OVERVIEW OF PROCUREMENT NEED SPECIFICATION AND THE ORGANISATION OF SUPPLY CHAIN PROCESSES TO FULFIL CUSTOMERS' NEEDS IN SOUTH AFRICA

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Abstract

The article focuses on the procurement need specification of goods to support the operations of organisations, and how product supply chain processes are organised to fulfil customers' procurement needs. Ten methods of procurement need specification for business purposes are dealt with. Product supply chain processes are executed as either 'push' or 'pull', or 'push-pull' oriented. Each of the approaches is discussed. Summaries of (a) the characteristics of the push and pull portions of supply chains; and (b) the spectrum of supply chain responses to customer demands are supplied.

Keywords: Procurement Need Specification, Pull-Based Supply Chain System, Push-Based Supply Chain System, Push-Pull-Based Supply Chain System

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1. Introduction

For a manufactured product to reach the market, all or some of the constituent parts for its processing need to be acquired through procurement transactions. It is evident, therefore, that procurement is an indispensable function within the supply chain of all finished products. The article focuses on the procurement of goods to support the operations of organisations, and how product supply chain processes are organised to fulfil customers' procurement needs.

The opinion of procurement and supply chain professionals from 34 business organisations in the various business sectors in South Africa was sought to determine (a) how they specify input needs; (b) how they select input suppliers; (c) how they control their input suppliers' performance; and (d) how product supply chain processes are organised to fulfil customers' procurement needs. Of these organisations, seven were in the primary (i.e. production) sector; 18 in the secondary (manufacturing) sector; and nine in the tertiary (i.e. service) sector. Of the latter group, four were wholesalers and five were large retail chain stores.

More specifically, the article looks at (a) identifying and specifying procurement needs (i.e. exactly *what* must be purchased), which is discussed in Section 2; and (b) reviewing *how* product supply chains respond to customer demands, with reference to South Africa, which is dealt with in Section 3. The conclusions of the study are contained in Section 4.

2. Procurement need specification

Ten methods of procurement need specification for business purposes dealt with the literature,[1] and which are applied in South Africa, are discussed here: by brand, by brand equivalence, by market grades, by sample, by commercial standards, by performance, by engineering drawing, by physical design, by material and method of manufacture, and by a combination of any of the afore-mentioned methods.

Specification by brand. The brand is the quality ordered. The higher prices paid for branded products are often offset by less preparation for need specification and lower inspection costs. Brand buying is used when:

- the supplier's production is secret;
- the item is covered by a patent;
- a supplier's workmanship exceeds that of all competitors;
- the quantity of items procured is so small that this renders the formulation of specifications unduly costly; or
- the downstream customers/end users have strong preferences in favour of certain branded items, which cannot be swayed when conforming to their requirements.

Specification by brand equivalence. Many types of branded products sell at price premiums, such as certain chemicals (e.g. antiseptics, cleaning compounds, medicines, ointments) and certain vehicle spare parts. For these products, a generic alternative may be preferable. When these products perform effectively, substantial savings may be realised. Medical-aid schemes often make it mandatory for members to make use of approved equivalents as opposed to more expensive prescribed medical remedies.

Specification by market grades. Need specification on the basis of market grades is confined mainly to organic raw materials, i.e. the primary products of agriculture, fishing and forestry. Market grading is a method of determining the quality of these natural products in unison with defined and generally accepted standards. Inspection to verify desired quality is vital if procurers are to obtain raw materials of the characteristics needed to produce a market-ready product of consistent quality.

Specification by sample. Need specification by sample is the submission of a sample of the needed item; however, this manner of need description is favoured only if other methods of need specification are not feasible. Features for which feasible alternative need descriptions often do not exist are (a) colour and texture; (b) printed matter; and (c) appreciation through sense perception. These aspects are addressed below:

(a) A precise shade of colour is difficult to match without a colour chart, or display of the item itself.
(b) Lithographic work is best described by proofs of what is desired.
(c) Sense perception might best be judged by visual appearance (e.g. wood), taste and odour (e.g. wine required for blending to ensure consistent quality), and sound (e.g. musical instruments).

