meet requirements, while taking into account lot size.
  - Open order discrepancies, for example when the present timing and/or amount for a scheduled receipt is not satisfactory.
  - Management type of problem areas, for example, a requirement has been offset into the past period and subsequently added to requirements in the most immediate period. Allocations exceed on-hand inventory (Vollmann *et al.*, 1997).

The MRP controller has two options for viewing planning results and managing by exception:

- MRP list

  For each material item a record exists which shows the output of the planning run. This output includes future stock and requirement developments. Various flexible display functions exist whereby the controller can evaluate the planning results. For example, all material items for which there were scheduling problems in the planning run and which may have to be re-scheduled can be grouped and displayed.
- Stock/requirements overview

  This option is identical to the MRP list, but the information in this stock overview is real time, while the MRP list is a static display of the planning situation at the time of the last planning run. By comparing the two lists, the controller can pinpoint any recent changes to the planning situation.

An MRP system is only as successful as the accuracy of its input data. The types of information needed in a typical MRP system are now discussed.

2.2.3 MRP Database (Material master data)

According to Volmann *et al.* (1997), data for a material item is captured in two files. The Item Master File contains information which describes the attributes of a material item. This information remains static over the planning horizon and will include the following:

- Material item number
- Name
- Code
- Unit of measure
- Drawing reference
- Release date
- Planner code
- Order policy code
- Lead time
- Safety stock
- Standard costs

Vollmann *et al.* (1997) explains that the information on the material item status is found in the subordinate file and includes the following information:

- Current allocations
- Time-phased scheduled receipts and order numbers
- Time-phased gross requirements
- Planned orders
- Linkages to the Item Master File

SASOL groups MRP data differently. All descriptive data is defined as Material

Master Data, while data used to optimise inventory levels (for example lead time and re-order levels) is called MRP data.

The previous paragraphs covered the basic functioning of MRP, the input data required and the role of MRP controllers. A discussion of the crux of MRP - optimal decision making - follows. In the section on MRP decisions the focus is on MRO goods.

2.2.4 MRP decisions

Tony Arnold (1991) and Fogarty *et al.* (1997) are in agreement that, in the case of MRO material items, the demand is independent. (This means that these material items are not on the lower levels of a BOM and thus the demand for them can not be traced down through the BOM). In managing independent demand, only two decisions need to be made:

1 How much to order (quantity).
2 When to order (time).

Tony Arnold (1991) and Fogarty *et al.* (1997) argue that, in most instances, the order point rule is used to determine the above and it works as follows: a fixed quantity is ordered whenever stock reaches a reorder level. The fixed quantity is the EOQ (Economic Order Quantity) and is calculated by taking into account:

- The cost of placing an order.
- The cost of carrying inventory.
- Quantity discount.

The re-order point is influenced by the following:

- The demand rate.
- The lead time required to replenish inventory.
- The amount of uncertainty in the demand rate and the replenishment lead

time.

- Management policy with regard to customer service levels.

As mentioned, the Item Master file contains a quantity for safety inventory. Tony Arnold (1991) and Fogarty *et al.* (1997) say that such a safety buffer is needed in inventory when demand is uncertain, to guard against stock-outs. This can be in the form of either safety stock or safety lead-time. Safety stock is the extra units in inventory above what is needed to satisfy the gross requirements. Safety stock is used when uncertainty exists with regard to demand quantities. Safety lead-time is a procedure whereby orders are released earlier than necessary to meet gross requirements. Safety lead-time is used as buffer when timing is uncertain.

Volmann *et al.* (1997) states that safety stock is determined by one of two methods in which a percentage is calculated by making a trade-off between funds lost in a stock-out situation versus the expense of extra investment in inventory:

- Stock-out probability

  An acceptable risk of stocking out during a replenishment order cycle is decided upon.
- Customer service level

  The customer service level is defined as the percentage of demand that can be supplied directly out of inventory.

Due to the fact that MRO materials demand is mostly forecasted, a short section on forecasting techniques has been added.

2.2.5 Forecasting

Forecasts for MRO goods are typically projections of historical demand patterns

according to Vollman *et al.* (1997). Basic forecast techniques include:

- Moving average

  It is not desirable to use only the average of all the historical demand data to forecast future requirements since the most recent history is most relevant in forecasting short-term demand in the near future. The moving average technique averages a number of the most recent historical data.

- Exponential smoothing

  The Moving Average method allocates the same weight to all the historical data used in calculating the forecasted demand. The Exponential Smoothing model does not eliminate any past data, but adjusts the weights given to the data so that older data gets increasingly less weight.

Vollman *et al.* (1997) suggests that a systematic pattern might outline historical demand data. Such patterns are taken into account in the forecasting models in the following ways:

- Trend enhancement
- Seasonal enhancement

When choosing an appropriate forecasting model for a specific environment, it is important to be able to evaluate the performance of various models. Vollman *et al.* (1997) suggests the MAD (Mean Actual Deviation), which is an indication of the reliability of a forecasting technique. This error is calculated by subtracting the actual demand from the forecasted demand. Standard deviation is 1.25 times the MAD.

Bernard Smith (as cited in Vollman *et al.*, 1997) developed a technique which makes it possible to utilise the best forecasting model for each new period. Focus Forecasting simulates forecasts of past periods for a variety of forecasting models. The performance that would have been achieved for each of these models is reviewed and the best performer is selected to do the forecasting for the next period.

As mentioned, SASOL uses SAP R3 software to do MRP. A short introduction to this software system follows.

2.2.6 SAP R3

This section starts with a short description of SAP R3 MRP, followed by a discussion of SAP configuration for lot sizing, safety stock, planning methods, exception messages and inventory counting.

2.2.6.1 Handling of MRP in SAP R3

SAP R3 compares available warehouse stock and scheduled receipts with planned requirements. If a material shortage is eminent, the system generates an order proposal. This process normally takes place once a day, at the end of the day. (The net change planning procedure discussed in MRP basics is used).

An order proposal is made in the form of a planned order, purchase requisition or delivery schedule. When a planned order is generated, procurement is only triggered when the MRP controller has converted it into a purchase requisition (SAP, 1996).

The following three paragraphs include the configuration within SAP for lot sizing, safety stock and planning methods.

2.2.6.2 Lot sizing

The SAP R3 system offers three lot-sizing alternatives to the MRP controller: lot-for-lot, fixed or part period balancing lot sizing. Lot sizes can further be limited by

the use of minimum and maximum lot sizes. A rounding value can be selected so that the lot size covers a multiple of the order quantity. The long-term lot sizing options allow one to select two different lot-sizing procedures for two different time periods (SAP, 1996). This is useful in a plant environment such as that of SASOL, since day-to-day maintenance requirements are different from shut-down material requirements. Different lot-sizing procedures will have to be defined for each.

2.2.6.3 Safety stock

Using the range of coverage profile, a safety stock range is calculated using the average daily requirements quantity. The controller specifies a minimum, maximum and target supply of stock in days, and the system generates a minimum, maximum and target safety stock (SAP, 1996).

2.2.6.4 Planning methods

SAP R3 offers three consumption-based planning methods:

- Reorder point planning

  Once available stock falls below the reorder point, an order proposal is created. Planning is done manually or automatically. During manual planning, the MRP controller specifies the reorder point and a safety level per material item. Alternately, during automatic planning, the system uses material forecasting techniques to calculate a reorder point and safety stock level, depending on the service level and replenishment lead time specified by the MRP controller.
- Forecast-based planning

  Material item requirements are determined on the basis of historic values, which are used as the starting point for the planning run.

- Time-phased planning

  If a vendor has a fixed delivery trend, material can be planned according to that fixed cycle, offset by the delivery time (SAP, 1996).

At Sasol the reorder point planning method is applied. MRP controllers determine the reorder point manually on the basis of historic values.

The subject matter – inventory – and the methodology in which it is managed – MRP – has now been considered in the literature study. The following paragraph deals with the organisational structure in which the inventory is managed – a shared services centre.

2.3 Shared services centres

More traditional models preceding the shared services centre include the outsourcing, centralising and decentralising models. The outsourcing model was adopted by companies with the supposition that an outside vendor could provide products and services faster and less expensively. Similarly, the centralised strategy combines common functions into a central division with a monopoly over services. Finally, a decentralised model dictates that each business unit conducts its own functions in an attempt to maintain flexibility in an ever changing market (Bergeron, 2003).

It was stated at the proceedings of the shared services conference (1998) that "shared services can be traced to the 1970's and 1980's when companies looked to decentralise support services in order to reduce the seemingly ever-growing corporate headquarters group, as well as improve customer relations. Support functions were moved from corporate headquarters to individual business units where a provider-customer relationship – in which the provider is accountable to each business unit, or customer – could be established. Unfortunately, the

consequence was substantial duplication of effort, often resulting in multiple (and incompatible) computer programs, training departments, and accounting groups. Staff and equipment redundancies meant higher costs, and deterred the quick and continual exchange of expert knowledge. What businesses needed were the benefits of centralization and decentralization, without the negative side-effects of either."

Now that a clear overview of the historical development of the shared services model has been given, it is appropriate to define a shared services centre.

2.3.1 Definition

According to Bergeron (2003) "(s)hared services is a collaborative strategy in which a subset of existing business functions are concentrated into a new, semi-autonomous business unit that has a management structure designed to promote efficiency, value generation, cost savings, and improved service for the internal customer of the parent corporation, like a business competing in the open market".

Elizabeth Fry (1998) states that "(a) shared services centre, where companies place far-flung finance and administrative operations under one roof, consolidates back-office functions into one seamless operation. …, a shared services centre typically operates as a stand-alone business, treating individual business units as actual customers. In theory, such a centre eliminates redundancies, standardises processes, and creates economies of scale".

It was added at the proceedings of the shared services conference (1994) that internal customers are permitted to outsource services if they are not satisfied with the performance of the shared services centre.

A shared services centre is defined by Deloitte Consulting (2004) as "a business

unit that performs administrative transactions for numerous divisions or subsidiaries of the same company, rather than having those transactions conducted in every division or subsidiary. These functions are usually associated with support services such as finance, human resources, payroll and property management or any function that is essential to the day to day running of a business, whereby there is a need for processes to be standardised and streamlined".

Wilson (2005) agrees that a shared services centre is created "by consolidating administrative support functions across various departments into single, stand-alone units. Those services can range from payroll, accounts and IT helpdesks to 311 call centres".

Concepts from the given definitions and other literature translate into the author's definition of a shared services centre:

A shared services centre consolidates services that support the primary operational activity into a new, semi-autonomous business unit that operates like a business competing in the open market. These services may include functions such as HR, finance, information technology and procurement.

A shared services centre will hold the following benefits:

- Leverage best practices, specialised knowledge, and technology (Proceedings of the shared services conference, 1998).
- Save costs (Accenture, 2004). According to Wilson (2005) savings of 25% to 40% can be made.
- Free up other departments to focus on their core competency.
- Streamline processes and subsequently improve service quality (Wilson, 2005).

- Eliminate redundant resources.
- Create economies of scale (Fry, 1998).
- A possible profit centre, serving external, as well as internal customers (Fry, 1998, CIPD (Chartered Institute of Personnel and Development), 2003 & Proceedings of the shared services conference, 1998). Revenues can then be used to leverage technology and other investment costs (Proceedings of the shared services conference, 1998).

Reilly & Williams (2003) and CIPD staff (2003) say that the element distinguishing shared services from, and making shared services more optimal than other models is the fact that services are customer oriented. They are dictated by the customers and are not corporately determined. The corporate part of the organisation only facilitates the shared services process.

There are two different types of shared services centres: “heavy-volume, transaction-intensive services (for example payroll), and knowledge-based, professional services (for example information technology) (Proceedings of the shared services conference, 1998). Infrachem has certain transaction-intensive services such as procurement, as well as professional services such as inventory optimization.

A short listing of the implementation steps for a shared services centre in the following paragraph complements the definition given above.

2.3.2 Implementation of a shared services centre

The following steps outlined during the proceedings of the shared services conference (1998) indicate the development of a shared services centre:

1 Define, redesign and consolidate core processes.

2 Reorganise leadership hierarchy.

3 Restructure senior reporting relationships.

4 Educate business unit presidents, operations line leaders and employees.

5 Focus on metrics.

6 Create service level agreements.

The first step of the above mentioned process is of vital importance. If the redesign phase is not executed, the centre will not be able to standardise and the benefits of a shared services centre will not be realised. For example, if processes are not standardised, duplication is not eliminated and savings are then not made.

Unfortunately, even the most advanced service models present certain pitfalls. Certain danger signs to be careful for when applying the shared services model will now be discussed.

2.3.3 Pitfalls of a shared services centre

"It's estimated that over 60% of shared services initiatives fail to fully deliver on their promises." (Fry, 1998). This is due to the following challenges:

- Inappropriate size of companies.
  "Small companies don't have sizeable enough operations to merit a centre, while mid-size companies often don't have the resources to pull off a proper implementation." (Fry, 1998).
- Overwhelming scale of implementation.
  Start on a manageable scale and don't underestimate when specifying the scale of capital and the resources required (Fry, 1998 & CIPD, 2004).
- Implementation of a shared services centre in an inappropriate environment.
  Fry (1998) warns that the shared services strategy is not the answer for all

companies. Various models exist and are applicable to different scenarios.

- The 'fiefdom syndrome'.

  Fry (1998), Younghusband (cited in Fry, 1998) and Hoffman (2005) all say that getting business units to buy into the concept is the biggest challenge of shared services: business unit heads build their own little kingdoms and usually view shared services as an invasion of their territory.

- Lack of senior management buy-in.

  Fry (1998) and Mergy & Records (2000) emphasise the importance of attaining full backing from senior management before attempting a shared services centre implementation. Senior management tends to pay less attention to shared services centres than to the operational business units that generate profits. Management needs to make a paradigm shift in this regard.

- Lack of business unit buy-in.

  During the proceedings of the shared services conference in 1998 it was stated that business unit buy-in can be achieved through the involvement of these units in the design and operation of the shared services centre.

- Responsibility and accountability disputes.

  Shared services mean shared responsibility and accountability. It is of utmost importance to clearly define the role, responsibilities and accountabilities of the shared services centre, its customers and the body corporate. (Fry, 1998, CIPD, 2004 & Proceedings of the shared services conference, 1998)

- Poor change management.

  Poor change management is the largest contributor to failed shared services centres. Acumen Alliance (2001) believes that shared services concepts "involve significant change programs and are affected by organizational politics" and thus companies must not solely focus on technical aspects. Fry (1998) emphasises the importance of working

closely with the HR department, while CIPD staff (2004) stress the significance of project teams, communication and involvement from employees. Good change management dictates appropriate training programs, as well as changes to the compensation and rewards system (Proceedings of the shared services conference, 1998). Change management is a science in its own right-although the author wants to highlight its importance, it will not be discussed in greater detail here.

- The "second class citizen" threat.

  This ties in with change management. Employees used in the shared services centre often feel inferior to other employees. "The idea that staff services have to become a supplier-of-choice is hard for people to stomach when for years they felt they were on par with the operating organizations" (Proceedings of the shared services conference, 1998).

- Lack of BPR.

  Business processes must be reviewed and redesigned. Three sources are quoted in support of this:

  "Simply pulling processes together in a central hub is unlikely to deliver a more streamlined, customer-driven service. Moving to a shared services provision requires a fundamental re-engineering of processes." (CIPD, 2004)

  "If you are simply laying people off and consolidating infrastructure, but have not changed the work or re-engineered your processes, then you are left with fewer people, the same work, and a lot of morale issues." (Proceedings of the shared services conference, 1998)

  Garcia (cited in Fry, 1998), the financial controller for the Brazilian subsidiary of Allied Signal, records how the American manufacturer made this mistake: "An account payable system that worked perfectly when run by individual operating units broke down when the processes were combined."

In the light of the above mentioned the following problems can be identified:

- If existing processes are used to serve customers, the shared services unit will be responsible for the same work as when the services were decentralised, but with fewer people.
- If existing processes are to be used, the shared services centre will be stuck with a collection of processes, since the various units would have performed identical functions differently.
- If one unit's processes are chosen above the others, it may not be compatible with the environments of all different business units.

- Poorly defined or communicated performance indicators.

  CIPD staff (2004), Mergy and Records (2000) all mention that the shared services centre, its customers and senior management should clearly define performance measures. One way to achieve this is by means of the SLA. According to CIPD "the SLA should contain the following:

  - What does the client expect?
  - What will the supplier supply or deliver?
  - How often will it be supplied?
  - To what quality standards will it be supplied?
  - At what price will it be supplied?
  - What are the customers' obligations?
  - What resources exist if those expectations are not reached?
  - What resources exist if the customer does not meet their obligations?
  - What resources exist on both sides if both parties fail in their obligations?"

- Lack of customer focus.

  Because the shared services model is customer oriented, it is of the utmost importance to manage the customer. Acumen Alliance (2001) suggests the following:

- Define the customer.
- Measure satisfaction levels before and after implementation.
- Develop an SLA.
- Manage the customer expectation gap.

Davis (as cited in the proceedings of the shared services conference, 1998) stresses the significance of training since "most people who start a shared services organisation do not come from a background where they win or loose clients on the basis of customer satisfaction levels, and are thus unfamiliar with trying to win clients".

- Poor integration of the shared services centre with the rest of the company.
  The shared services centre must be well integrated into the business to prevent it from competing with other business units for resources (Proceedings of the shared services conference, 1998). Mergy and Records (2000) agrees by saying that "(s)hared services units, lacking senior management attention, tend to create their own set of objectives that may or may not be linked to those of the business unit or the overall company".
- ROI only after four years.
  Wilson (2005) says that a company can easily become discouraged when setting up a shared services centre, since returns on investment are only experienced four years after implementation. He says that performance should be measured constantly and small successes celebrated in order to keep everybody motivated.

The functional, discipline-related themes; inventory, MRP and shared services centres; have now been discussed in this literature study. The next group of themes, the problem solving methodologies will now be discussed. The study concentrates on two improvement methodologies - FIS and BPR - as possible solutions to Infrachem's high inventory investment and low customer service

levels. In addition two analysis techniques are discussed since they are of cardinal importance during the review phase of an improvement project. The said techniques are VM numerical analysis and TOC process thinking tools.

2.4 Problem solving methodologies

This section is dedicated to the investigation of FIS and BPR as possible alternative improvement methodologies to apply in the SASOL Infrachem P&SM environment. Any improvement project has a project management leg, an analysis leg and an implementation leg. In this particular study VM numerical analysis and TOC process thinking tools will be leveraged in the analysis phase to review and define the problem clearly. The FIS and BPR discussions will be followed by a section dedicated to these two techniques.

2.4.1 BPR and FIS

“A business can be more directly influenced by addressing its processes than by improving its functions.” (David Hughes cited by NCC Blackwell, 1994). According to Astro Tech (BPR course, 2005) “a function is a task- or skill-based grouping into which we organise our activities“, while “a process is a sequence of activities performed on one or more inputs to deliver an output to the customer of the process”. Industrial history shows that this process focus mentioned by Hughes is the crux of industrial development over the past 45 years (Johansson *et al.*, 1993):

World War II left the world scattered with companies governed by autocratic management and bureaucratic production strategies. The drive was to secure **supply**. An attitude of “what’s good for the company, is good for the nation” was at the order of the day (Johansson et al., 1993).