Specification by commercial standards. A commercial standard is a comprehensive description of an item that has been standardised. The description covers aspects like quality of materials/ingredients, workmanship required in manufacture, dimensions, constituent parts/ingredients, tolerances and containment/packaging required. Recurring needs for the same products have led industry and authorities to develop standards for such products. Components such as nuts, bolts, screws, nails, pipes, wire, cables, fishing line, electrical items and building components (e.g. door and window frames) that are manufactured to standard specifications can be expected to fit all standard applications regardless of the manufacturer. Material ordered according to standard specifications leaves no doubt on the part of either the procurer or the supplier as to what is needed.[2]

Specification by performance. Performance specification is both application and output oriented. The procurement need is specified in terms of the functionality required of the item, i.e. what it is required to achieve. No mention is made of any design specifications, leaving the supplier with the initiative on how to provide the most effective product. Manufacturers of electronic ware, aircraft, sailing vessels, road vehicles, mechanical handling equipment and machine tools frequently use this method of need specification. There are potentially two primary advantages obtainable through specifying the required quality of output: firstly, ease of formulating desired performance; and secondly, assurance of obtaining this performance. Supplier compliance under this specification is a prerequisite for the procurer to manufacture a product whose functionality testifies to its high level of technological advancement.

Specification by engineering drawing. Specification by engineering drawing particularly applies to construction projects, machine and job shop work, mechanical components, electric and electronic

assemblies, forgings, castings and stampings. Engineering drawings are often supplemented by descriptive text to simplify completion of the required product. Specifying by engineering drawing is the appropriate and most accurate method to describe those subsystems, components and items that require a high level of manufacturing precision. There are four main benefits of specifying by engineering drawing:

- It is both accurate and precise.
- It is the most practical method to specify items that require extremely high tolerances.
- It is amenable to open competition among competent suppliers.
- It establishes definite standards for inspection.

Specification by physical design. Several items and materials required in manufacture are not covered by brands or standard specifications, and procurers prepare their own specifications for these. By developing their own specifications, procurers can avoid the price premiums of branded products, and infringement of patented, copyrighted and proprietary products. This, however, entails risk, therefore items or materials procured under this method of need specification normally require special inspection, the cost of which can be high. The method provides definitions of the properties of the materials (the 'recipe's ingredients') that the procurer desires. This method endeavours to state in measurable terms the properties critical for desired use at minimum cost and in line with desired quality. This method of need specification is the opposite of specification by performance. The procurer provides exact chemical, electronic, dimensional or other physical specifications of the product it requires, and assumes full responsibility for the product's performance.

Specification by material and method of manufacture. Under this method of specification, both the material and the method of manufacture (i.e. the complete recipe) are prescribed to potential suppliers. In business this method is used when special needs exist and the procurer is willing to accept responsibility for results. Specifications under this method are costly to prepare, and the ensuing costs of inspection are generally higher than those incurred by other methods of need specification. Consequently relatively little use is made of this form of need specification. It is, however, utilised by large resellers of paint, large retail chains that sell so-called 'no-name brand' products, and large resellers of 'generic' medication and remedies.

Combination of methods of need specification. Businesses often use a combination of the methods described above to specify a need, simply because some needs cannot be sufficiently described by one method alone. A growing number of finished products require more than one method of need specification. For example, curtain manufacture may require specification by commercial standards to describe the cloth, its density and the fire resistance required; specification by physical design to prescribe the length and width of the drops, and whether they should be lined or unlined; and specification by sample to demonstrate the shade of colour desired.

3. Product supply chain processes

Product supply chain processes have traditionally been executed as either 'push' or 'pull' oriented. Later, a mixed 'push-pull' approach also developed.[2] These supply chain processes are at the heart of both manufacturing and inventory management. The decision to adopt any one of these processes dramatically influences the manner in which manufacturing and inventory systems are handled. Each of the approaches are discussed in the subsequent three sections.

3.1 Push-based supply chain systems

Push-based supply chain systems put the onus on the manufacturing entity to decide when and how much of a given product will be sent into storage. Manufacturing and distribution (mainly inventory and transportation) decisions are based on long-term forecasts of demand and the present inventory position. In this system it is the manufacturing entity that sets the pace and determines priorities from the point of view of the supply process.

Manufacturers typically base demand forecasts on orders received from wholesalers and retailers. It will therefore take substantially longer for a push-based supply chain to react to changing consumer/end-user market conditions. This can lead to (a) an inability by manufacturers to meet changing consumer demand patterns; and (b) the obsolescence of some supply chain inventory because demand for certain products

disappears. In addition, the variability of replenishment orders received from the wholesalers and retailers is usually larger than the variability in their customer (i.e. end-user) demand. More specifically, this increase in variability leads to:

- bigger and more variable production batches;
- excessive inventories due to the need for huge safety stock;
- product obsolescence; and
- unacceptable service levels due to stockouts.

Push systems usually offer suppliers economies of scale through increasing lot sizes during manufacturing and through freight consolidation during carriage. Large buffer stocks of finished products close to customers also reduce the risk of sales losses.

3.2 Pull-based supply chain systems

Pull-based supply chain systems use exactly the opposite set of determinants as those that apply in push-based supply chain systems. In this case it is the warehousing function that dictates how much of a given product is required and when. In situations where the organisation manufacturing the products does not maintain buffer stock and order information is not communicated early and effectively, pull systems can lead to some customers not being able to have their orders fulfilled when required.

In a pull-based supply chain, manufacturing and distribution are demand driven. They are coordinated with actual customer rather than forecast demand. In a pure pull system, the firm carries no product inventory, and its supply reactions/responses are order specific. This is made possible by fast information flow mechanisms to transfer information about customer demand, for example point-of-sale data to the various supply chain members. In comparison with push-based systems, pull-based systems offer the following advantages:

- A decrease in order/delivery lead times achieved through the ability to better anticipate incoming orders from the retailers.
- Less inventory at the retailers since inventory levels at retail warehouses increase with order/delivery lead times.
- Reduced variability in the system and, in particular, variability faced by manufacturers due to order/delivery lead-time reduction.
- Less inventory at the manufacturer due to the reduction in order/delivery lead-time variability.

Therefore, in a pull-based supply chain, there is usually (a) a substantial decrease in system inventory levels; (b) an enhanced ability to manage resources; and (c) a reduction in supply costs when compared with the equivalent push-based supply chain.

Pull-based supply chain systems are often difficult to implement when lead times are so long that it becomes unrealistic to respond to demand information. In pull-based systems it is often more difficult to take advantage of economies of scale in manufacturing and transport because these supply systems are not planned far ahead in time. These advantages and disadvantages of push and pull supply systems have led to firms seeking new supply chain tactics that benefit from the best of both, which often would entail a combined push-pull supply chain configuration.

3.3 Push-pull-based supply chain systems

With push-pull-based supply chain approaches, the upstream (i.e. initial) stages of the supply chain are often operated in a push-based manner, while in the downstream stages a pull-based approach is utilised. The interface between the push-based and the pull-based phase is known as the customer order decoupling point. This may be regarded as the push-pull boundary. If one visualises a supply chain time line, described as the time that elapses between the procurement of raw material (i.e. the beginning of the time line) and the delivery of the eventual customer order (i.e. the end of the time line), the order decoupling point or push-pull boundary occurs at a point along the time line. It indicates the point in time when the chain's push phase switches to its pull phase. The push phase consists of the standardised (generic) stages, and the pull phase of stages that contribute towards product differentiation.

The manufacturing process starts by manufacturing a generic or family product, which is differentiated to a specific finished product once demand is revealed. The phase of the supply chain before product differentiation is operated using a push-based approach. The generic product is built and transported based on a long-term aggregate forecast. Because demand for the generic component is the sum of the demand for all its related finished products, forecasts are more accurate, therefore inventory levels are reduced. Against this, customer demand for a specific finished product usually has a high level of uncertainty, therefore product differentiation occurs only in reaction to individual or specific demand. Consequently, the phase of the supply chain starting from the time of differentiation is pull based.

3.4 Implementing a supply chain approach

Different supply chain approaches are necessary in different industries and in different market conditions. The approaches vary primarily as to where the customer order decoupling point is located. The customer decoupling point is considered to be the furthest upstream point in the supply chain where a specific customer order effects inventory-level decisions directly. The concept of decoupling implies that even in cases of continuous production, if an organisation ensures that it has sufficient inventory and that buffering has been set up between each stage of the production, all the processes on that production line can operate independently of one another.

The characteristics of the push and pull portions of supply chains are summarised in Table 1.[3] In a supply chain that utilises a push-pull approach, the push and pull portions interact only at the customer order decoupling point. At this point there is a need to coordinate the two supply chain approaches, which is generally done through buffer stock. (Note that buffer stock fulfils a different role in each supply chain portion. At the downstream end of the push portion, it is part of the inventory generated in the tactical planning process. In the pull portion of the chain, the inventory forms the feeder stock to the fulfilment process.)