Companies grew exponentially in post-war years and competition skyrocketed. Over time organizational functions expanded and separated into departments. Management became bureaucratic: functional heads governed departments like fiefdoms. Barriers appeared between departments – documents, materials and information flow between departments was hampered. Great delays occurred and office politics made co-operation between these hierarchical functional departments almost impossible. Objectives of individual departments were not in line with company mission statements, and costs grew out of control! Adam Smith's philosophy that work should be broken down into its simplest and most basic tasks shaped the functional structures of these mass manufacturing companies (Johansson *et al*., 1993, SM Thacker & Ass., 2005 & NCC Blackwell, 1994).

In the 1960's Japanese companies moved towards **process excellence**. They realised at a very early stage that local optimization had to be prevented and problems had to be addressed from a global point of view. In other words, the improvement of tasks within functional silo's had to be replaced by a process focus, which is cross-functional (NCC Blackwell, 1994, Astro Tech BPR course, 2005 & Zhang & Cao, 2002).

New philosophies such as JIT and TQM emerged. These philosophies are collectively known as FIS and are continuous, incremental improvement designs (SM Thacker, 2000).

According to Johansson *et al*. (1993), JIT is "a unified philosophy that calls for a total reorganization of operations activities in order to minimise waste and non-value adding activities, align operations and balance operations to demand. It utilises the technical enablers of "pull" systems to have one operation pull work from the upstream operation rather than upstream operations pushing work downstream, and focuses heavily on lead time reduction".

TQM, on the other hand, "seeks to create an atmosphere in which "doing it right

the first time" becomes the goal, where quality is designed and built into each activity rather than being inspected in after the fact. It is heavily white-collar orientated, and the focus is often one that uses changes in organizational culture to drive the entire effort" (Johansson *et al*., 1993).

The West lagged behind the East (Japan) in these fundamental paradigm shifts. The western world only followed suit in the 1990's.

According to Johansson *et al*. (1993), Astro Tech (BPR conference, 2005) & NCC Blackwell (1994), FIS often disappoint users since, although they were designed to do so, techniques such as TQM struggle to cross functional boundaries across the supply chain.

When the Japanese realised this, they defined four new "value metrics" – excellence in quality, service, cycle time and cost, with no room for trade-offs between the four. They achieved these high levels through the use of BPR, which pushes JIT and TQM philosophies across the company boundaries; upstream and downstream to the customer and the supplier. Thus, although JIT and TQM started out as inventory controlling philosophies BPR makes them applicable to the entire company (Johansson *et al*., 1993 & NCC Blackwell, 1994).

BPR moves away from mere continuous, incremental improvement dictated by JIT and TQM. Paul O'Neill is quoted by Johansson *et al*. (1993) and Zhang & Cao (2002): "I believe we have made a major mistake in our advocacy of the idea of continuous improvement. Let me explain what I mean.

Continuous improvement is exactly the right idea if you are the world leader in everything you do. It is a terrible idea if you are lagging in the world leadership benchmark. It is probably a disastrous idea if you are behind in the world standard… We need rapid, quantum-leap improvement. We cannot be satisfied to lay out a plan that will move us toward the existing world standard over some

protracted period of time – say 1995 or the year 2000 – because if we accept such a plan, we will never be the world leader." Therefore, BPR is required to become a world leader.

Recently, however, due to the high failure rates of BPR projects, companies have become sceptical of the promises made by BPR prophets. Smith and Finger have introduced a new name, BPM (Business Process Management), to fight against the stigmas that now cling to BPR. More information is given on BPM in 2.4.1.3.

Now that definitions for all the FIS methodologies have been given, BPR will be defined.

2.4.1.1 BPR definition

In 1993 Michael Hammer and James Champy were the first persons to give the philosophy of BPR a name (Marjanovic, 2000). According to Hammer and Champy (cited by NCC Blackwell, 1994 & Astro Tech BPR Course, 2005), BPR is "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed".

Johansson *et al*. (1993) defines BPR as "the means by which an organization can achieve radical change in performance as measured by cost, cycle time, service, and quality, by the application of a variety of tools and techniques that focus on the business as a set of related customer-oriented core business processes rather than a set of organizational functions". (A core process is a set of activities that crosses the organizational boundaries. Core processes address the needs of the marketplace and drive the organization's capabilities (Johansson *et al*., 1993 & NCC Blackwell, 1994).

Butter Cox Foundation 1991 (cited by NCC Blackwell, 1994) declare BPR as "…a way of transforming the business, which frees it from restrictions of the traditional approach by cutting across functional divisions. Information systems… are the fundamental ingredient of redesigned business processes".

Teng *et al*. is quoted by Malhotra (1998) that BPR is "the critical analysis and radical redesign of existing business processes to achieve breakthrough improvements in performance measures".

Crowe *et al*. (2002) quotes Goll's (2002) definition of BPR: "a total transformation of a business, an unconstrained reshaping of all business processes, technologies and management systems, as well as organizational structure and values, to achieve quantum leaps in performance throughout the business".

A combined definition will include the following aspects:

- Radical change.
- Re-design (not tweaking of existing processes).
- Process-oriented and cross-functional.
- Customer driven performance measures: cost, cycle time, quality, speed and service.

Clear definitions have been documented for both FIS methodologies and the BPR methodology. The question is how to apply the continuous, incremental improvement designs in synergy with the drastic, quantum-leap model. The different methodologies and their applicability in various circumstances will now be compared.

2.4.1.2 Comparison of BPR and FIS

Table 5 stipulates the similarities and differences between FIS and BPR.

Table 5: Purist view of FIS and BPR (Malhotra, 1998 & Zhang&Cao, 2002)

	FIS	BPR
Similarities	Process-excellence	
	Tools (refer to *Paradigms in FIS and BPR,* the following heading)	
Differences	Improving existing processes by asking "how?"	Re-designing processes by asking "why?" ("Clean slate" approach)
	Incremental improvement	Quantum-leap improvement
	Bound by company functional boundaries	Cross-functional
	Short- to medium-term investment	Long-term investment
	Low risk	High risk

FIS has a direct influence on the efficiency of a process, while BPR drives effectiveness as well. Table 6 shows a matrix that explains in layman's terms the difference between an efficient and an effective company.

Table 6: Effectiveness vs. efficiency

	Efficient	Inefficient
Effective	A company doing the right things in the right way	A company doing the right things in the wrong way
Ineffective	A company doing the wrong things right	A company doing the wrong things wrong

If a company is not performing the correct activities, it must redesign its processes completely before attempting to improve the performance of the processes. There is little to be gained if the wrong task is performed perfectly.

Although theory defines FIS and BPR as two clear-cut, different philosophies, the distinction of these concepts in practice is less rigid. Both apply the same tools, but on different levels. (See Appendix J *Paradigms in FIS and BPR* to view the paradigms from which these tools evolved.) FIS lies on a slide scale towards the incremental, low-level change side, while BPR involves radical change and

giant improvement potential as illustrated in figure 4 (Malhotra, 1998 & Al-Mashari *et al*., 2001).

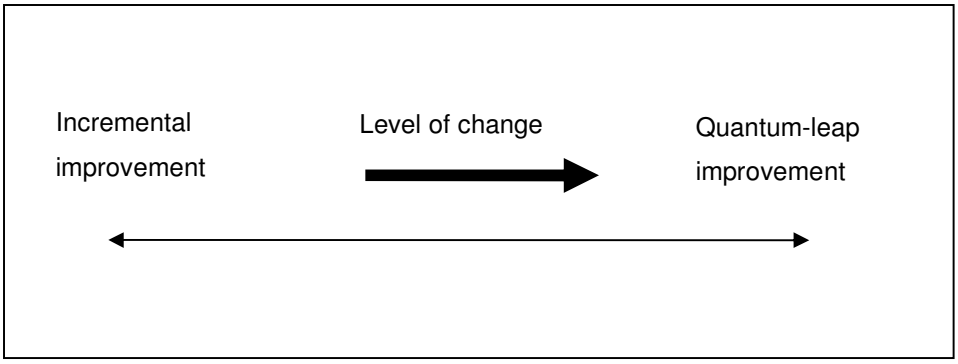

Figure 4: Level of change (Astro Tech BPR course, 2005 & NCC Blackwell 1994)

Astro Tech (BPR course, 2005) suggests that only if it becomes apparent that building or leveraging an existing base will not result in an acceptable performance change, the team should consider process redesign. And even then the company must first determine if it has the capacity to survive such a change. Appendix A shows a questionnaire developed by Coopers and Lybrand that can be completed to determine this.

FIS is at a tactical level of short- to medium-term investment that keeps motivating the workforce through incremental benefits. For this reason, NCC Blackwell (1994) suggests that a mix and match approach be applied in order to keep employees motivated and Zhang & Cao (2002) illustrate this approach in figure 5.

BPR is known mainly as Business Process Redesign or Business Process Reengineering. The latest jargon for the methodology is BPM. The next paragraph explains the evolution of BPR to BPM.

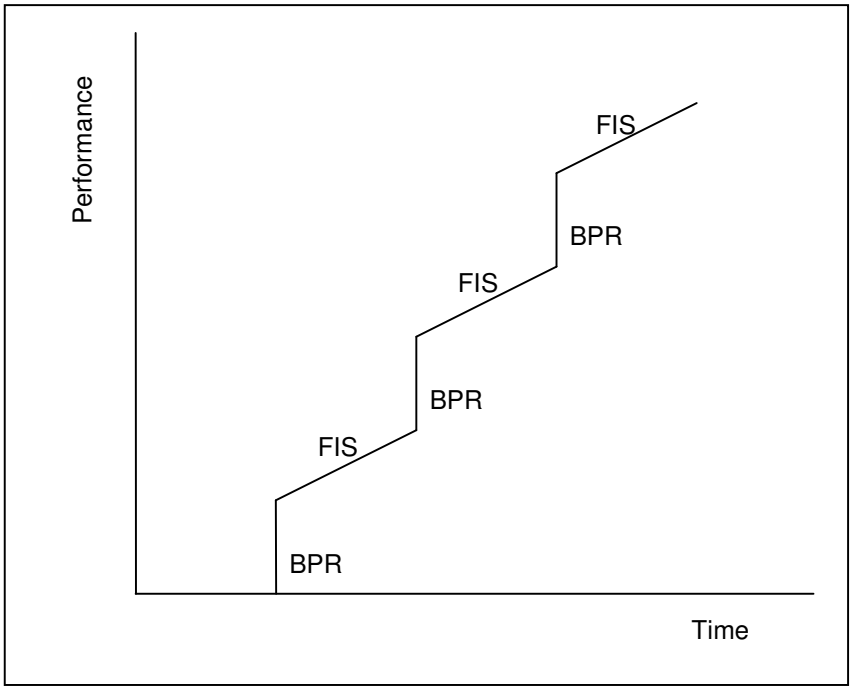

Figure 5: Mix and match of BPR and FIS (Zhang & Cao, 2002)

2.4.1.3 BPR and BPM

IT is a key enabler of BPR. Through the success attained by the application of IT tools in BPR projects, BPR is re-establishing the good name of IT and correcting the imbalance existing in businesses due to the unreasonable expectations demanded from IT systems since the late 1990's.

This special link between redesign and IT lead to the development of a new acronym for the traditional BPR, namely BPM. According to Smith and Fingar (2002) BPM is bringing IT up to speed so that IT can meet the demands of reengineering. In other words, BPM speeds up and simplifies the transition from the "as-is" processes to the "to-be" by means of IT. Smith and Fingar (2002) states that "business people don't want to have to change and then re-deploy applications, no matter whether they or their IT department is responsible; they want applications themselves to be able to change".

It was found in the Infrachem P&SM environment that the current ERP system will hinder re-engineering efforts. This point is discussed further in 4.8 as one of the implementation challenges of the study.

Although BPR offers high potential returns many challenges must be overcome to reach these profits. The next paragraph outlines the challenges that can plunge a BPR project into failure.

2.4.1.4 BPR challenges

In an article published by ProQuest (2005), the author warns that "sensible bosses should proceed with care" when considering a BPR venture. This warning is justified by the large failure rates of BPR studies. A study done by Al-Mashari *et al*. (2001) proves that 44.54% of BPR initiatives fail, while Yung & Chan (2003) gives a figure of 50-70%. Malhotra (1998) states a 70% failure rate and suggests the following reasons why BPR initiatives fail:

- Long-term investment (12 -18 months and often much longer).
- Lack of sustained management commitment and leadership.
- Loss in employee motivation and interest.
- Unrealistic scope and expectations.
- Resistance to change.

He also quotes Bashein (1994), who believes that the following should be added to the list of challenges:

- Cost-cutting focus.
- Narrow technical focus.
- Too many studies under way.
- Animosity towards and from IS and HR specialists.
- Unsound financial conditions.

Al-Mashari *et al*. (2001) agrees with Bashein and states that the largest contributor to failure is due to the primary focus on technical aspects and a disregard of softer issues. He mentions that Irani *et al*. adds several more problems faced by BPR participants:

- Loss of nerve, focus and stamina.
- Departmental fiefdoms.
- Local optimization, instead of global approaches.
- Fear of IT.

Astro Tech (BPR course, 2005) gives the following reasons for failure:

- Modest or inappropriate BPR goals and objectives.
- Approaches tailored to a particular situation and procedure rather than creative approaches.
- Rhetoric empowerment.
- Focus on internal issues and a loss of sight of the external customer.
- Time devoted to understanding current organizations rather than the consideration of alternative options.
- Rivalries between FIS and BPR studies.
- Rivalries between specialists and self-contained groups.
- The drowning of voices of caution by consultants who push and promote benefits of BPR.
- In the drive for speed of response, insight, sensitivity and flexibility are replaced by automation, predictability and programming.
- The creation of complex processes when trying to cater for every eventuality.
- New opportunities for white-collar fraud.

Crowe *et al*. (2002) warns that it is important to judge the risk of a BPR study not only by the risk involved, but also by the potential return. Since BPR studies promise significant improvements, the acceptable risk is relatively higher than

with less risky FIS studies.

BPR can overcome many of these challenges through the application of three helpers, namely: IT, benchmarking and change management. Appendix K, M and L contain paragraphs on the application of each of these respectively in an improvement project.

One of the major parts of an improvement exercise is the review / analysis phase in which the business is investigated and the root problem identified. For this particular study the VM numerical analysis and TOC process thinking tools will be applied during the review phase of the improvement methodology. The two techniques will be discussed in the following two sections.

2.4.2 VM numerical analysis

Numerical analysis is a technique contained in the Functional Thinking module of "Innovative Decision Making through Value Management" of 1992 compiled by VM Services. This technique is designed to analyse and prioritise alternate solutions. Later in the analysis phase of the study, numerical analysis is slightly adjusted to prioritise alternate problems instead of solutions.

VM numerical analysis includes three steps. The steps are illustrated by means of the example given in "Innovative Decision Making through Value Management" of 1992.

Step 1

Formulate the objective of the workgroup:

For example, identify opportunities by which to simplify the assembly of a penlight.

Step 2

Describe each problem area by a verb and a noun. This combination is called a function. A through to H are the functions that contribute to the simplicity of the penlight assembly:

A. Locate components
B. Control circuit
C. Secure location
D. Exert force
E. Provide energy
F. Permit access
G. Conduct current
H. Produce light

Step 3

Place functions in a matrix and judge them against each other, in relation to the objective. In other words, which function has the larger negative impact on the simplicity of the assembly of a penlight. One function is compared to another function in order to determine which is more important. The key letter of the more important function is written in the grid. A weight factor is assigned to show the difference in importance, as shown in figure 6.

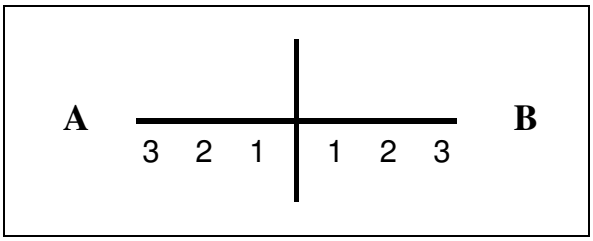

Figure 6: Weighting scale (VM Services, 1992)

For example, function A is considered to have three times more impact on simplicity of assembly than function B (see table 7). Furthermore, function A has

twice the impact that function C has. Each of the matrix squares are completed in this fashion.

Table 7: Example of a numerical evaluation matrix

Numerical Evaluation								Symbol	Function	Score	Ranking
A	A3	A2	A3	A3	A1	A2	A3	A	Locate components	17	1
	B	C1	D1	B1	F2	G1	B2	B	Control circuit	3	6
		C	D2	C1	F2	G2	C1	C	Secure location	3	5
			D	D1	F2	G1	D2	D	Exert force	6	4
				E	F2	G2	E1	E	Provide energy	1	7
					F	F1	F2	F	Permit access	10	2
						G	G2	G	Conduct current	8	3
							H	H	Produce light	0	8

Once the functions have been compared, the score for each function is calculated. For example, function A's key letter is located in the matrix and the numerical values are added. Table 8 illustrates this reasoning.

Table 8: Example of function scoring

A	A3	A2	A3	A3	A1	A2	A3	= **17**

The functions with the highest scores are then regarded as the elements that impact the objective the most. In this case, function A is ranked as the high-impact function.

Another analysis technique widely applied is that of TOC process thinking tools. The following paragraph includes a quick description of TOC and a step by step illustration of the process tools.

2.4.3 The theory of constraints and thinking process tools

TOC accepts the existence of an unbalanced company in which certain resources have smaller output capacities than others. The resource with the least output capability is the bottleneck and Goldratt calls it the CCR (Capacity Constraint Resource). Fogarty *et al.* quotes The Race: "such a constraint will dictate the rate of production of the entire plant". This resource must be identified and managed through the Drum-Buffer-Rope concept (Fogarty *et al.*, 1992, Tony Arnold, 1991 & Vollmann *et al.*, 1997).

Firstly, a buffer is placed in front of the CCR to ensure that this resource is utilised 100%. Secondly, the rate of output of the CCR is 'scheduled backwards' so that all resources before the CCR have the same output rate as the CCR. The result is that any disturbances in the 'feeding operations' of the CCR are absorbed by the buffer, and output build-up (waste) between operations is reduced (Fogarty *et al.*, 1992, Tony Arnold, 1991 & Vollmann *et al.*, 1997).

Once the constraint has been secured and protected by the Drum-Buffer-Rope concept, the goal is to break the constraint and then identify the next constraint in a never ending, continuous improvement process (Vollmann *et al.*, 1997, Rizzo, 1996).

One way of identifying the CCR is by applying Eli Goldratt's Thinking Process Tools: the current reality tree, evaporating cloud, future reality tree, prerequisite tree and the transition tree. The current reality tree, evaporating cloud and future reality tree tools are used in this dissertation during the analysis phase and will therefore be discussed in more detail.

2.4.3.1 The current reality tree

A current reality tree is "a sufficiency-based logic diagram that captures the

experience and intuition of the involved individuals" (Rizzo, 1996). It is in fact a cause-effect diagram that is expanded to the lowest level cause/s of undesirable effects. This analysis allows one to identify the one condition that, when eliminated, results in the disappearance of all (or most of) the unwanted effects (Rizzo, 1996). A simple example is used to illustrate the concept. A series of unfortunate events have been happening to John, over the past five years on Saturday evenings. These undesirable events are plotted on a cause-effect diagram in figure 7.

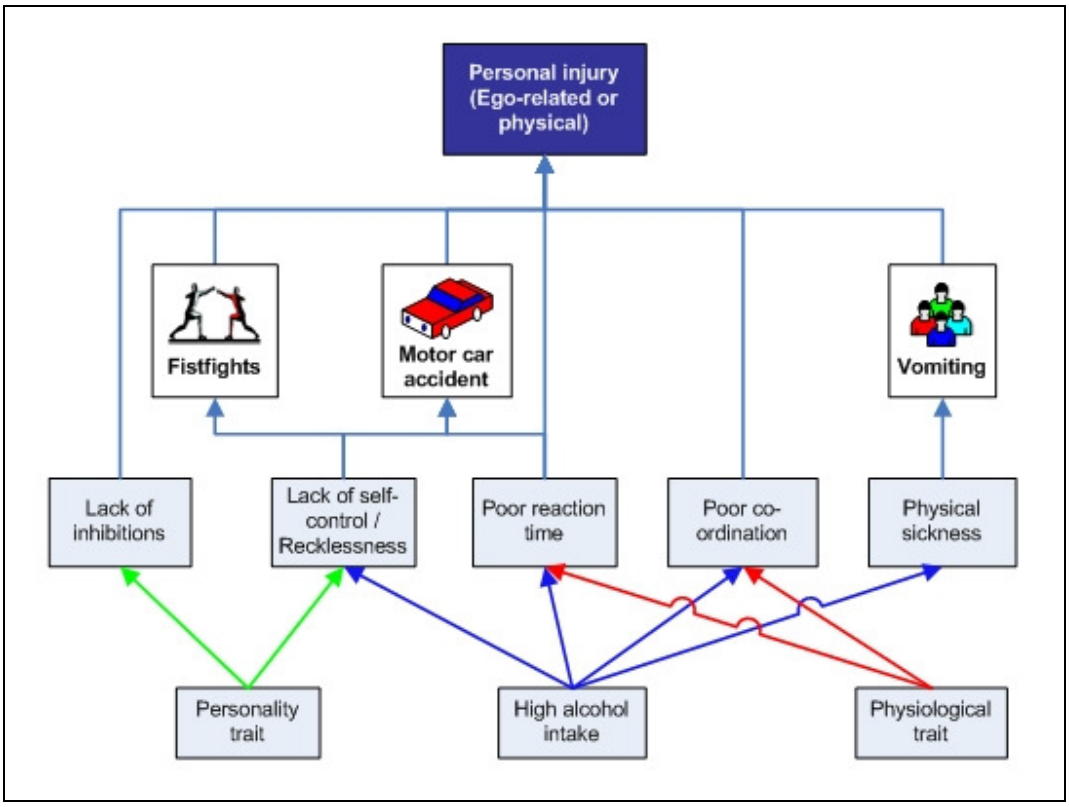

Figure 7: Current reality tree example

Fist fights, motorcar accidents and vomiting are the causes of personal injury to John's body and to his ego. Either his personality or a high consumption of alcohol results in a lack of self control, which in turn leads to fist fights. All the

incidents can be extended to their lowest level causes. If the assumption is made that John's personality and physiological fitness are fixed, it appears that the root is his high alcohol intake.

Once the root cause has been identified, the objective is to solve it. The next paragraph shows how this is done via the evaporating cloud.

2.4.3.2 The evaporating cloud

Goldratt argues that the core problem in an environment would have been eliminated if it had not been fed by an existing conflict. The evaporating cloud uncovers the conflict by challenging the assumptions that lead to the conflict. Once the organisation realises that it has been labouring under false assumptions, the conflict evaporates rapidly, just like a cloud of steam (Rizzo, 1996). The previous simple example can be elaborated on to illustrate the evaporating cloud principle (see figure 8).

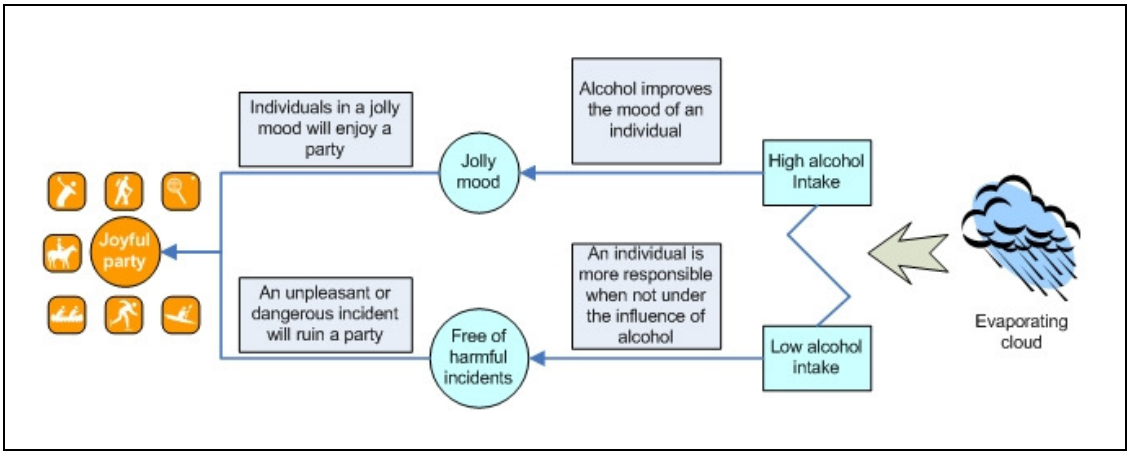

Figure 8: Evaporating cloud example

Why has the root problem not been solved in the past five years? The only

logical explanation would be the existence of an evaporating cloud.

An assumption is made that in order to have fun at a party, the individuals at the party must be in a jolly, party mood. A further assumption is that to achieve this, a high alcohol intake is required.

The lower leg assumption is that a party is only joyful if it is free of harmful incidents such as fistfights and motorcar accidents. It is supposed that this in turn requires a low alcohol intake.

The two opposing statements on the right form the evaporating cloud. It is evident that John has not decreased his alcohol intake in the past five years because he believes that a high consumption of alcohol is needed for him to have fun at his Saturday night parties. In order to solve the problem the assumptions made have to be challenged. When an assumption is proven to be wrong, a leg in the evaporating cloud will fall away and the cloud disappears.

Once the cloud has evaporated, the future can be predicted by compiling the future reality tree.

2.4.3.3 The future reality tree

To forecast the effect that the elimination of the root cause will have on the undesirable effect - Personal injury - a future reality tree is compiled. The root cause, High alcohol intake, is converted into a positive statement, Low alcohol intake, and the arrows are traced through the current reality tree to delete the undesirable effects that directly or indirectly result from this cause. In the future reality tree compiled of John's problem, the undesirable effect, Personal injury, disappears as the cloud is evaporated or as alcohol intake is lowered.

In the literature study the subject matter – inventory – has been covered, as well as the methodology which SASOL Infrachem utilizes to manage the inventory – MRP. The way in which these discipline-related functions are organised at Infrachem - a shared services centre - was then analysed. Since this model is currently not performing optimally within SASOL, improvement methodologies which could improve the situation were considered. Finally two review / analysis techniques that could be used during the improvement exercise were reviewed in the literature study.

The knowledge acquired through the literature study can now be applied to solve problems experienced by the shared services centre, SASOL Infrachem P&SM. The next chapter of the literature study deals with an improvement methodology, which will be applied to the Infrachem problem in chapter four.

3 Adapted improvement framework

Various BPR and FIS methodologies (SM Thacker, 2000, Malhotra, 1998, NCC Blackwell, 1994 & BPR course, 2005) were studied to compile the design illustrated in figure 9.

The study is executed in parallel with a change management action plan.

3.1 Phase 1: Trigger

The trigger is the element which sets off a need for action, and hence, an improvement study. Triggers may include:

- The need for a new department will require new business processes to be designed by means of BPD (Business Process Design).
- A new need can prompt a different process output than before. BPR can be used when processes are ineffective or to create a radically different output, while FIS can change the process output incrementally.
- A problem area can be addressed by BPR or FIS depending on the scale of change needed and the effectiveness of the current processes.
- Changed targets can be addressed by either BPR or FIS, depending on the potential improvement expected and the effectiveness of the current processes.

Change management in this phase includes creating awareness of the study and the reason for the change (NCC, 1994).

Also note that benchmarking can be used in this phase or could even be the cause of the trigger, since the gap between internal and external practices creates the need for change. Refer to Appendix L *The role of benchmarking in improvement* for theoretical information on benchmarking.

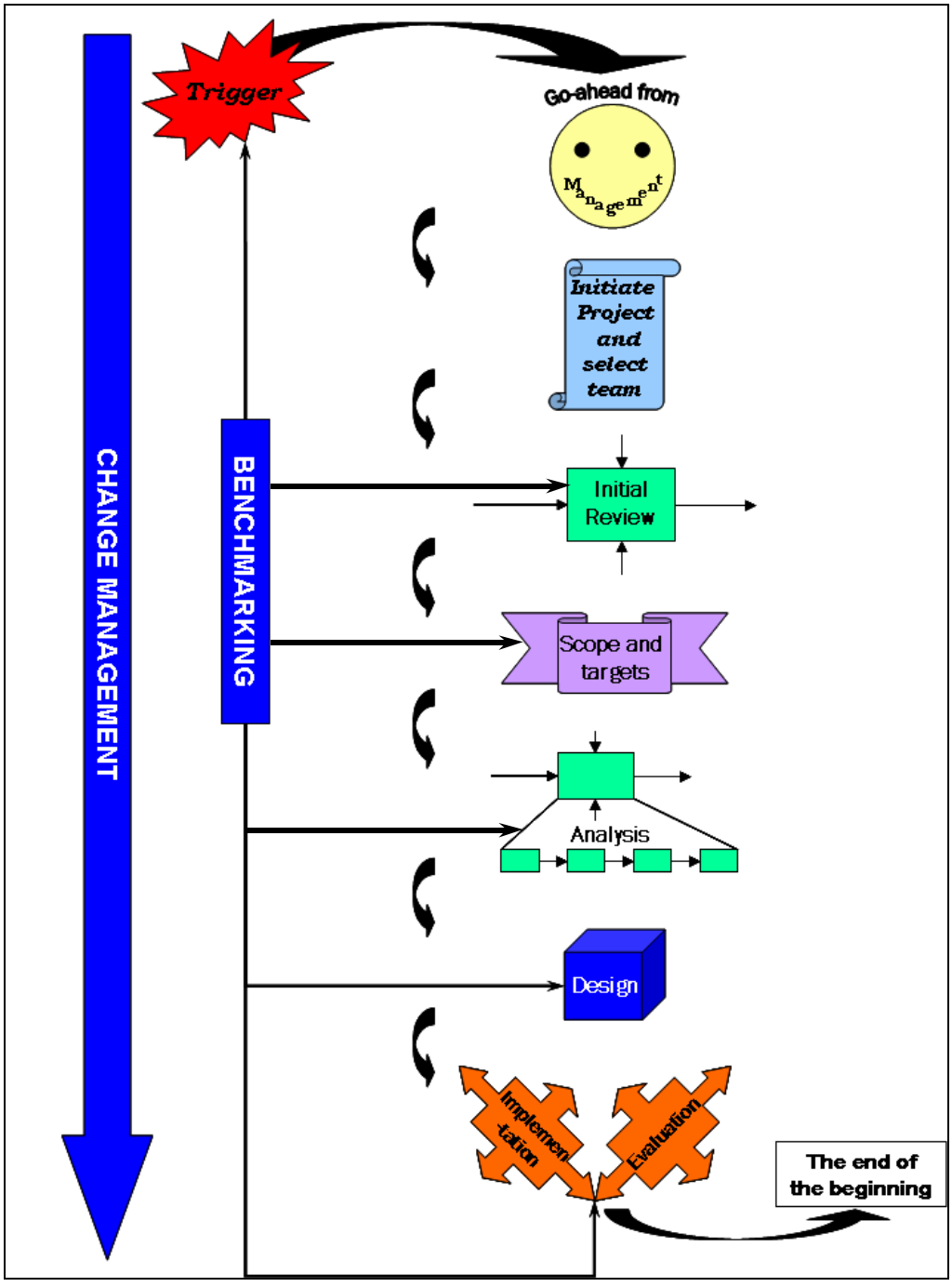

Figure 9: Adapted improvement methodology (adapted from SM Thacker, 2000, Malhotra, 1998 & BPR course, 2005)

3.2 Phase 2: "Go-ahead" from management

Support from senior management is crucial. In phase 2, management is convinced of the need for change and gives the "go-ahead".

To ensure successful change management the support earned from senior management is crucial. Employees respond to leadership and will only buy into a proposed change if their leaders do so first.

3.3 Phase 3: Initiate project and select project team

This phase includes the selection of a senior influencer, project leader and functional team members.

- A senior influencer should allocate 10% of his/her time to the project.
- A project leader must be appointed full time.
- A multi-disciplinary / multi-functional team is to be selected with the following collection of skills amongst them:
  - Organization and methods.
  - Process analysis.
  - Process design.
  - Human resource management.
  - Quality management.
  - Project management.
  - Metric and benchmarking.
  - IT/IS knowledge (NCC, 1994 & Astro Tech BPR course, 2005).

  The team should include at least one representative of the process customer in order to maintain a customer orientation (Astro Tech BPR course, 2005). In addition to this, the team should include members that will be responsible for the PCC (Project Co-ordination Centre) mentioned in *Phase 8*.

- Consultants are optional.

  Company involvement is crucial to avoid that employees are "left holding the baby" when consultants are gone. (NCC, 1994 & SM Thacker & Ass., 2000). External assistance will depend on the scale and complexity of the study (Astro Tech course, 2005).

3.4 Phase 4: Initial review

This phase involves a high-level analysis and the aim of this phase is to acquire an understanding of the business and determine the underlying cause/s of non-optimality. Two of the possible approaches, which can be utilized to do this, are the gap analysis approach and the TOC process thinking tools.

In a gap analysis the current capabilities of the business are compared to the actual client needs. The belief is that when the gap is closed between these two, the best scenario would have been reached. The following steps outline this approach:

1. Process overview

   1.1. Complete the organization's value chain.

   1.2. Identify core business processes. (Be sure to distinguish between processes and their support systems (Astro Tech BPR course, 2005)).

   1.3. Complete a high-level map (including external connections) of the core business processes of the organization.

2. Strategy overview

   Determine the Mission Statement and the CSF's (Critical Success Factors) of the high level processes by asking the question: "Why is the process performed?"

3. Stakeholder analysis

Determine the stakeholders involved and their requirements (Stakeholder Analysis).

3.1. Customers (SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis)

Understand the different segmentation of customers and products, and assess the priorities and trade-offs of service, functionality, quality and price for each.

3.2. Suppliers (Backward value chain analysis)

3.3. Employees

3.4. Shareholders (Future improvement cash flows)

It is useful to benchmark the stakeholder needs of other companies with the one being analysed. This will verify and validate the findings made during the stakeholder analysis. Verification and validation is very important since all the following steps are directly dependant on the stakeholder analysis findings.

4. Overview gap analysis

The deviation of the stakeholder needs from the mission statement, and the urgency of alignment will determine the scale of change required. A larger change will promise larger potential improvements in KPI's, which will mean a sounder financial picture (SM Thacker & Ass., 2000).

The second approach mentioned is the *Theory of constraints and Thinking process tools*. This approach has been discussed in detail in the literature study. Through this method the root cause of all non-optimality is identified. By solving the evaporating cloud conflict, the problem is eliminated.

Astro Tech suggests that it is a good idea to identify the culture and values of the company during this phase as well (Astro Tech BPR course, 2005). This is imperative for the change management project configuration. Cultures and

values will give a change specialist insight into the receptiveness of the employees to change.

3.5 Phase 5: Scope and targets

3.5.1 Scale of the study

- Decide whether processes are inefficient or ineffective. If processes are ineffective, BPR must be applied.
- Decide on the scale of change on the slide scale shown in paragraph 2.4.1.2 *Comparison of BPR and FIS*.

3.5.2 Prioritising of processes

- Decide on the processes to be addressed by means of profitability or value added analyses. Keep in mind the following:
  - Are other initiatives under way on the process in question?
  - How much impact does the process have on the CSF's?
  - How many staff members can relate to the benefits?
  - Is the scope too wide?
  - Does the company have the cost capability? (BPR is naturally much more expensive than FIS).
  - Can the company cope with the level of change expected (NCC, 1994)?
- Prioritise processes in sequence of engineering.

  A high-impact or exhaustive approach can be used. The first focuses on the processes that conflict most with the company mission, while the other prioritises in order of redesign urgency (Malhotra, 1998).

3.5.3 Study objectives

- Align CSF's with stakeholder requirements for the high level process in order to set objectives (KPI's (Key Performance Indicators)). SM Thacker (2000) warns that objectives should not encourage local optimums. NCC (1994) agrees and adds that more than one target should be stipulated, since a single target may oversimplify the view on the business needs being addressed. Astro Tech BPR course (2005) suggests the SMART technique to set these objectives for the study:

  S pecific

  M easurable

  A chievable

  R esult oriented

  T eam specific

  Benchmarking can be used to determine acceptable KPI's. This will ensure that project objectives are at an industry standard.

3.5.4 Change management

- Decide on the level of cultural change required and whether the company has the capacity to achieve this change (Refer to Appendix M *The role of change management in improvement* on how to determine the capacity of cultural change).
- Decide on the timing of the change. (Refer to Appendix M *The role of change management in improvement* on how to determine the timing of cultural change).

3.5.5 Project management

- Identify required resources.
- Complete a draft project plan. Be sure to include accountability and responsibility in the plan. The draft should also include the following:
  - Project definition
  - Aim of the study
  - Deliverables
  - Benefits to be achieved
  - Key players
  - WBS (Work breakdown structure)
  - PERT chart and critical path
  - Task summary sheet
  - Milestone summary sheet
  - External dependencies
  - Resource summary
  - Gantt chart (should make provision for 3-4 days of team dynamic training)
  - Work-to list
  - Cost summary and budget, and other resource requirements
  - Amendment sheet
  - Completion sheet (Astro Tech BPR course, 2005)
- Refine the team selected in phase 2.

3.6 Phase 6: Analysis

Radical BPR studies do not have an analysis phase. The aim of the phase is to determine and understand the “As-Is” scenario for the processes selected in the scoping phase. The business process analysis is done on a detail level and the following must be understood at a detail level of the core business processes

selected for improvement (Ask the question “How is the process performed?”)

- Process customers and suppliers.
- Drivers of performance and performance measures.
- Local constraints (SM Thacker & Ass., 2000).

The idea is to understand the constraints of the business and to utilise the elements that work well during the redesign of the processes. The gap or the root problem identified in the initial review phase shows the way during this phase and will determine the direction of the project.

Mostly, the analysis does not have to go as far down as the transaction level of detail. A real-time balance must be created between the level of detail and the usefulness of the analysis. The danger is that, while elaborate process models are built, people in the organization may lose interest and commitment due to the lack of apparent progress (Astro Tech BPR course, 2005).

It is therefore important to identify quick wins that will sustain the study during this phase (Astro Tech BPR course, 2005). This change management technique ensures motivation and involvement from employees. As part of change management, all relevant employees must also be involved in the analysis phase to ensure that workers feel a sense of ownership with regard to decisions made in the design phase.

Tools used during this phase could include those referred to in Appendix K *The role of IT (Information Technology) in improvement.* It is useful to benchmark with industry leaders when deciding which tools and techniques of analysis are more effective.