Table 1. Characteristics of the push and pull portions of supply chains

Characteristic	**Push portion**	**Pull portion**
Objective	Minimise cost	Maximise service level through flexibility
Complexity	High	Low
Demand	High certainty	High uncertainty
Focus	Efficient resource allocation	Effective responsiveness
Lead time	Long	Short
Processes	Supply chain planning according to forecast	Order fulfilment
Product	Standard	Customised or differentiated

The location of customer order decoupling points is described in the sections that follow, and illustrated in Figure 1. The different ways in which a supply chain can respond to customer demand is detailed in the sections below.[4, 5]

3.4.1 Pick and ship to stock

The use of 'pick and ship to stock', also called 'assemble and ship to stock', allows for the swift delivery of products to the customer. The customer order decoupling point is located at the distribution centre. This is typical of the fast-moving consumer goods (FMCG) industry, where the finished goods inventory must be available on the shelves at all times. If the product is not available, the consumer is likely to buy a substitute product or go to an alternative retail outlet to purchase it.

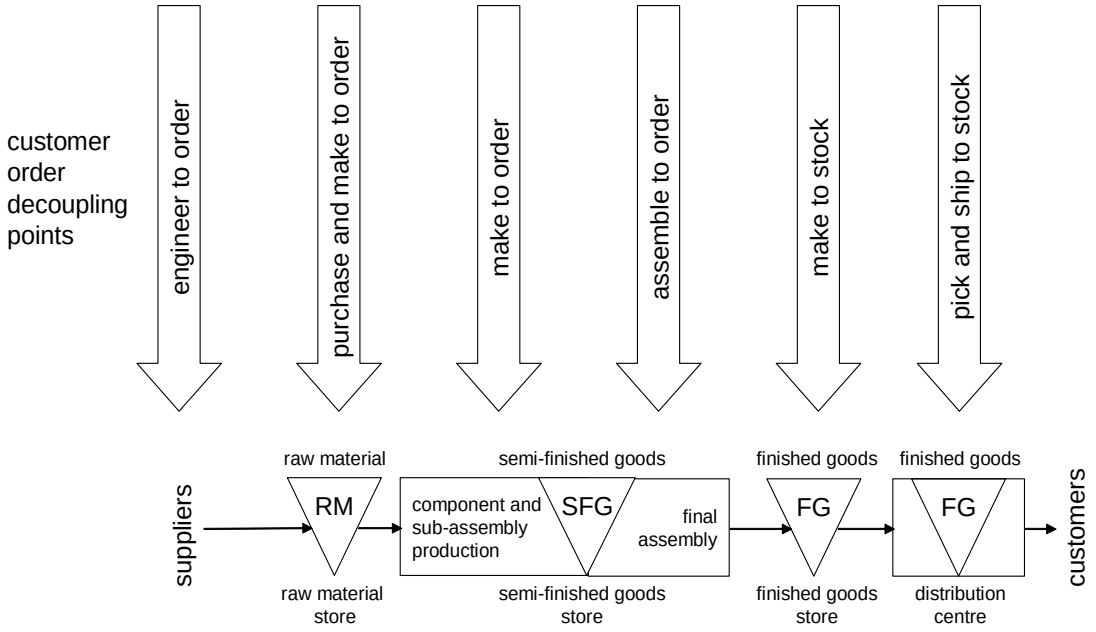
Being a 'push' supply tactic, the main challenge facing this process is demand management, and more specifically the forecasting of independent demand. The major risks in this concept lie in the inventory levels. Shortage of inventory will result in poor consumer service. Surplus of inventory might result in obsolescence, either through the product's shelf life expiring or the demand falling away.

3.4.2 Make to stock

'Make to stock' is a supply tactic where finished product is continually held in plant or warehouse inventory to fulfil expected incoming orders or releases based on a forecast. The customer order decoupling point is located at the finished goods store. This is typical for consumer ware that is not consumed but used over time, for example domestic appliances. Relatively few products are kept for display and demonstration purposes in showrooms, but back-up inventory is kept in a central finished-goods store.

The customer order triggers the delivery of the goods from the location of the finished goods either to the customer or to the sales outlet for replenishment. Being a 'push' supply tactic, the main challenge of this logistics concept is to manage demand, and particularly to forecast independent demand. The main risk lies in the management of inventory levels.