3.7 Phase 7: Design

During this phase the “To-Be” scenario is created on a detail level by:

- Designing, redesigning or improving the “As-Is” processes by generating a

range of options that will deliver significant performance improvements. These improvements can be achieved by identifying a breakpoint in a process. A breakpoint is the achievement of excellence in quality, cost, time and/or service that creates a disproportionate and sustained increase in market share (Astro Tech BPR course, 2005). A breakpoint can be found in the factors that the customer recognises as needs:

- Robustness
  The fitness of a product for use, ease of manufacture and ability to recycle.
- Price
- Lead time
- Flexibility
  The ability to respond immediately to a customer requirement.
- Process design
  Enhanced market image through improved process design.
- Reliability
- Differentiation
  The cutting-edge factor that gives a competitive edge to a company.
- Environmental protection
- Product design
- Service empathy
  Caring for customers through individual attention and recognition of needs.
- Information systems
  Business intelligence can enable optimal use of information (Astro Tech BPR course, 2005).

- Test the impact of each alternative on the CSF's of the company and select the best contender.
- Designing, redesigning or improving the performance measures by

translating the strategic CSF's to a tactical, operational and transactional level.

- Refine the draft project plan completed in phase 5.

Make sure that all the paradigms listed in Appendix J *Paradigms in FIS and BPR* are applied. For example, become customer focussed and design performance measures to meet customer needs. In addition to this, IT support tools such as those mentioned in Appendix K *The role of IT (Information Technology) in improvement* can be utilised during this phase. For example, business and process modelling tools such as process flow and IDEF0 can be very useful to draught "To-Be" processes.

To complement the top-down engineering by bottom-up empowerment is one change management technique to be remembered at this stage.

Benchmarking is also very important during this phase. Refer to Appendix L *The role on benchmarking in improvement* for literature on benchmarking and its use in design.

3.8 Phase 8: Implementation and evaluation

FIS

- Determine the gap between the "As-Is" and the "To-Be" scenario's.
- Bridge the gap.
- Train employees.
- Monitor.

BPR and BPD

- Implement designed / redesigned processes.
- Train employees.
- Monitor.

Throughout implementation, close monitoring of both action and result are of the utmost importance. Astro Tech (BPR course, 2005) suggests a PCC (Project Co-ordination Centre) to monitor the project actions and results.

Actions should be monitored against project plans in terms of time, cost, quality and effectiveness. A pro-forma questionnaire can be completed weekly by the project managers and sent to the PCC team. The aim of the pro-forma is not to check up on employees, but to ensure management support throughout implementation. An example of a pro-forma questionnaire is given in table 9.

Monitoring of time can be done in the following ways:

1 Colour code reporting (Green = everything is on schedule; yellow = study is suffering problems, but the final deadline will be met; red = the deadline will not be met).
2 Interim milestone reporting.
   The study is broken up into milestones each with its own deadline.
3 Critical path monitoring.
   Since milestone reporting will not indicate whether the final deadline will be met, critical path monitoring is recommended in addition to milestone reporting.

Since it is important to understand why delays occur, it is not wise to monitor time on its own. Monitoring of resources will include the monitoring of people and money, while quality must be checked on the following levels:

1 Study objectives
2 Management support
3 Departmental co-operation

Table 9: Pro-forma questionnaire (Astro Tech BPR course, 2005)

Project Name:					**Ref:**	
Project Manager:					**Date:**	
Status:	RED	AMBER	GREEN			
	Very early	**Early**	**On time**	**Late**	**Very Late**	
Will the next milestone be reached?						
Will the project be completed on time?						
Will the project be completed to budget?						
Will we meet the project objectives?						
Have you sufficient resources?						
Do you have sufficient support from senior management?						
Do you have sufficient co-operation from organizational departments?						

Finally, effectiveness can be regulated by considering the amount and type of support from management for change. An outside facilitator can be used for this monitoring.

Monitoring of results should be done against the targets identified for customers, suppliers, employees and shareholders in phase 4. Customer satisfaction can be determined through surveys that measure perceived value and perceived level of service. Satisfaction will also be evident in sales levels and market shares. Results relating to suppliers can be sighted in the income and balance sheets: the cost of suppliers and levels of inventory will indicate the optimality of suppliers. Speed and quality are the other telltale signs of supplier performance. Employee results should be considered on the "hard" operational side, as well as the "soft" psychological side. Labour costs, and quality and speed of work pertain to the "hard" side, while staff turnover will indicate results on the "soft" side of employee results. Finally, shareholder results will show in the financial statements and the share price of the organization.

Once again, to ensure the use of best practices during implementation, benchmarking is advisable. Yet again IT acts as enabler – refer to Appendix K *The role of IT (Information Technology) in improvement.*

As part of change management, the project team has to introduce new operational targets and appraisal systems. In conjunction with this, employees must be kept motivated by the short-term benefits planned in phase 4.

The adapted improvement methodology outlined in this chapter lays a strong foundation for a study of the Infrachem P&SM business. This framework constitutes a step by step guide that will subsequently be followed in the dissertation.

4 Application of the adapted improvement methodology

The well defined problem statement and critical research objectives will now be addressed at the hand of the adapted improvement methodology that flowed directly from the literature study. After defining the trigger, a broad review of Infrachem will be given to gain insight into business processes and cultures. As part of this phase, the root problem will be identified by means of VM numerical analysis and TOC process thinking tools. Due to time and complexity constraints, the scope of the study will then be narrowed down to one process which will serve as an illustration of the remainder of the methodology.

4.1 Phase 1: Trigger

In the case of P&SM MM (Materials Management) the trigger would be the unacceptably high inventory investment figures and low customer satisfaction. The considerable savings forecasted in 1.2 *Problem statement* definitely contribute to the attractiveness of the study. In the calculation of the savings the internationally accepted benchmark for inventory investment of 0.65% ERV was used.

4.2 Phase 2: “Go-ahead” from management

Chris Boyce, the divisional director of P&SM MM is the sponsor of the study. He assigned the project to SE Maré on 7 January 2005. The potential savings of the study were presented to Mr. Boyce and he promised complete support for the study. The divisional director was present at many interviews with employees which shows his commitment to the study. The results of the project were used

as a point of departure for a P&SM improvement project, which had been launched on 1 November 2005. A project manager, organisational specialist, change specialist and consultants were dedicated to the improvement project.

4.3 Phase 3: Initiate project and select project team

The study was launched on 7 January 2005. The size of the study and the substantial amount of time allocated to it made it possible for SASOL to assign the author as only human resource on the project.

4.4 Phase 4: Initial review

Before addressing the problem statement, the analyst must gain a general overview of the Infrachem P&SM business. Therefore, the initial parts of phase 4 are dedicated to the study of the "As-Is" business processes existing within P&SM.

4.4.1 Current SAP IP cluster MRO goods MRP business processes

Figure 10 is a value chain diagram of Infrachem P&SM.

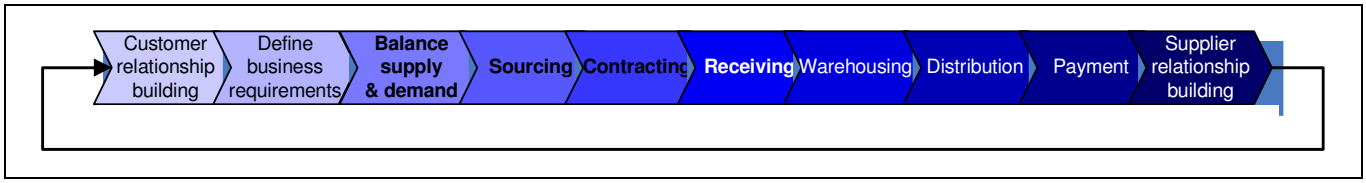

Figure 10: Value chain for Infrachem P&SM (*Infrachem P&SM value chain*, 2006)

The MM functions in the value chain include:

- Customer relationship building.

- Define business requirements.
- Receiving.
- Warehousing.
- Distribution.
- Supplier relationship building.

The recorded core business processes within the above-mentioned functions include the following:

- New material registration.
- Alterations to master data.
- Deletion of materials.
- Linking and unlinking of BOM's.
- Registration of new equipment numbers.
- Deletion of equipment numbers.
- Alterations to equipment numbers.
- Reconditioning.
- Receiving of materials.
- Quality assurance.
- Binning and preservation.
- Issuing of materials.
- Distribution of materials.
- Stock write-off.
- Inventory management.
- Perpetual inventory (SASOL intranet, 20 March 2006).

View Appendix B for an example of a works instruction of a process. (All the works instructions of the above-listed processes are available on CD). In the following sub-paragraph, four important processes are plotted on process flows. These processes were favoured to be studied in the initial review stage because they give the analyst an insight into business within Infrachem P&SM.

Figure 11 shows the line of events in the creation of a new material item on SAP. Once a material item is created, an order can be placed for that specific material, as evident in the second chart. Figure 13 depicts the procurement of a material item, while the last process flow outlines the way in which a material item is disposed of.

4.4.1.1 New material registration

Figure 11 is a flow diagram that shows the steps taken to create a new material item on SAP. A request for the creation of a new material on the system can be made by means of a SI (Stock Inquiry), SPIR (Spare Part Interchangeable Record) form or Master Data template, depending on the source of the request. Once duplicate resolution has been performed, a new material number is created and the necessary master data entered into SAP. MRP controllers or spares coordinators verify and validate populated MRP data (Vermaak, 2005 & Fourie, 2003).

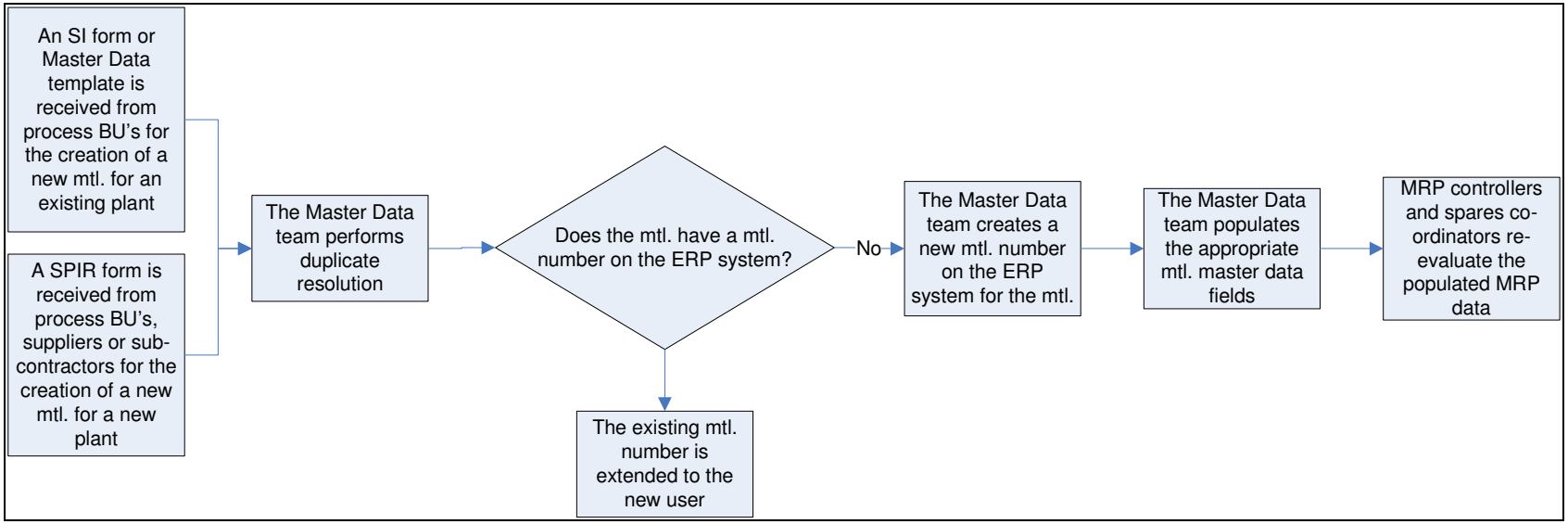

Figure 11: Population of a new material item on SAP

4.4.1.2 Material issues and Inventory management

Figure 12 depicts the Material Requirements process flow. A request for material can be prompted by a reservation, transport order, sales order or works order, depending on the source of request. If there is not enough stock on-hand, the non relevant steps are omitted and the process moves on to procurement. If the order can be fulfilled by the stores, SAP calculates the new stock level and the goods are delivered. If the minimum re-order point has been reached, SAP MRP generates a PO (Planned Order) (Steyl, 2005). A distinction must be made between a reservation and a purchase requisition. If the client operates on the same SAP 'box' as Infrachem, a reservation is created. Should the user be on a different SAP 'box' a purchase requisition is created. A requisition must be authorized prior to being converted to a PO.

Note: If BU's are on different 'boxes', they are configured under different companies in the same SAP system. On the other hand, BU's with different plant numbers are grouped under the same parent company, which means that in SAP these companies are on the same 'box'. This technical aspect is explained in more detail in paragraph 4.4.2.1.

MRP controllers access allocated MRP records daily. If an unprocessed PO is identified, the controller verifies and validates it, and converts it to a PR (Purchase Requisition). This requisition is the input for the procurement process flow (Steyl, 2005).

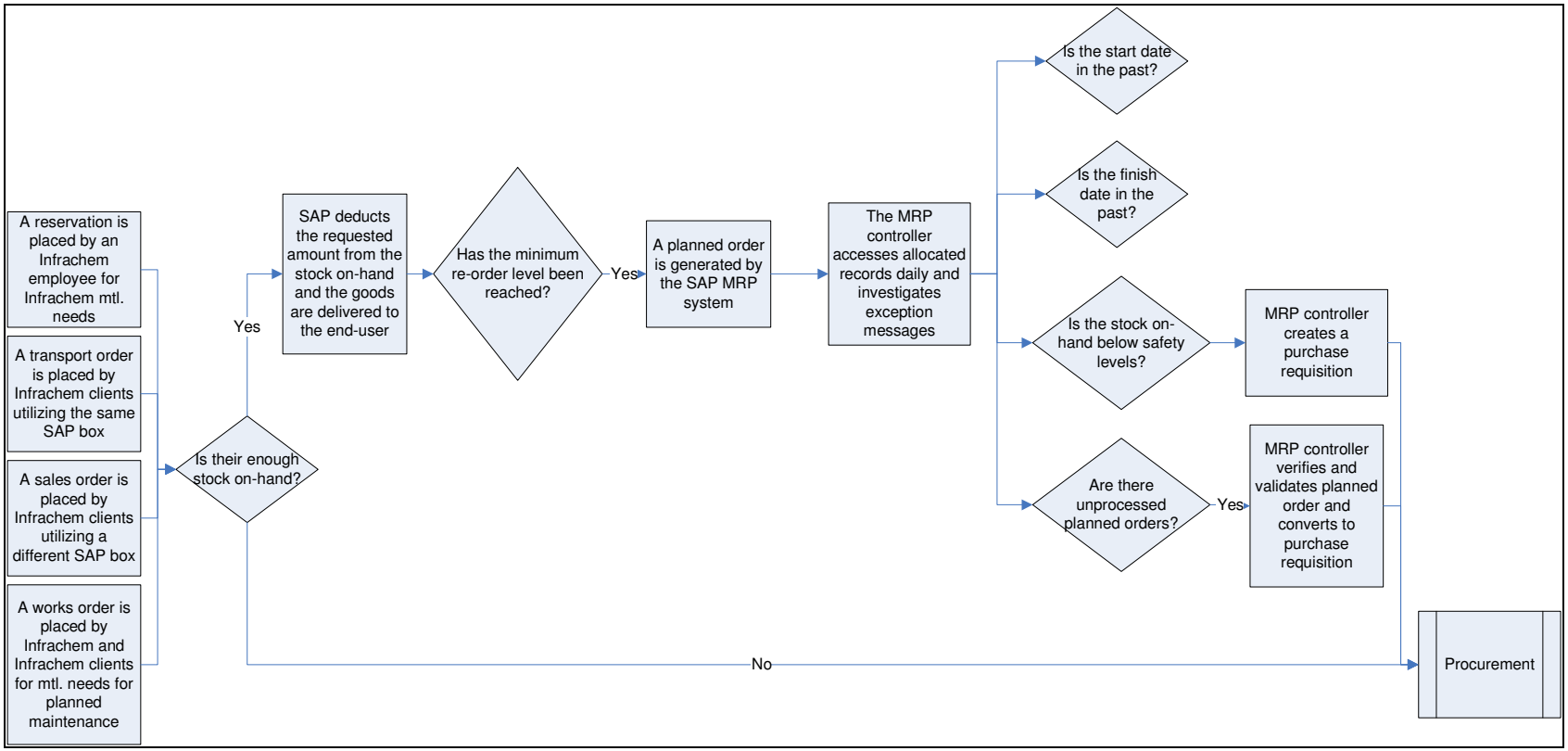

Figure 12: Material requirement

4.4.1.3 Procurement

The procurement process is depicted in figure 13. If a material item is registered as a contract item, a buyer selects the suitable supplier and places an order. Goods are received at the main stores where lead times are captured upon receipt. Once goods have been inspected, they are binned or delivered to the end-user. If a material has been purchased for the first time, the master data team captures a visual image of the item on the ERP system (Potgieter, 2005).

If a material is not a contract item, it is purchased 'directly' from a non-contract supplier. If requirements for the specific item justify the creation of a contract, a suitable supplier is selected and a contract drafted. Supplier and material master data are updated (Potgieter, 2005).

4.4.1.4 Stock write-off's

Material writing off of materials is shown in figure 14. If an inconsistency is identified after a stock-take, a PI (Product Inquiry) is created and the stock unit is flagged for write-off. Other reasons for material write-offs are expiration or damage. An end-user may request a write-off, or a stock age analysis could prompt the deletion of a material. In these cases, the master data team will mark the item for deletion, an issue clerk will issue the stock on SAP, and the goods will be removed to the redundant sales yard (Fourie, 2003).

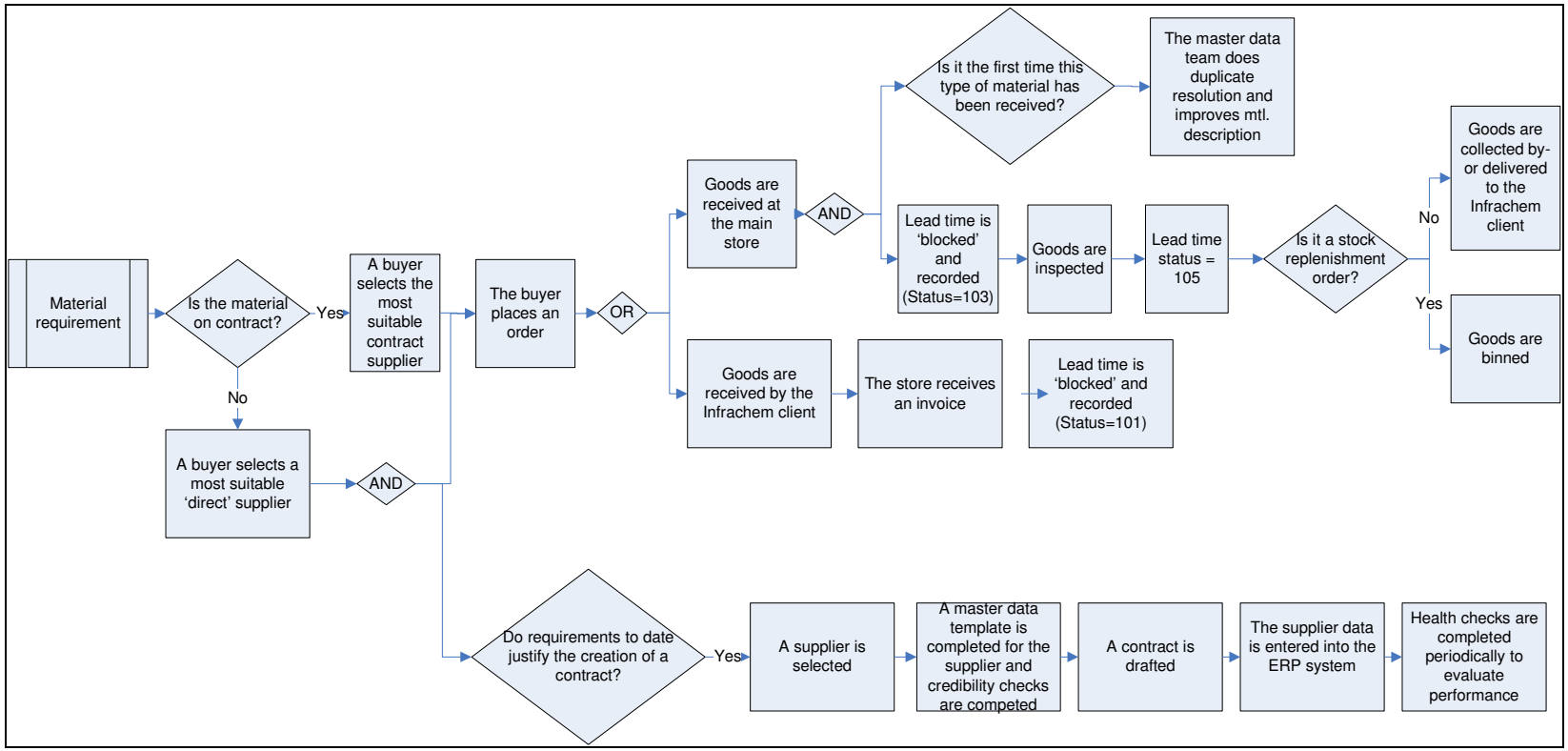

Figure 13: Procurement

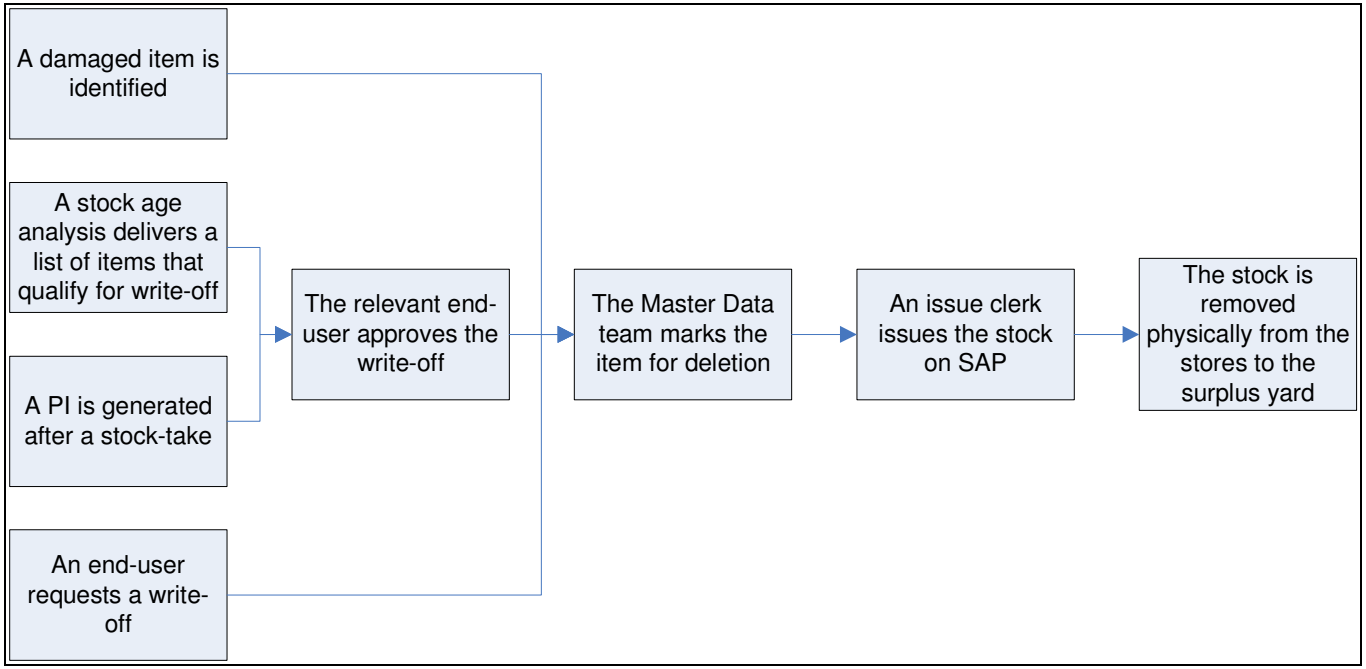

Figure 14: Write-off of material items

An insight into the current IP cluster business processes has been gained through the discussion of the process flows. Together with the stakeholder analysis which follows, a background knowledge of the Infrachem P&SM business is acquired which lays the foundation for the analysis of key problem areas.

4.4.2 Stakeholder analysis

The three key stakeholders to consider when optimizing a business environment are the clients of the enterprise, the employees working for the enterprise and the shareholders who own the enterprise. A short overview analysis of each is given in the following three paragraphs.

4.4.2.1 Clients

Figure 15 illustrates how the IP cluster is configured in SAP. This gives insight into the environment in which Infrachem and its clients interact.

Infrachem and Polymers are configured as two companies on a SAP system called the IP cluster, which means that they are on different 'boxes'. Each of these companies has a collection of BU's dedicated to it. These BU's are given company codes, for example Infrachem affiliates are grouped under the company code ZA37 under the parent company Infrachem, while Monomers has a unique company code under Polymers. Each unit with a company code can be broken down into plants, for example each of the affiliate BU's have a unique plant number under the company code ZA37. Therefore, Infrachem and the affiliates are on the same 'box' because they are grouped under the same parent company, but have different plant numbers.

Table 10 describes certain technical specifications of the Infrachem P&SM clients and the materials management services that these clients utilize.

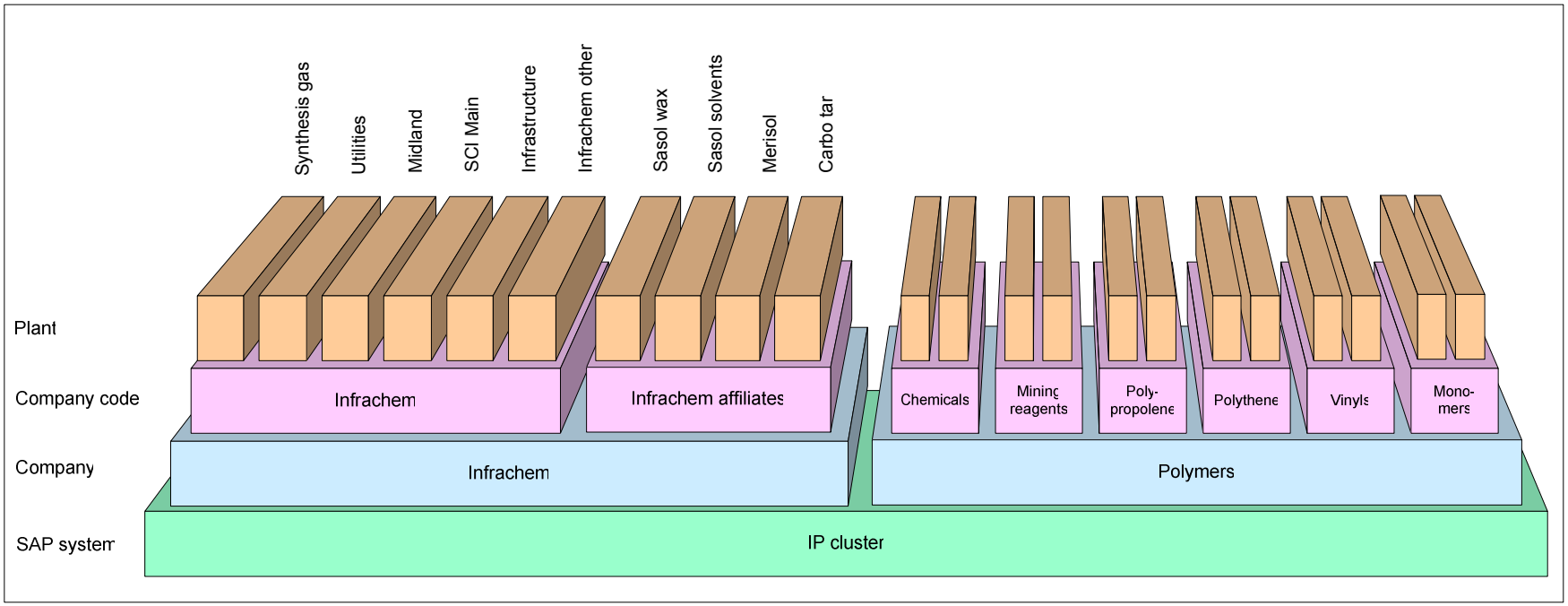

Figure 15: IP cluster configuration in SAP

Table 10: Client analysis

	BUSINESS UNIT	1. SCHUMANN SASOL	2. SASCON	3. SMX	3.1 SASOL AGRI	4. CARBOTAR	5. SOLVENTS SASOLBURG (SASOL I SITE)	6. n BUTANOL & AAA (MIDLANDS SITE)	7. CHEMCITY	8. SOLVENTS GERMISTON	9. SASOL LTD	10. SASTECH ENG. STOCK	11. MERISOL	12. AMMONIA	13. SASOL POLYMERS	14. SASTECH R&D	15. MONOMERS	16. NATREF	17. S/COAL	18. SASOL GAS
MATERIALS MANAGEMENT SERVICES	MATERIALS MASTERDATA	√	√	√	√	√	√	√	√	BUSY	√	X	√	√	√	X	√	X	X	X
	PLANT SPECIFIC/DEDICATED STOCK : REPLENISHMENT (MRP)	√	√	√	√	√	√	√	√	N/A	N/A	√	√	√	√	√	√	N/A	N/A	N/A
	PLANT SPECIFIC/DEDICATED STOCK : PHYSICAL STORAGE & MATERIALS HANDLING	√	√	√	√	√	√	√	√	N/A	N/A	X	√	√	√	X	√	N/A	N/A	N/A
	GENERIC STOCK : REPLENISHMENT & STORAGE	√	√	√	√	√	√	√	√	N/A	N/A	√	√	√	√	√	√	N/A	N/A	N/A
	DIRECT PURCHASES	O	O	O	O	X	X	X	√	N/A	N/A	X	X	O	O	X	X	N/A	N/A	N/A
	E-PROC SYSTEM ADMIN	√	√	√	√	√	√	√	√	N/A	√	√	√	√	√	√	√	√	N/A	√

SASOL INFRACHEM P&SM	√	SASOL INFRACHEM IN CLIENT'S OWN SYSTEM	X	CLIENT OWN P&SM IN OWN SYSTEM	O

As stated in the problem description, customer satisfaction is 44.3%. Qualitative data from interviews showing poor satisfaction amongst clients had also been discussed in the problem description. In following interviews with managerial and operational employees of three key clients - Solvents, Nitro and Polymers - certain pressing issues in services offered by Infrachem were revealed. These were considered important enough to be regarded as CSF's to their businesses (Interview Van Zyl, Hamman, Greyling, Smit, Da Silva, Bester, Du Preez, Hattingh, Kruger & Marx, 2006). The first four of these issues relate to internally focussed operational effectiveness issues:

- Unreliable, inaccurate MRP data.
- Non-optimal inventory planning (MRP).
- Lack in on time, in full deliveries.

- Slow or no follow-up on open orders and other queries.

The following five are Customer Relations Management concepts:

- Inaccurate performance evaluation of service provider by client management, as well as by operational employees.
- Lack in transparency and communication with clients.
- Lack in personalised attention.
- Lack in insight into client business and resultant business priorities.
- Lack in clear responsibility and accountability boundaries between client and service provider.

Overall, clients are not satisfied with the service offerings and this initial client analysis has already isolated certain issues in the material management environment. The next important stakeholder to be discussed is the employee.

4.4.2.2 Employees

Interviews revealed that most employees are despondent, unmotivated and demoralised. A study by a change specialist (Anonymous, 2006) proved this observation. Figure 16 shows a matrix that was used by the specialist to rate the wellness of a sample of employees. From the matrix it is evident that an employee who scores high on work devotion and vitality will have a high work engagement. Such an employee has the ideal state of wellbeing. On the other hand, a worker can be burnt out if he/she is mentally distant and exhausted. Over-commitment is obvious in employees with high work devotion and low energy levels. Figure 17 depicts the outcome of the study on the employee sample.

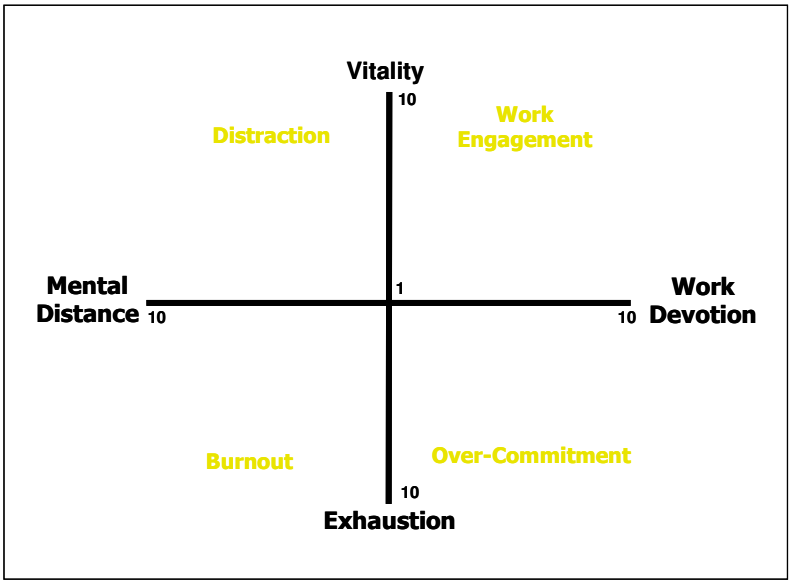

Figure 16: Wellbeing matrix

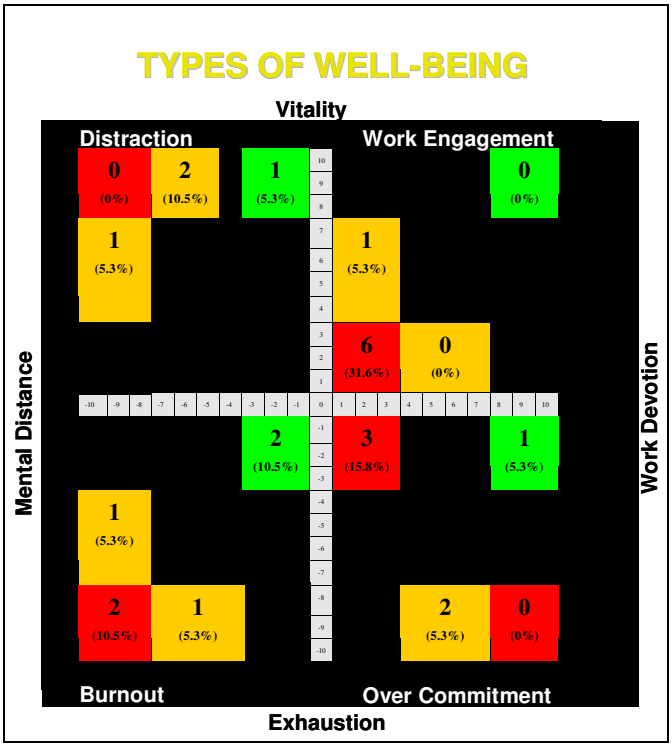

Figure 17: Sample outcomes of wellbeing study

Six of the employees (31.6% of the sample) have low work engagement. This means that these employees have scores of zero for both energy and work devotion. Two of the workers (10.5% of the sample) are in burnout, which means that they are exhausted and mentally completely distracted from their work. Not a single person scored high on energy and work devotion, which means that none of the employees have high work engagement.

Generally, employees are not experiencing job satisfaction and the change specialist suggests the need for drastic changes in individual attitudes and hence, cultural change.

A final stakeholder is the shareholders of SASOL.

4.4.2.3 Shareholders

Shareholders are directly affected by the high investment in inventory. The most threatening expense of inventory is the holding cost and a potential saving of R 47.6 to R 240.5 million annually was indicated.

The key business processes have been documented and analyzed. With this background knowledge, the analysts can attempt to find the root cause of non-optimality for the IP cluster. VM numerical analysis and the TOC process thinking tools were applied during this phase of the study.

4.4.3 Key problems in the current strategy and business process

The Pareto principle was applied and only the most problematic areas were investigated to isolate the root cause/s of undesirable effects in the IP cluster. A Value Management Workgroup was held to identify these areas of study. Eli

Goldratt's Theory of Constraints approach and Thinking Process Tools were used to analyse the mentioned areas of study: a current reality tree was compiled and an evaporating cloud, showing the root cause/s, was identified.

4.4.3.1 Value management workgroup

The value management workgroup was used to prioritise problem areas within the IP cluster materials management environment. The technique applied is that of VM numerical analysis in an interactive workgroup of six employees.

The six employees chosen for the workgroup included people from the operational through to the strategic level. They were:

- Divisional director (Chris Boyce).
- MRP configuration specialist (Sanita Auret).
- SAP specialist (Kevin Hughes).
- Procurement and Supply Management SAP specialist (Etienne Oosthuizen).
- MRP controller (Karin Steyl).
- Master data configuration specialist (Pieter Vermaak) (Boyce *et al.*, 2005).

4.4.3.1.1 Step 1

The first step in the VM analysis is to define the objective of the workgroup:

Identify the main areas contributing to the non-optimality in the Materials management department of Infrachem P&SM.

4.4.3.1.2 Step 2

The problem areas identified in 1.2 are refined and expressed as functions to be prioritized:

A. Measure performance.

   Three main KPI's are available to measure the performance of the Materials management department: inventory investment, service level and backlogs. This function refers to the accuracy and degree of utilization of KPI's to achieve continuous improvement.

B. Manage suppliers.

   This function firstly refers to the collaboration with and control of suppliers. Secondly it includes the alignment of the actual supplier performance with that specified in the SLA's.

   An example of a difficulty experienced in this area is the incorrect capture of supplier lead times, which reflects poorly on suppliers even if they are performing as agreed in SLA's. Such inaccurate performance appraisals of suppliers result in damaged supplier relationships.

C. Co-ordinate maintenance execution with MRP.

   Plant personnel schedule maintenance tasks, but do not inform Infrachem of stock requirements in time. Consequently, such scheduled maintenance appears as unscheduled stock requirements on the MRP records.

D. Manage redundant stock.

   This function includes the unnecessary pile-up of redundant stock and the need to remove it in time. This, of course, results in unnecessary high inventory levels and unhappy customers.

E. Manage employees.

   Encompassed in this function are the training of employees, and the allocation and enforcement of ownership and responsibility in the workforce. Currently, for example, employees are unmotivated and not sufficiently empowered to enable bottom-up inputs. Clients perceive employees as unfriendly and service as unprofessional.