Figure 1. Customer order decoupling points



3.4.3 Assemble to order

'Assemble to order' is a production method where a product is assembled after receipt of a customer's order. The key components (bulk, semi-finished, intermediate, sub-assembly, manufactured, purchased, packing, and so on) used in the assembly or finishing process are planned and usually stocked in anticipation of a customer order. Receipt of an order initiates assembly of the customised product. This tactic is useful where a large number of end products (based on the selection of options and accessories) can be assembled from common components.

The customer order penetrates into the final assembly line, where sub-assemblies and semi-finished goods are picked and assembled to the customer's desired configuration. All permutations of the various possible configurations must be offered, but these cannot all be kept in the finished goods store, as this will inflate finished goods inventory levels and total logistics cost.

This customer order decoupling point is typical of markets where mass customisation is essential. An example is the laptop computer industry. Many motor vehicle manufacturers also utilise this process. In the manufacturing process, they allow and make provision for orders for specific options on vehicles. The inventory must be controlled at the sub-assembly level. Although 'assemble to order' is predominantly a 'pull' approach, it has a minor 'push' element. The manufacturer has to forecast the independent demand for the sub-assemblies.

This process can satisfy the customer's needs for a specifically configured item. The challenge is to keep the assembly lead times short in order for this to add value for the customer. Capacity constraints should not cause the final assembly to extend the delivery time. The major risks are excess stocks and the subsequent obsolescence of sub-assemblies and/or components due to changes in market demand.

3.4.4 Make to order

A 'make-to-order' manufacturing process approach is where the trigger to begin manufacture of a product is an actual customer order or release, rather than a market forecast. For make-to-order products, generally more than 20% of the value added takes place after the receipt of the order or release, and all necessary design and process documentation is available at the time of order receipt.

The customer order decoupling point is located at the component and sub-assembly manufacturing point. This is typical of industries that manufacture items such as custom-made furniture. The manufacturer utilises unique components or sub-assemblies to make the furniture. This process is more extensive than in the motor vehicle industry, where the optional sub-assemblies are standard and only the choice of the optional sub-assemblies makes the car unique to the customer.

'Make to order' is predominantly a pull approach, with a relatively small push element. The forecasting that does occur here is focused on replenishing the sub-assemblies to maintain the semi-finished goods store inventory. The assembly process of the basic item is only started once an order is received, therefore the independent demand for components and sub-assemblies needs to be forecast. One of the major logistics challenges here is to balance the capacity of the supply chain. The people employed in this type of environment are usually multi-skilled.

3.4.5 Purchase and make to order

The term 'purchase and make to order' refers to situations where a manufacturer will wait until there is a firm order for a product. All aspects of the manufacturing process will wait, including the final assembly of the product, its packaging and its delivery.

The major problem with purchase and make to order is the fact that the business is never in a position to know precisely how many materials, components or parts will be required at any given time to fulfil these customer orders. Consequently the problem extends to the suppliers, who may be expected to deliver the necessary material to the manufacturer at extremely short notice.

Purchase and make to order is a pure 'pull' process. It is typically used in industries where the components and/or sub-assemblies are very expensive, or where the components are not used frequently. In the manufacturing process, this is the traditional 'job shop' process. The customer order decoupling point is located at the raw material store. The business does not carry the inventory, but orders the components once the customer order has been received, therefore the bill of materials (BOM) for the components (i.e. the detailed list of required inventory) is of critical importance. An incorrect BOM will result in delays, which will impact on the production cycle time and also order lead time.

3.4.6 Engineer to order

'Engineer to order' is often known as 'design to order', and refers to situations where businesses undertake the engineering of products and their subsequent manufacture in line with the specific instructions or requirements of customers. Engineer to order is considerably more complex than most other forms of manufacture, as each product has to be designed to the customer's exact specification. The business therefore needs to be able to give the customer an accurate assessment of the delivery time, which incorporates all the lead times associated with engineering, component development, procurement, manufacture, assembly, packing and shipping.

Organisations that offer an engineer-to-order product supply need to have a fully integrated system, which incorporates close cooperation between the designers, the engineers, the buyers, the manufacturing (construction) team and any other associated area of the business. Although each specific project may be significantly different from those which the business has already experienced, customers will expect relatively accurate indications of the stages through which their products will be developed and manufac-

tured, as it may be a requirement of the customer to be involved in the progress and inspection of the products. 'Engineer to order' applies only to organisations that actually design, engineer, manufacture and then fulfil the customer's specification.