F. Overcome shared-service challenges related to materials management.

Examples of such challenges include:

- A lack of trust from Infrachem clients.
- Terminology discrepancies.
- Business unit politics and narrow mindedness.
- Responsibility discrepancies, for example: Is Infrachem or the Maintenance Division responsible for the BOM record updating?
- Governance discrepancies: each division has its own hierarchy of control. Infrachem does not have absolute hierarchical control over Infrachem Affiliates.
- Unique maintenance and materials management strategies of clients and affiliates.
- Unique ERP configurations for different divisions due to the independence of the business units within the IP cluster.

G. Optimise ERP system configuration.

The optimization of the ERP system configuration deals with the improvement of the set-up of SAP with regard to Materials management functionality. For this particular function, the following can lead to poor inventory investment and client satisfaction:

- Underutilization of MRP functionality
- Poor choice of ERP system for the IP cluster environment
- SAP is perceived as a controlling system instead of an operating system. For example, electronic firewalls are continuously installed to enforce strict adherence to set procedures and prevent criminal activities by employees. This slows employees down in the execution of their tasks and inhibits the empowerment of the workforce.
- Unique ERP configurations for different divisions

H. Optimise master data.

This refers to the unreliability of input data to the MRP system. Such data

also become outdated. Unreliable data leads to poor MRP and eventually to non-optimal inventory levels and unhappy clients.

4.4.3.1.3 Step 3

The functions are placed in a matrix (Table 11) and judged against one another, in relation to the objective. In other words, which problem area has the larger negative impact on Materials management?

Table 11: Numerical evaluation matrix

Numerical Evaluation								Symbol	Function	Score	Ranking
A	B3	C3	A2	E3	F3	G2	H3	A	Measure Performance	2	7
	B	C2	B3	B2	F2	G1	H3	B	Manage Suppliers	8	4
		C	C3	C3	C3	C2	H3	C	Eliminate Unscheduled Maintenance	16	2
			D	E2	F3	G2	H3	D	Manage Redundant Stock	0	8
				E	F1	E2	H3	E	Manage Employees	7	5
					F	F2	H3	F	Overcome Shared-Service Challenges	11	3
						G	H3	G	Optimize ERP System (SAP) Configuration	5	6
							H	H	Optimize Master Data	21	1

The functions can be plotted as shown in figure 18.

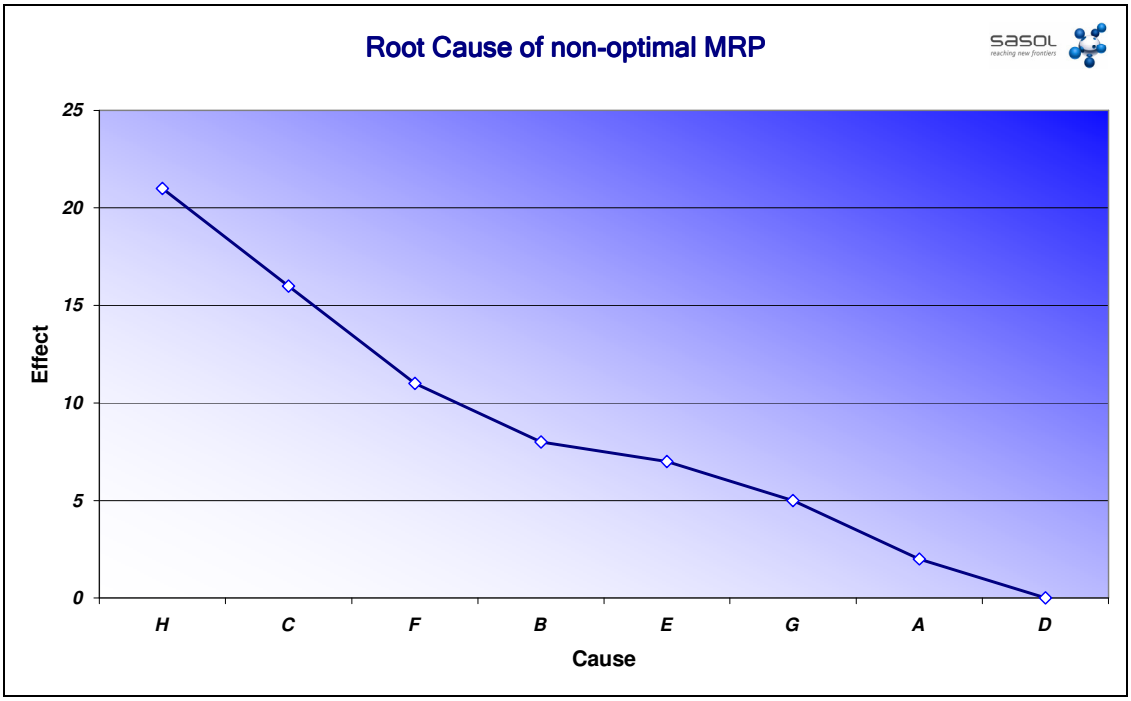

Figure 18: Root cause of non-optimal MRP

Functions H, C, F and B have the highest scores. The other problem areas carry much less weight than these four. Consequently, these problem areas are investigated in order to compile a complete and accurate current reality tree.

4.4.3.2 Current reality tree

The four functions that carried most weight in the VM prioritization were investigated in more detail and the final Cause-effect diagram that was compiled from the information gathered can be seen in Appendix C. An overview diagram can be seen in figure 19. The information needed to draw the diagrams was gained from interviews with Boyce, Auret, Steyl, Hughes, Oosthuizen, Van

Pletzen, Groenewaldt, Visser, Roets, Conradie, Vermaak, Potgieter, Fourie, Brummer, Horstman, Dicks, Greyling & Jordaan (2005). A second workgroup and individual interviews (Interviews, Boyce, Hughes, Oosthuizen, Brummer, Horstman & Esmaraldo, 2005) were held to ensure maximum accuracy and comprehensiveness of this reality tree.

From figure 19 the way in which all causes interact and are extended to the lowest level causes is evident.

Two main undesirable effects are experienced by Infrachem:

1 Inventory investments are above target percentages of ERV.
2 Customers are unsatisfied with services provided.

The only two elements that have an effect on inventory investment as a percentage of ERV are the ERV of the plant, and the actual investment in inventory. Since the ERV of the plant is a fixed entity, the tree is only extended through the inventory investment input.

Similarly, unsatisfied customers are created if inventory investment is high, unprofessional service is received or stock is unavailable when needed.

The eight areas identified and mentioned in the problem statement translate into eight undesirable effects:

A. Non-optimal Master Data.
B. Maintenance execution not co-ordinated with MRP.
C. Non-optimal Shared Services.
D. Supplier performance measured as below expectations.
E. Ineffective, inefficient employees.
F. Poor management of redundant stock.
G. Inadequate / under-utilised SAP MRP configuration.
H. Non-optimal / wrong KPI's.

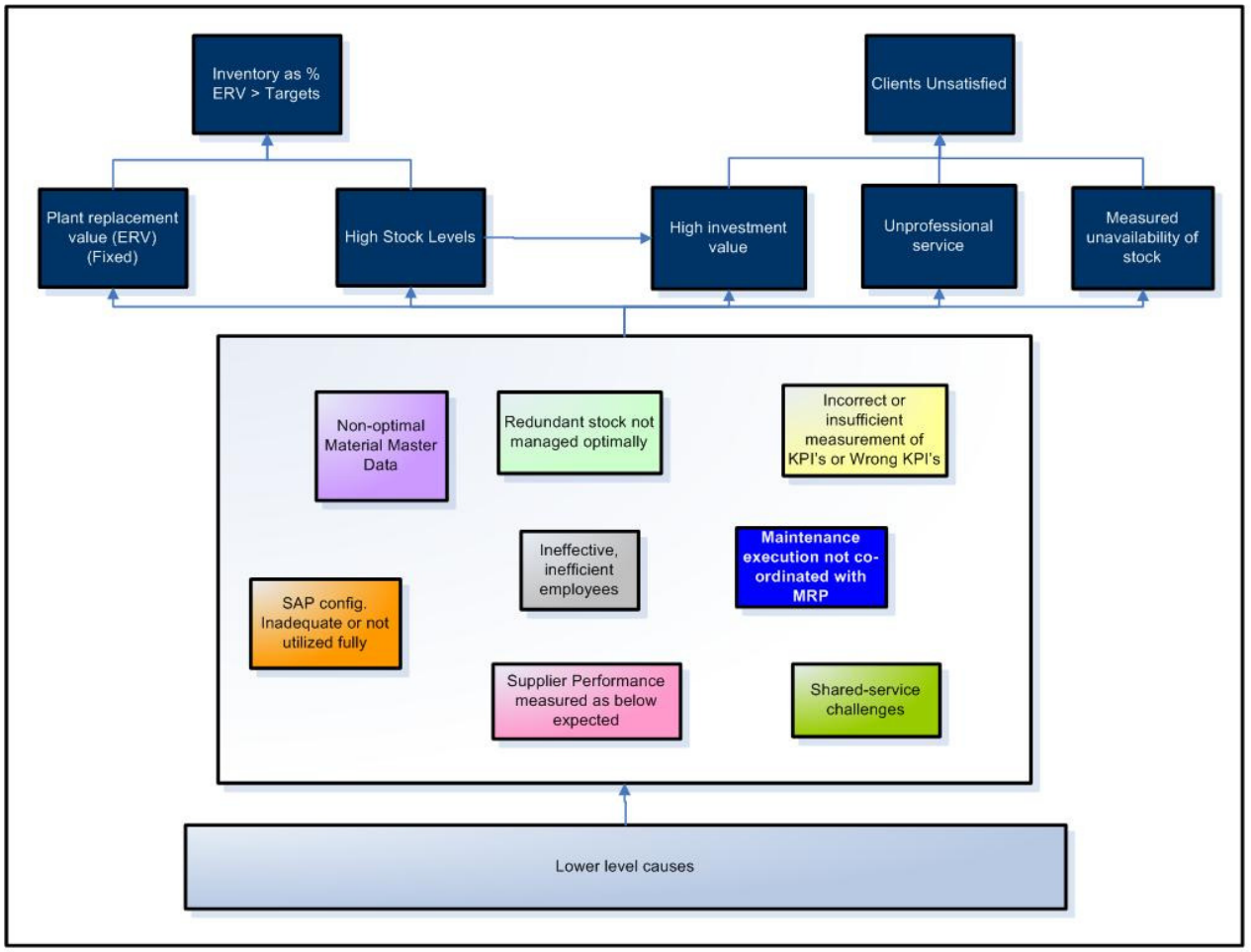

Figure 19: Basic current reality tree

Appendix C shows how these interact with one another and lead to the two main undesirable effects mentioned before, namely *Inventory Investments above Targets* and *Unsatisfied Customers*. The diagram is further extended by identifying the causes of these eight effects, in order to prove the lowest level causes:

- Centralization of the PSM function.
- Diverse, customised service offering.
- Business units are reluctant to relinquish control.
- Poor use and/or knowledge of best practices.
- Non-optimal business strategy.
- Poor translation of strategy into process.

These low-level causes were investigated in order to identify the evaporating cloud for the process.

4.4.3.3 Evaporating Cloud

A close study of the six main causes reveals that a conflict exists between the first two. Figure 20 illustrates the conflict in an evaporating cloud diagram.

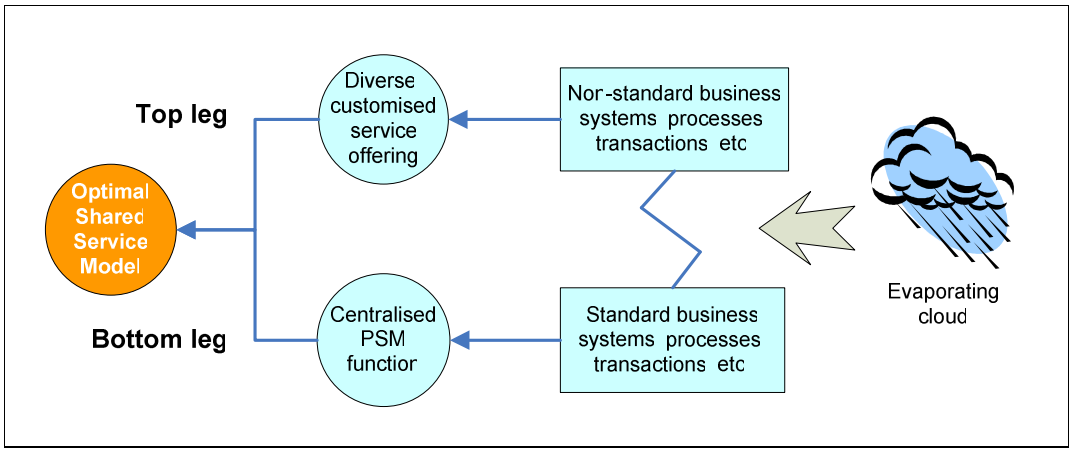

Figure 20: Evaporating cloud

Firstly, in order to justify the existence of the Shared-service model above a decentralised model, the unit must be customer oriented and services must be improved. The assumptions state that this is only possible through a diverse, customised service offering because each customer has a unique set of needs and all customers must be satisfied in all their needs.

Secondly, for a shared-services model to be feasible, costs must be reduced. For the lower leg, the assumptions state that this can be achieved through a centralised P&SM function, since it will eliminate duplicates, downsize employees, achieve economies of scale, create specialised knowledge and technology, and streamline processes.

Since a diverse, customised service offering requires non-standard business processes and transactions, while a centralised P&SM prompts standard processes and transactions, a clear conflict exists in the shared services environment.

This conflict resulted from a poor business strategy and a poor translation of this strategy to the operational level. SASOL started out as a hierarchical company with different independent departments. Since then, the company has divided into independent business units/divisions. Currently, SASOL is following the international trend to create interdependence between units by forming shared services centres for common functions such as HR and P&SM.

During the independent phase Infrachem acted as a service provider of gas and utilities. When the move to interdependence was prompted, Infrachem was the obvious choice for a shared services centre. Since Infrachem had previously performed P&SM functions for itself, they had standard documented ways of performing these functions. They proceeded to deliver common services in the “Infrachem standard” way. However, these processes did not support their customers’ strategies and lead to poor translation of strategy into process.

A lack of best practice in strategy and process results in BU's reluctant to relinquish control to Infrachem.

The root cause is therefore the conflict which exists in the shared services environment. This conflict results in a move towards standardized, rigid systems, processes and transactions, together with a drive to customize systems, processes and transactions for complete flexibility.

What impact does this root cause have on the problem of high inventory investment and low customer service levels? In order to answer this question, it is necessary to refer back to the reality tree and trace the root problem through the tree. The root cause blocks (Centralised P&SM and Diverse service offering) lead to three of the eight main problem areas: Ineffective, inefficient employees, Non-optimal shared services, and SAP configuration inadequate and not utilised fully. These all lead to high stock levels, high investment, unprofessional service and unavailable stock. These, in turn, lead directly to inventory levels above target %ERV and unsatisfied customers.

The root cause was verified through additional interviews with strategic employees (Dicks, Vermaak, Marylin, Suzette, Brummer & Lochner, 2005). In addition to this the literature supports the existence of a conflict in a shared services set-up: "Two distinctive features of shared services centres are:

- They offer a common service provision of routine and, sometimes, additional service.
- They are service-focused, enabling the customer of the shared services to specify the level and nature of the service" (CIPD, 2004).

The next step in the process thinking tools is the evaporation of the cloud (root cause).

4.4.3.4 Evaporation of the cloud

The solution to the root cause lies in challenging the assumptions made in the evaporating cloud. Once a statement is proven false, the conflict evaporates.

The assumptions made in the top leg are:

1 Each customer has a unique set of needs.

2 All customers must be satisfied in all their needs.

These assumptions are untrue because:

1 Customers needs can be grouped or categorised into a finite set of needs.

"This build-up of redundant systems was the result of "little fiefdoms" that cropped up in each of the operating companies" (Hoffman, 2005).

As pointed out by the excerpt and already stated in 2.5.4 *Pitfalls* bullet 4, each Business Unit develops into a "fiefdom" with its own hierarchy and processes. These translate into certain preferred ways of performing tasks, which the BU's regard as 'needs'. The end result is a collection of business units with non-standard processes, transactions and configurations. It is the responsibility of the shared services centre to distinguish between "fiefdom preferences" and "needed preferences". Once all the unnecessary preferences have been eliminated, the centre is left with a finite set of customer needs. In order to standardise its services in this way, the shared services centre must sell the customer on the selected *actual needs*. As stated at a shared service conference in 1998, "perception can be managed by basic marketing".

2 Emphasis should be on satisfying valued customers.

At the same conference, it was mentioned that "while all clients are important, not all clients are created equal". Hampton stated at the conference that "…in the real world, when you have customers that you do not like, you just triple the price or make them pay for a lot of add-ons. You do different things within the mechanism to force that customer to move

elsewhere. Those are the types of things you do internally because usually that customer is one of your smaller customers and they are eating up a lot of resources and are not paying their fair share. If you price them properly, either they will change their attitude or go elsewhere."

In order for this statement to make sense in the SASOL environment, "most valued" customers must be determined very carefully: customers must be rated through the use of evaluation criteria that are relevant for Infrachem and the impact on the SASOL Group as a whole must be considered.

By nullifying the assumptions in the top leg of the evaporating cloud, the conflict can be solved. The following statements outline the solution:

1 Determine the actual needs of the customers. If 'preferred needs' are detected, market the actual needs.
2 Determine the most valued customers.
3 Design a set of standard configurations, processes and transactions in a finite number of standard service offerings to satisfy a percentage of the most valued customers.
4 Increase mark-ups for non-standard requests (add-ons).
5 Put in place a strict acceptance procedure if non-standard services are to be recognised as standard.

The above-mentioned can be achieved through BPR. In other words, the cloud can be evaporated by means of a BPR project that can enable steps 1-5 listed above.

As mentioned in 2.5.4 *Pitfalls* bullet 10, the underutilization of BPR in the implementation of a shared services centre will possibly lead to failure. A second argument for BPR as the chosen solution is apparent from the history of SASOL Sasolburg.

As stated previously, when SASOL Sasolburg decided to create a shared services centre, P&SM functions were grouped and dedicated to Infrachem. At

that stage Infrachem was one of the many operational business units with its own support service functions. Consequently, Infrachem proceeded to perform the three selected services for all the IP cluster business units in exactly the same way it had executed the services for itself. Since the 'Infrachem way' was not compatible with all business unit environments, and since customers preferred their own methods, Infrachem shared services was forced to extend its services to an infinite set of non-standard transactions, processes and configurations. In order to cope with the extra workload, Infrachem needed more resources, and expenses rose until, recently, top management demanded a 20% saving from P&SM.

From this it is evident that processes, transactions and configurations must be defined and redesigned to streamline activities, save resources and satisfy customers. This is possible only through BPR.

Unfortunately, BPR is very costly and the ROI on such a project can only be seen after approximately 3 years. It is however the only option since processes, transactions and configurations are not only inefficient but also ineffective. P&SM can only be saved if they 'do the right things'.

The future reality tree is compiled in the next paragraph. This tree shows the effect gained from eliminating the root cause from the current reality tree.

4.4.3.5 Future reality tree

Refer to Appendix D for the future reality tree. The red arrows follow the path of influence of the root cause throughout the tree. In other words, if all arrows leading to an UDE (Undesirable Effect) are indicated in red, the UDE falls away. It is clear in the appendix that all UDE's within the scope of the study fall away. Most importantly the elimination of the root cause eventually leads to the

elimination of the two main UDE's, namely high inventory investment and unsatisfied clients. The future reality proves that if the root cause is addressed, the objectives of the dissertation will be achieved.

An overview analysis of the current Infrachem P&SM business processes and stakeholders enabled the analyst to compile the current reality tree. From this, the evaporating cloud and resultantly, the root cause of the majority of undesirable effects in the current reality tree could be isolated. With the root cause revealed a scoping exercise can be done for the study.

4.5 Phase 5: Scope and targets

4.5.1 Scale of the study

The scale of the study depends on whether the analyst will use incremental improvement techniques or follow a larger scale BPR approach. The argument under 4.4.3.4 states very clearly that BPR is the only improvement methodology that can address the Infrachem P&SM problem.

4.5.2 Prioritising of processes

The processes listed in 3.*1 Current SAP IP cluster MRO goods MRP business processes* were prioritised by rating them against the current reality tree undesirable effects in a matrix. (See Appendix E). The undesirable effects were each given a weight by calculating the vector total of an UDE's importance and its rate of ineffectiveness. If an UDE had an effect on a certain process, the vector total of the UDE would be added to the total score of the process. Table 12 and figure 21 show the outcome of the exercise.

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Table 12: Process prioritising

Process	Priority weight
Inventory management	25.60
Alteration to master data	18.34
New Material Registration	16.12
Issuing of materials	15.57
Deletion of materials	14.85
Deletion of equipment nr's	13.55
Registration of new eq nr's	12.92
Stock write-offs	12.55
Alteration of eq nr's	12.49
Distribution of materials	12.35
Receiving of materials	11.29
Linking + unlinking of BOM's	11.09
Reconditioning	9.86
Quality assurance	9.72
Perpetual inventory	9.71
Binning and preservation	9.03

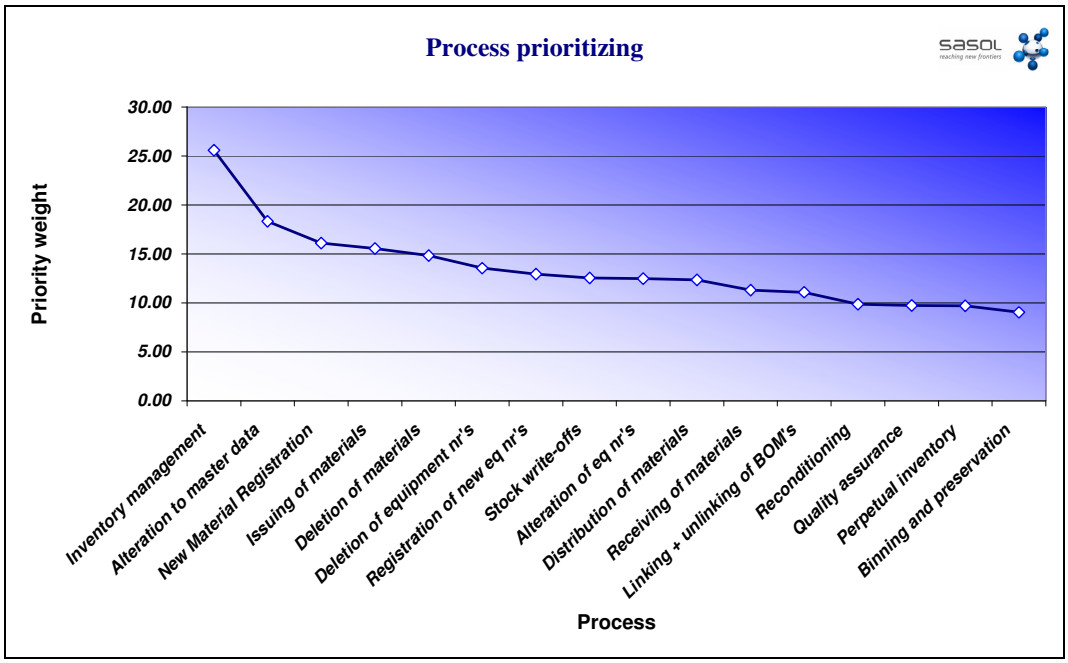

Figure 21: Process prioritising

The first five processes are ranked as follows:

1 Inventory management
2 Alteration to master data
3 New material registration
4 Issuing of materials
5 Deletion of materials

Due to the following reasons, the scope of the next steps will be limited to priority number 4 – Issuing of materials:

- This process includes a direct interface with the client that the other processes lack. Since the evaporating cloud is so closely related to the service provider-customer relation, a process showing the direct link between the two will add more value to the study.
- The resources available for the study complement the study of the above mentioned process – issuing of materials.
- The time constraints dictate that the complexity of the chosen process is limited and the issuing of materials complies with this requirement.

4.5.3 Study objectives

The study objectives have already been stated under 1.2 *Problem statement*. In order to reach these objectives, all processes must be addressed and the evaporating cloud eliminated. It has already been shown in the future reality tree to what an extent the elimination of the root cause improves inventory investment and customer satisfaction. For the purpose of the study, the aim is to illustrate how the cloud can be evaporated in a single process. The objective of the pilot run is therefore to evaporate the cloud in the issuing process.

4.5.4 Change management

All employees are despondent, unmotivated and demoralised. Figure 17 clearly shows the need for a drastic change in individual attitudes and consequently, cultural change. By referring to table 1 in Appendix M, it is evident that the need for a change in attitudes, combined with the substantial change expected from the BPR process, will require change management before, during and after the BPR initiative.

The change management before the start of BPR involved interviews with all relevant parties. Post BPR change management will ensure the sustainability of the changes brought about by BPR.

The initial review allowed the analyst to scope the study. The next step is the detail analysis of the priority process identified.

4.6 Phase 6: Analysis

4.6.1 The current stock issuing process

Figure 22 is a simplified version of this process flow. It is essential to understand the process flow in more detail. Refer to Appendix F for the detail process flow of the stock issuing process. When a material need is experienced, the client can enter this need into the SAP system in various ways as illustrated in table 13.

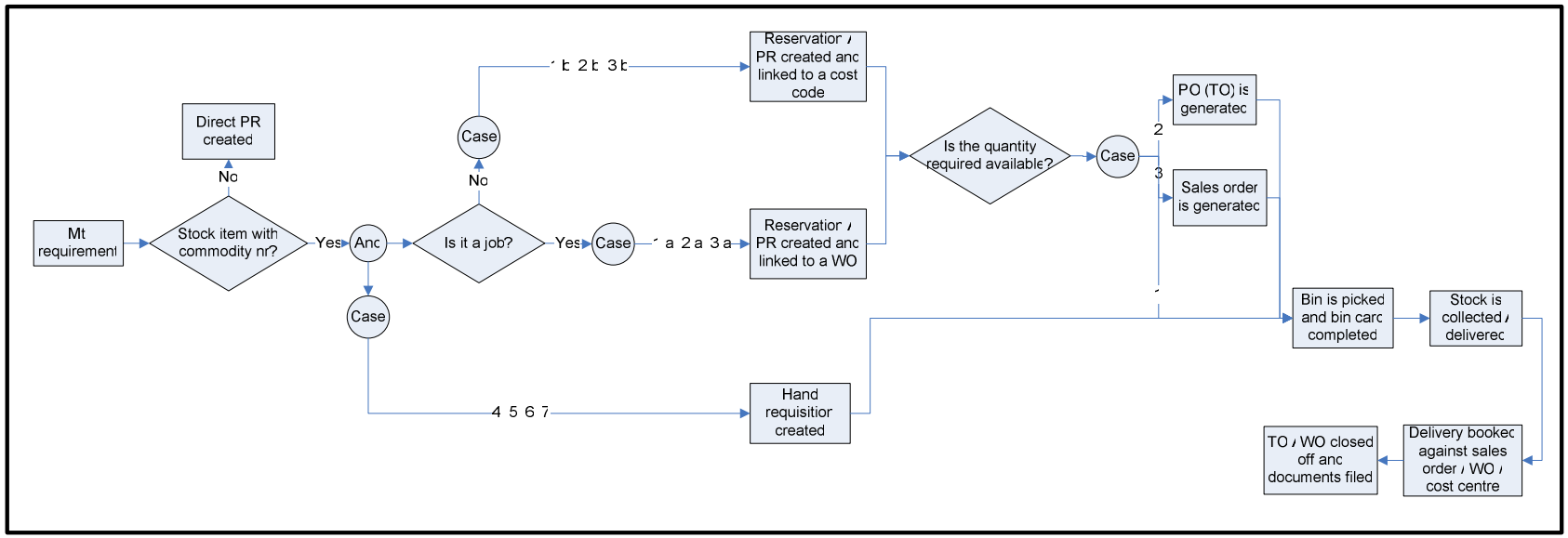

Figure 22: Simplified version of the current stock issuing process

Table 13: Stock request methods

Case	Client system configuration	Plant specific stock / Generic stock	Transaction
1	Infrachem SAP box and plant nr	Generic	Reservation
1		Plant specific	Reservation
2	Different SAP box	Generic	PR
1		Plant specific	Reservation
3	Different plant nr.	Generic	PR
1		Plant specific	Reservation

The stock can be drawn against a WO (Works Order) or a cost centre. If a WO is created, reservations and PR's are linked to the WO and payment is made by changing purchases against the WO number. (Cases 1.a, 2.a and 3.a). If stock is charged against a cost centre, the client will create a reservation or PR with reference to the cost code. (Cases 1.b, 2.b and 3.b).

If a hand reservation is made for case 1, it becomes a case 4 transaction. If a requisition is made for cases 2 and 3, these become cases 5 and 6 respectively. Sub-contractors also make use of hand requisitions (case 7) and these are charged against customer numbers.

Clients have the functionality of a BOM at their disposal to search for stock items. The BOM is printed and required items are entered onto the WO, reservation or PR.

If a commodity number cannot be found for an item, the goods must be purchased from an external vendor via a PR. These PR's are handled by the procurement department. If a generic item is not extended to a certain plant, the users of that plant cannot purchase the item.

Sometimes such extensions are not updated or correct. Users are consequently unable to find the commodities on their stock list. In such cases, as soon as the problem is picked up, the extension must be made by the master data team.

In certain cases, users do not make use of the stores for generic items at all. The store stock lists are not consulted and such items are purchased from external vendors.

If the user finds a commodity number for the required item and the item is a non-stock item (for example vendor held stock), the unit is also purchased externally. Sometimes it goes unnoticed that the item is a 'no-planning' unit and the user places an order for it at the store. If this happens, the user may either be prompted by SAP, or the order may go through and only be noticed by the administrative issuing clerk.

In the event of the client finding the item that he/she requires and the item existing as a stock unit, the client must verify that the quantity required is available. If not, the spares co-ordinator has to check for availability of stock in QA (Quality Control). If the item is located in QA, the item must be received on the system before it may be issued. In certain cases this order of proceedings is not followed and leads to inaccurate data on the SAP system.

If an order is placed for an unavailable stock unit, the system will automatically generate a backorder. Sometimes the client purchases the item from an external vendor after an order is placed, to ensure the shortest possible lead time.

Before completing reservations, WO's or PR's, the delivery option must be accepted or rejected.

If a case 3 client creates a PR, the system will automatically convert it to a TO (Transport Order) in the Infrachem system.

If a case 2 or 3 client creates a PR, the PR must be authorised before being converted to a PO (Purchase Order) by a buyer.

The user is obliged to inform the administrative issuing clerk of his/her reservation, WO or PR. This can be done in the following ways:

- The clerk can be phoned with the transaction number after which he/she

will print it.

- The transaction number can be handed to the clerck personally after which he/she prints it.
- The client prints the order personally and takes it to the administrative issuing clerk.

(If the client ordered a plant specific item and he/she is on another box or plant number, the order must be printed by the client – the admin issuing clerk does not have access to print it.)

When materials arrive at the store, the list of open orders is used to check if backorder items have arrived. If this is the case, the order is printed for issuing.

Open reservation lists are drawn from the system. This cannot be done for clients on other boxes – in these cases, it is the responsibility of the client to draw lists and forward them to the issuing clerk.

Printed orders are given to the operations issuing clerk to pick bins. This clerk first accesses SAP for more information on the items in order to prevent inaccurate bin picking. Once an item bin has been located, the quantity picked and the balance of stock on-hand are entered on the bin card (this only happens in the small items store).

If the system reflected availability of an item and the bin picker discovers that the actual quantity on-hand does not correlate with that on the system, a technical officer attempts to find a similar item to supply in place of the unavailable one. If such an item is found, the original order must be adjusted. This is not always done and data is consequently corrupted.

Once all stock units have been picked for a certain delivery note, the client signs the note as proof of delivery/receipt. This document is returned to the administrative issuing clerk where the issue is entered into the system by booking the delivery note.

If the client is on another SAP box, the administrative issuing clerk creates a sales order on the Infrachem system.

As soon as the delivery note completes an order, the order can be closed off.

All hard copies are filed.

As mentioned under 4.4.3.4, the designer can only 'evaporate' the 'cloud' if he/she has identified a standard set of needs for all customers. This leads to a stakeholder analysis.

4.6.2 Stakeholder analysis

The two most important stakeholders for the issuing process are the customers and the employees.

A collaborative session was held where both Infrachem employees and clients were present. The clients and employees are operational level workers; operational employees are directly involved with the process and are therefore the only employees qualified to comment on the needs addressed by the process. Bottom-up communication is not often enabled or encouraged in SASOL, which is partly to blame for the process being ineffective.

The following parties were present:

- K. Steyl (Infrachem employee: MRP controller and technical SAP specialist).
- M Behr (Infrachem employee: Administrative issuing clerk).
- J Serero (Infrachem employee: Operations issuing clerk).
- Francois Hattingh (Client: Nitro employee).
- John Eloff (Client: Solvents employee).
- Hennie Greyling (Client: Polymers employee) (Steyl *et al.*, 2005).

After a short discussion of the "AS-IS" process (explained in the previous paragraph) each participant was asked to list five personal needs that the issuing process has to comply with. These were listed and briefly discussed.

The attendants voted to prioritise the needs. Initially, they voted with a "customer hat on", which forced Infrachem employees to look at the process from the viewpoint of the customer. After this, they voted with an "Infrachem employee hat", which gave customers insight into the needs of Infrachem for the process. Table 14 is a list of the needs and the number of votes each received.

The first interesting observation is the fact that customer and employee needs are very much the same: needs mostly received both client and employee votes. Secondly, the three representatives from three different client business divisions expressed identical needs. This proves that the assumption made in the top leg of the evaporating cloud - customers have unique needs - is untrue. It makes it unnecessary to serve only valued customers, since the assumption can be made that the other customers have these same needs.

The top five needs are:

1 Simple, standard procedures and systems.
2 Accurate, real time SAP MRP data.
3 Master data descriptions - understandable, logical and standard.
4 SAP training for Infrachem employees.
5 Necessary authorisation in place (empowerment to do my job).

The top need is irrevocable proof that the evaporating cloud exists! By ranking standard processes and systems as their most critical need, customers and employees have illustrated the conflict between a drive for standardization and a need for customization.

After a standard set of needs have been compiled, the designer is enabled to design a standard process to address these needs.

Table 14: Needs specified for the stock issuing process

Need	Customer score	Infrachem employee score	Total
Simple, standard procedures and systems	4	6	10
Accurate, real time SAP MRP data	6	2	8
Master data descriptions - understandable, logical and standard	3	3	6
SAP training for Infrachem employees	3	3	6
Necessary authorisation in place (Empowerment to do my job)	2	3	5
Backorders print automatically for issuing once items are received at the store	1	4	5
Deliver world-class service - meet customer needs	2	2	4
Control over the accuracy of orders	1	2	3
SAP training for customers	1	2	3
Communication of changes	2	1	3
Friendly service and attitude	2	0	2
Tracking of reservations / orders (workflow function)	2	0	2
Paperless system	1	1	2
Optimal MPR (Balance inventory investment and availability of stock)	0	1	1
Leadtime (delivery within 24 hours)	0	1	1
Client must be available to receive deliveries	0	0	0
Effective preservation	0	0	0
Functionality to book stock out on a loan basis	0	0	0
Confirmation of receipt of orders / reservations at issuing clerk at store	0	0	0

A change management technique suggested for the following phase is to complement the top-down engineering by bottom-up empowerment. This was done by asking the participants of the meeting to brainstorm ideas on how to achieve the top five goals. From these ideas the new, improved process was designed.

4.7 Phase 7: Design

During the design phase the 'cloud' must be 'evaporated' by designing a standard process to address the standard set of needs identified in the analysis phase.

The ideas generated in the previously mentioned collaborative session were benchmarked against the Synfuels stock issuing process. Refer to Appendix G for the works instructions for this process. Figure 23 shows a simplified version of the new stock issuing process flow.

It is necessary to discuss the process in more detail. Refer to Appendix H for the detailed version of the newly designed stock issuing process. In the new design, the request for materials by clients is standard for all. This can only be done if all stock is transferred to Infrachem books and all transactions are execute on the Infrachem ERP system.

The client enters the P&SM portal and creates a reservation against a WO or a cost centre, depending on the method in which he/she wants costs to be recovered. In the portal, the client can enter commodity or equipment names or numbers into the search engine in order to find the items required. For equipment numbers, BOM's are available to lead the search.

If the item cannot be found, it means that no commodity number exists for the unit, and it must be purchased externally, via the procurement department. Alternatively, if the unit's commodity number is discovered, the end user can select the item for purchase from the store.

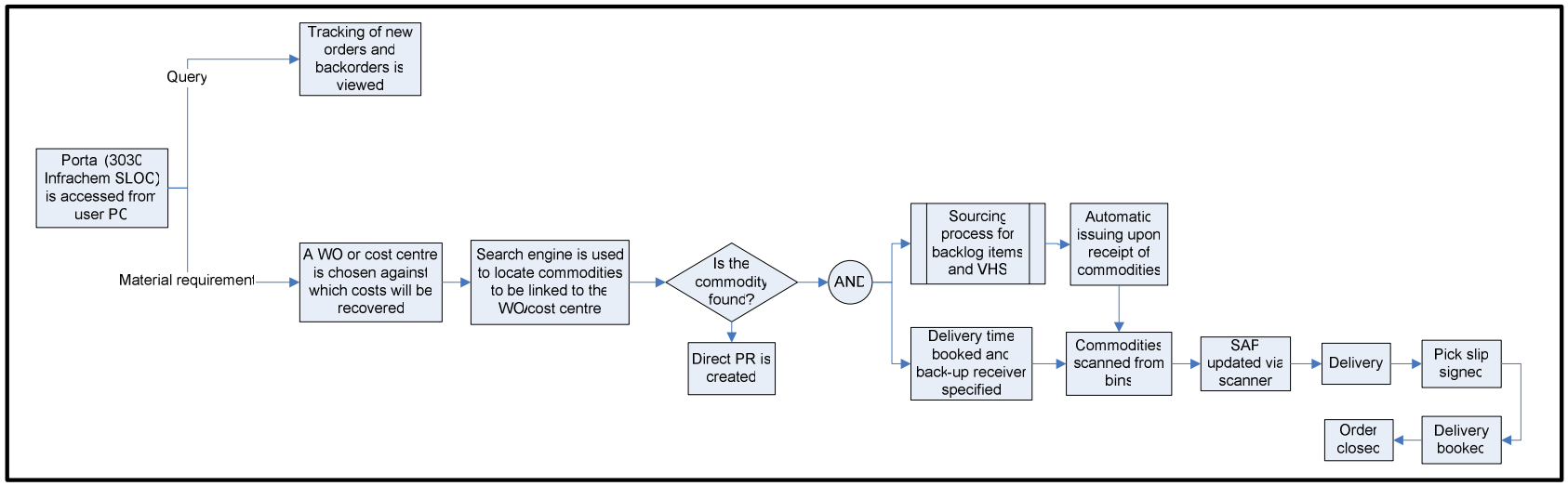

Figure 23: Simplified version of the new stock issuing process

Once all the required items have been selected, the user exits the search engine and views his/her order summary. The order summary will display the following information:

- Stock Commodities
- VHS (Vendor Held Stock) commodities
- Backorders
- Price

If the user is satisfied, s/he selects the 'buy' option. A delivery time, which is later than the agreed lead time of the stores, is specified. This time is booked out as a meeting in the client's Outlook calendar. In addition to this, the end user is compelled to specify a substitute person to receive goods if s/he cannot be located upon delivery.