The customer order decoupling point is located at the raw material supplier level. This process is typically used to supply unique products or services, and is very often undertaken as a special project. The design and construction of a winery production cellar, a bridge or a seaport terminal are examples. There are no repeat orders, no economies of scale, and no predetermined BOM. The cost and the lead times are determined for each individual project.

3.4.7 Assessment of business response level

The concept of service level can be used in a number of production and inventory-based situations. When considering a pick-and-ship-to-stock and a make-to-stock system, i.e. the two push systems, the service level is the percentage of products or orders that are immediately available from the organisation's inventory. When the term is used in connection with assemble-to-order, make-to-order, purchase-and-make-to-order and engineer-to-order systems, i.e. the four systems that have a significant pull portion, service level is usually measured in terms of on-time delivery. The on-time delivery performance is measured as the percentage of orders that are received by the customer either by the promised or the requested time. An organisation can improve its on-time delivery performance by improving the reliability (i.e. consistency) of the level of promise it gives customers through reducing its production cycle and order lead times. These may be achieved by successfully making use of time compression opportunities during the production cycle and by applying service flexibility during order lead times.

4. Concluding summary

The 10 methods of procurement need specification for business purposes that are applied mostly in South Africa are: by brand, by brand equivalence, by market grades, by sample, by commercial standards, by performance, by engineering drawing, by physical design, by material and method of manufacture, and by a combination of any of the afore-mentioned methods. The first five of these are use mostly in push-based supply chain systems, while the last five are used mostly in pull-based and push-pull-based ones.

The various ways in which supply chains can respond to customer demand is summarised in Table 2.

Table 2. Supply chain responses to customer demands

Supply system	Supply concept	Inventory situation	Decoupling point	Order lead time	Examples
Pick and ship to stock	A pure push concept. Standard and generic consumer ware stored in distribution centre inventory	Large inventory of finished goods	At the distribution centre	Only the order picking and delivery time	Picking an order of consumer ware from a distribution centre, destined for a supermarket
Make to stock	A pure push concept. Standard finished products are stored in inventory	Large inventory of finished goods inventory. Usually also has WIP* and raw materials	At the finished goods store	Only the delivery time from the finished goods warehouse to the customer	Medical devices, many consumer products, white goods and standard home furniture
Assemble to order	A push-pull concept. Semi-finished products and sub-assemblies, assembled in response to a customer order specified from a set range of optional features	Inventory of sub-assemblies and semi-finished products. Usually also WIP* and raw materials	At the final assembly line	The assembly and delivery time	Personal computers, cars, recreational vehicles, modular furniture assemblies

Make to order	A push-pull concept. Raw materials are transformed into a customised end product	Usually inventories of raw materials. It is possible to implement with no inventory	At the component and sub-assembly manufacturing point	The component and material manufacturing, assembly and delivery time	Customised clothing, custom-made furniture, injection-moulded parts
Purchase and make to order	A pure pull concept. Customer-specified high-value components and raw materials are transformed into a customised end product	Potentially no inventory of high value components. Usually also some inventory of raw materials	At the raw material store	The purchase of raw materials, component manufacturing, assembly and delivery time	Custom-made durable/indivisible equipment, usually movable and with unique features (such as small watercraft and light aircraft)
Engineer to order	A pure pull concept. A (unique) design is developed and constructed/assembled (usually on the customer's site) for a particular customer need	Usually no inventory. Could have limited inventory of sub-assemblies and raw materials	At the supplier level	The design, development and (a) construction/ assembly; or (b) delivery and installation time (if built elsewhere)	Custom-built fixed construction or immovable capital equipment

[*] (WIP = work-in-progress.)

Endnotes

1. Burt *et al*., 2010: 121–128; Johnson *et al*., 2011: 149–153; Hugo *et al*., 2006: 142, 143; Pienaar, 2012(a): 311–313.
2. Govil and Proth, 2002: 65–68; Handfield and Nichols, 2002: 53; Simchi-Levi *et al*., 2008: 188–195; Sutherland. and Canwell,2004: 153; Vitasek, 2005: 64.
3. Simchi-Levi *et al*. 2008: 188; Pienaar 2012(b): 63)
4. Simchi-Levi *et al*. 2008: 91.
5. Linford, 2002: 52, 53.

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