Once the 'buy' option has been selected, SAP will initialise sourcing for any backorder and VHS items. Parallel to this, the system will automatically print an order (which acts as a picking slip) at a general point for storemen to receive.

Once backorder or VHS items are scanned upon arrival at the store, SAP will pick up that they are backorder or VHS stock, and will automatically print orders (that act as picking lists) at a general point for storemen to receive.

A storeman will locate the bins and scan items for issuing. In addition to this, the storeman will update the bin card with the date, the quantity picked and the balance left in the bin.

Once all the items have been picked, the storeman places his scanner in the cradle, which allows the system to update itself. Once the stock controller has checked the goods for accuracy against the pick list, the storeman places the stock and pick list in the lay-down area, ready for delivery.

If the quantity picked is not equal to the quantity stated on the order, the storeman is flagged. If the quantity promised by the system is not available in the

bin, SAP will automatically print proof of the discrepancy in the form of an order with the actual quantities picked. The storeman must hand the form to the stock controller, who will ensure that the system data is updated. SAP will then automatically generate a backorder. The picked stock and the pick list can now be placed at the lay-down area, ready for delivery.

Once the goods are ready for delivery, the client is contacted to confirm the delivery time. Goods are then transported to the customer, where his/her permit is scanned upon receipt. The end-user signs the picking slip, which is returned to the store and filed by the storeman.

Upon return to the store, the storeman places the scanner in its cradle and the system is updated. SAP books out the delivery and if the order is complete, SAP closes the order.

Stock controllers draw open order lists routinely and follow them up if lead times extend past acceptable periods.

If there is SAP or scanner downtime, the hand-reservation system of the old system will be followed.

The stores will allocate space for an ‘issuing café’ where there will be PC’s and assistants available to assist end-users in placing reservations for stock. This centre will especially be helpful when sub-contractors want to place requests for stock.

The new system will result in numerous improvements and address the needs of the stakeholders. The needs addressed in the new process are listed in the next paragraph.

4.7.1 Stakeholder needs addressed in the new process

1. Simple, standard procedures and systems.

   The new process is completely standard for all participants and users of the process.

   1.1. All customers enter a request for stock items in exactly the same way by simply creating a reservation. This will be possible if all stock lies on Infrachem's books. Plant specific and generic stock are accurately divided and distinguished. (Accurate classification of criticality of stock will prevent over-investment). No distinction is made based on the source of the reservation – instead all reservations follow the same procedure, from creation to delivery of goods.

   1.2. Clients no longer have an assortment of ways in which to inform the issuing clerk of their request. Reservations are automatically printed at the stores once the 'buy' option is clicked.

   1.3. Infrachem employees no longer have access problems with regard to backorders. Backorder lists are drawn routinely.

2. Accurate, real time SAP MRP data.

   The new scanning technology ensures a constant update of system information. For example, storemen will not be able to issue stock directly from QA, prior to the receipt of the goods on the system, because scanning upon issue will flag an error. Also, storemen will not be able to pick the wrong items, because the system will once again flag an error.

3. Master data descriptions - understandable, logical and standard.

   Since all stock lies on Infrachem's books, there is an opportunity to standardise descriptions and numbers of commodities. The search engine will be designed in such a way that any user will be able to track down commodities with terms and numbers understood by him/her.

4. SAP training for Infrachem employees.

   The new process can only be implemented with adequate training for employees (and customers).

5. Necessary authorisation in place (empowerment to do my job).

   Authorisation problems fall away with the new process: Infrachem employees do not have to access client systems, since all stock now lies on Infrachem books and requests for stock are all done via reservations. In other words, there is no need for inter-systems communications, because all issuing transactions are executed in one SAP box.

   Plant extensions will not be required for generic stock items, which will eliminate the problems that occur when such an extension has been omitted.

6. Other needs.

   6.1. Backorders print automatically for issuing once items have been received at the store.

   6.2. Control over the accuracy of orders.

   6.3. One of the needs specified by the end users of the issuing process was the ability to track their orders and backorders. This will be possible with the new scanning technology. Users will be able to enter the P&SM portal and select the tracking option which allows them to view at which of the following stages an order is:

   - Expected date of arrival of backorder stock.
   - VHS or backorder stock has passed QA.
   - Order has been printed at the stores.
   - Stock has been picked.
   - Stock has been delivered.
   - Order has been closed.

   The new scanning system ensures control over the accuracy of picking.

In addition to this, all orders are checked by the stock controller before delivery.

6.4. Paperless system.

The scanning system reduces the use of paper drastically.

6.5. Once all stock is on the Infrachem ERP system, Infrachem will have full visibility of inventory dynamics. This will provide them with the business intelligence to do effective and efficient inventory optimisation. In addition to this, they will finally be able to capitalise on synergistic opportunities across business units, for example economies of scale and elimination of duplicates.

As mentioned in 4 *Solution*, increased mark-ups for non-standard requests (add-ons) have to be demanded of the process. A strict acceptance procedure will be put in place to evaluate which non-standard services should be recognised as standard.

4.8 Phase 8: Implementation and evaluation

Due to practical limitations, as mentioned previously, the implementation of the newly designed process will not be included in the study. However, the following implementation suggestions and challenges are applicable:

- SAP related issues
  - Remove the MM modules from the ERP systems of the customers
  - Transfer and standardise the MRP master data of all the MM modules in the Infrachem MM module. Data must be easily understood by all users.
  - Link the different SAP boxes in such a way that the customer box can register purchases made on any of its cost codes.

  - Develop an Infrachem e-procurement portal.
  - Establish a master data management system / centre to ensure the continuous update and integrity of data.
- Change management issues
  - Acquire buy-in from customers and Infrachem to take on newly defined roles in which Infrachem must carry all stock on their financial system and will be held responsible and accountable for MM functions, while customers must relinquish control of their MM functions.
  - Infrachem must establish the capacity and competencies required to do MM across business units (and effective inventory optimisation).
  - Customers must be trained in the use of the portal.
- Other issues
  - A financial model must be designed in which Infrachem is reimbursed for carrying all inventory.

This dissertation paves the way not only for further improvement in the Infrachem P&SM environment, but also in the shared services industry as a whole. The study is concluded in the next chapter by summarising the findings. Future steps to be taken and potential contributions of the study (to the body of knowledge and to the industry) are suggested.

5 Conclusion and recommendations

A study of the P&SM MM department at the hand of TOC thinking process tools lead to the discovery of the root cause: the conflict between a drive for standardization and a simultaneous need for customization.

An analysis of the evaporating cloud proved that the cloud could only be evaporated if all processes, systems and transactions were standardised. This could be done by:

- identifying the standard set of needs of the customers, and
- prioritising the needs by identifying the valued customers.

Standardization of the design could be improved by charging extra mark-ups for non-standard requests, and initialising a strict acceptance procedure for requests for non-standards to be accepted as standard.

As stated in 2.5.4 *Pitfalls*, “Simply pulling processes together in a central hub is unlikely to deliver a more streamlined, customer-driven service. Moving to a shared services provision requires a fundamental re-engineering of processes.” (CIPD, 2004). This lead to the understanding that the solution above could only be achieved through the use of BPR.

A trial run for the stock issuing process was completed to test the BPR solution. During the analysis phase, the top-down engineering was complemented with a bottom-up empowerment. Employees and customers on an operational level were drawn together in a facilitated session. The customer representation, combined with the employee input ensured a collaborative group dynamic between the most important role players of the process.

Three interesting discoveries were made:

1 The needs of the various customer representatives were almost exactly the same. This proves that the statement made in the top leg of the evaporating

cloud - all customers have unique needs - is false.

2 The needs that clients and the customers have for the stock issuing process proved to be almost identical. This strengthens the argument that a standard process can be designed, since the needs that the process has to address are not diverse.

3 The most important need identified in the session was: 'simple, standard procedures and systems'. This proves the existence of the evaporating cloud by illustrating the conflict between a drive for standardization and a need for customization.

The standard set of needs for the stock issuing process lead to the design of a simple, standard process. The design was made collaboratively, with the input of both customers and Infrachem employees. The implementation of the design will not be included in the study, but the foreseen challenges are recorded. However, the *future reality tree* predicts the improvement that the elimination of the cloud in the P&SM MM processes will have on both inventory investment and customer satisfaction.

The author recommends that the processes listed in 4.5.2 be addressed in a similar fashion, in the order suggested in 4.5.2.

The study has the following to contribute to the industry:

1. This SASOL specific study has illustrated how the TOC process thinking tools can be applied as a creative problem solving methodology. A current reality tree can speedily lead an analyst to a root problem, which can be solved by means of an evaporating cloud study.

2. Process theory dictates that the root cause present in the Infrachem P&SM shared services centre is also at the root of many problems experienced in other shared services centres. All companies utilising the shared services model will experience the conflict between a push towards standardization and a constant pull towards customization. The second contribution,

therefore, of this study to the industry is that it establishes the methodology to follow if a company is experiencing non-optimality with a shared services model. Such a methodology will include the initiation of a BPR study in which the analysts will follow the steps listed in 4.4.3.4. This will be done in collaboration with the customers, while driving the redesign of the processes from the bottom up.

To conclude, this study has lead to an approach in which various theoretical models were consolidated to form a methodology that is innovative, effective and practical for companies aiming to optimise their shared services centres.

References

Accenture. (2004). *Finance and Performance Management: Creating and Operating an Effective and Equitable Shared Services Chargeback Framework*. Retrieved September 28, 2005, from the World Wide Web:http://a456.g.akamai.net/7/456/1701/03f8b8671b6070/www.accenture.com/xdoc/en/Services/Finance/fpm_sspov_creating.pdf.

Akkermans, H.A., Bogert, P., Yucesan, E. & Van Wassenhove, L.N. (2003). *The impact of ERP on supply chain management: Exploratory findings from a European Delphi study*. European Journal of Operational Research, 146, 284-301.

Al-Mashari, M., Irani, Z., Zairi, M. (2001). *Business Process reengineering: a survey of international experience*. Business Process Management Journal, 7.5, 437-455.

Anonymous, Interview, (20 March 2006). *Change readiness*.

Astro Tech Projects and Systems Engineering course. (2005). *Business Process Re-engineering*.

Bergeron, B. (2003). *Essentials of Shared Services*. New York: John Wiley & Sons Inc.

Boyce, C. (2005). *PSM Functional Organigram Oct 2004.*

Boyce, C. (2005). *Main summary of inventory as at 31 March 2005.*

Boyce, C. (7 Jan 2005). Interview. *Masters degree topic and background.*

Boyce, C., (13 April 2005), Auret, S., (19 May 2005), Steyl K., (19 May 2005), Hughes, K., (19 May 2005), Oosthuizen, E., (20 May 2005), Van Pletzen, H., (26 May 2005), Groenewaldt, W., (26 May2 005), Visser, J., (26 May 2005), Roets, F., (27 May 2005), Conradie, F., (27 May 2005), Vermaak, P., (22 June 2005), Potgieter, J., (22 June 2005), Fourie, F., (23 June 2005), Brummer, J., (23 June 2005), Horstman M., (23 June 2005), Dicks, L., (23 June 2005), Greyling, H., (24 June 2005) & Jordaan, H., Interview, (6 July 2005). *Information gathering for current reality tree.*

Boyce, C., Hughes, K., Oosthuizen, O., Brummer, J., Horstman, M. & Esmaraldo T. Interview. (10 August 2005). *Confirmation of current reality tree.*

Boyce, C., Steyl, K., Auret, S., Vermaak, H.,Hughes, K., Vermaak, P., Oosthuizen, E. Interview. (25 March 2005). *Problem areas in the IP cluster environment.*

Chase, R.B., Jacobs, F.R. & Aquilano, N.J. (2004). *Operations Management for Competitive Advantage*, 10th ed. New York: McGraw-Hill Companies Inc.

CIPD (Chartered Institute of Personnel and Development) (Author not provided). (2004, November). *HR Shared Service Centres*. Retrieved September 28, 2005, from the World Wide Web:http://www.cipd.co.uk/subjects/hrpract/general/hrshrscen.htm?IsSrchRes=1&cssversion=printable.

Crowe, T.J., Fong, P.K., Bauman, T.A., Zayas-Castro, J. (2002). *Quantitative risk level estimation of business process reengineering efforts*. Business Process Management Journal, 8.5, 490-511.

Deloitte Consulting (Author not provided), (2004). *Shared Service Centres.* UK Trade and Investment.

Dewey, T. (2001). Acumen Alliance Shared Services. *Managing Cultural Change in a Shared Services Centre Environment.* Retrieved September 28, 2005, from the World Wide Web:http://www.acumen.com.au/Sharedservices /article_cc.htm.

Dewey, T. (2001). Acumen Alliance Shared Services. *Managing Customer Expectations in a Shared Service Centre Environment.* Retrieved September 28, 2005, from the World Wide Web:http://www.acumen.com.au/sharedservices/ article_ce.htm.

Dicks, L., (27 Sept 2005), Vermaak, P., (28 Sept 2005), Marylin & Suzette, (30 Sept 2005), Brummer, J., (30 Sept 2005) & Lochner, T., (30 Sept 2005). Interview. *Root cause verification*.

DNA Supply Chains (2002). *Integrated Supply Chain Management – A supply chain management course aimed at giving companies the competitive advantage.*

Sasol (Author not provided), (2003, February). *Explore Sasol – business overview*. Retrieved October 19, 2006, from the World Wide Web: *http://www.sasol.com/sasol_internet/ frontend/*navigation.jsp?navid=700003&rootid=2.

Fogarty, D.W., Blackstone, J.H. & Hoffmann, T.R. (1991*). Production and Inventory Management* (2nd ed.). Ohio: South-Western Publishing Co.

Fourie, K. (2003). *Planning of Product Realization for inventory management*.

Fourie, K. (2003). *Planning of Product Realization for stock optimization (write-offs).*

Fourie, K. (2003). *Planning of Product Realization work instructions for inventory management.*

Fourie, K., (2003). *Planning of Product Realization work instructions for write-offs.*

Fry, E. (1998, November). *Shared Services, Private Headaches*. Retrieved September 28, 2005, from the World Wide Web:www.cfoasia.com/archives /9811-36.htm.

Goolam, O. Interview. (2006). *August 2006 Business Development report.*

Hoffman, T. (2005, July 25). *Farewell to Fiefdoms.* Computerworld, 42. Infrachem P&SM Value chain, Retrieved March 20, 2006, from the SASOL intranet: *Http://intwww.SASOL.com/SASOLinfrahcem/Body.asp?Body* ID1073&ID=1073.

Johansson, H.J., McHugh, P., Pendlebury, A.J., Wheeler III, W.A. (1993). *Business Process Reengineering – Breakpoint strategies for market dominance.* England: John Wiley & Sons Ltd.

Kanawaty, G. (1992). *Introduction to Work Study* (4yh ed.). Cape: Clyson Printers.

Malhotra, Y.M. (1998). *Business Process redesign: An Overview*. IEEE Engineering Management Review, 26.3.

Marjanovic, O. (2000). *Supporting the "soft" side of business process reengineering.* Business Process Management Journal, 6.1, 43-53.

Mergy, L.,& Records, P. (2000, June). *Unlocking Shareholder value from Shared Services.* Strategy and Leadership, 29.3, 19-22.

Narayanan, V. K. (2001). *Managing Technology and Innovation for Competitive advantage.* New Jersey: Prentice-Hall.

NCC Blackwell. (1994). *The BPR Handbook – A practical guide to business process redesign.* England: H. Charlesworth & Co. Ltd.

Page, C. & Meyer, D. (2000). *Applied research design for business and management.* Australia: McGraw-Hill Book Companies Australia Pty. Limited.
Potgieter, J., (12 Feb 2005). Procurement for the IP cluster.

Proceedings of the shared services conference, (1998). *Shared Services: Achieving Higher Levels of Performance.*

ProQuest (Author not provided). (2005, June). *Reengineering*. Management Today, 24.

Reilly, P. & Williams T. (2003). *How to get best value from HR: The Shared Services Option.* Burlington: Gower Publishing Company.

Rizzo, T. (1996). *The Theory of Constraints.*

SAP (Author not provided), (1996). *Functions in Detail – PP; R/3 System; Integrated Manufacturing.*

SASOL Infrachem (Author not provided), (2005). *Inventory Strategy for SASOL Group of Companies, May 2003.*

SASOL's group communication and brand management department (Author not provided), (2004). *SASOL facts 2004*.

SM Thacker & Ass (Author not provided). (2000, April). *Focussed Improvement Systems – A development of TQM and Kaizen.* Retrieved November 22, 2005, from the World Wide Web: http://www.smthacker.o.uk/focused_improvement_ *system.htm.*

Smith, H. & Fingar, P. (2002). *The third wave.* Florida: Meghan-Kiffer Press.

Steyl, K., Interview. (20 Feb 2005). *MRP on SAP*.

Steyl, K., Behr, M., Serero, J., Hattingh, F., Eloff, J., Greyling, H., Interview. (30 March 2006). *Needs of the stock issuing process.*

Tony Arnold, J.R. (1991). *Introduction to Materials Management.* New Jersey: Prentice-Hall.

Van Zyl, Hamman, Greyling, Smit, Da Silva, Bester, Du Preez, Hattingh, Kruger & Marx. Interview. (10-20 March 2006). *Stakeholder analysis.*

Vermaak, P. Interview. (20 Feb 2005). *Population of new Materials on SAP*.

Visser, R. Interview. (7 Feb 2005). *Masters degree topic and background.*

VM Services (Author not provided), (1992). *Functional Thinking module of Innovative Decision Making through Value Management.*

Vollmann, T.E., Berry, W.L. & Whybark, D.C. (1997). *Manufacturing Planning and Control Systems* (4th ed.). New York: Irwin/McGraw-Hill.

Wilson, D. A. (2005, April). Learning to Share. *American City and County*, 120.4, 30-30.

Boyce, C., Auret, S., Hughes, K., Oosthuizen, E., Steyl, K., Vermaak, P. Workgroup. (2 April 2005). *Weighting of key problem areas for the IP cluster*.

Yung, W., K. & Chan, D., T. (2003). *Application of value delivery systems (VDS) and performance benchmarking in flexible business process reengineering*. International Journal of Operations & Production Management, 23.3, 300-315.

Zhang, Q. & Cao, M. (2002). *Business process reengineering for flexibility and innovation in manufacturing.* Industrial Management Data Systems, 102.3, 146-152.