

Methods of Inventory Monitoring and Measurement

R L Ballard



**Paper presented at the National Materials Handling Centre conference
"Warehouse Accuracy - Approaches to Error Reduction"**

INTRODUCTION

Much has been written about the management and control of inventory but very little has been written about how inventory can best be monitored and measured in the warehouse. This is surprising considering that stock is monitored and measured every day by thousands upon thousands of organisations.

There is perhaps an element of elitism in this. Inventory control is seen as the management function - forecasting, determining requirements, setting targets and issuing instructions, whereas the monitoring of stocks in the warehouse is seen as a supervisory function requiring less skill and experience. And yet, if the monitoring and measurement process is overlooked or given less than its due consideration, the feedback information, upon which management depends to determine the effect of its instructions, is unreliable and gives no indication as to the quality of the inventory management. The purpose of inventory monitoring and measurement should be to provide management with the information to improve operations and reduce errors, but so often it is merely an accountancy function which is more concerned with stock valuation than effective logistics.

These comments are not intended to decry the numerous good textbooks which cover the subject of inventory control. It is a huge subject with many different facets and is an important discipline in its own right, within the wider field of logistics and supply chain management. Many of these texts provide much useful information on the subject of stock monitoring and control and for those interested in taking the subject further, a reading list is included at the end of the paper.

There is, however, considerable scope for improvement in the literature available to help those managers who have the task of monitoring and measuring inventory in a warehouse. There is no doubt that the emphasis is changing, at one time with limited information resources, inventory management was dependent on feedback of information at relatively long time increments and was often solely dependant on formal stock checks. However, improvements in information systems over recent years mean that feedback can be much more frequent and in some cases can be virtually instant, thus providing real time control capabilities.

Requirements such as reduced stock holding, demonstrating supplier capabilities to customers, dealing with EPOS systems and the demands for access to more information are examples of some of the ways in which managers in the supply chain are faced with more pressure. The need for rapid and accurate monitoring and measurement of inventory is thus being seen more and more as a vital part of the process of remaining competitive.

INVENTORY IN THE WAREHOUSE

Inventory is generally considered to comprise three main areas

- ↳ Raw materials and components - the goods that are purchased by the organisation
- ↳ Work in progress - items that have been partly manufactured and have had value added
- ↳ Finished goods - the completed products awaiting shipment to customers.

Where these are held and in what quantities, and how they are managed will vary significantly from one organisation to another. In some organisations all three will be held in a store at some time, whereas in others, raw materials may arrive just in time and finished work in progress will be held only alongside the production line. Inventory has to be monitored wherever it is held but for the purposes of this paper consideration is given only to the monitoring and measurement of those goods within the warehouse environment. Monitoring and measurement is considered as a part of the overall process of warehouse management.

WAREHOUSE MANAGEMENT IS NOT INVENTORY CONTROL

Warehouse management systems and inventory control systems should not be confused. Figure 1 shows a typical supply chain configuration. Inventory management is concerned with the control of stocks throughout the whole supply chain. Inventory monitoring and measurement takes place at each point in the supply chain.

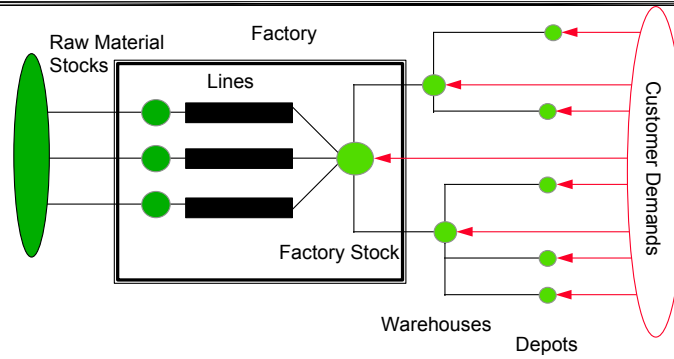


Figure 1 - Typical Supply Chain Network

Tomlinson (Ref. 1) defined four levels of business control as shown in Figure 2.

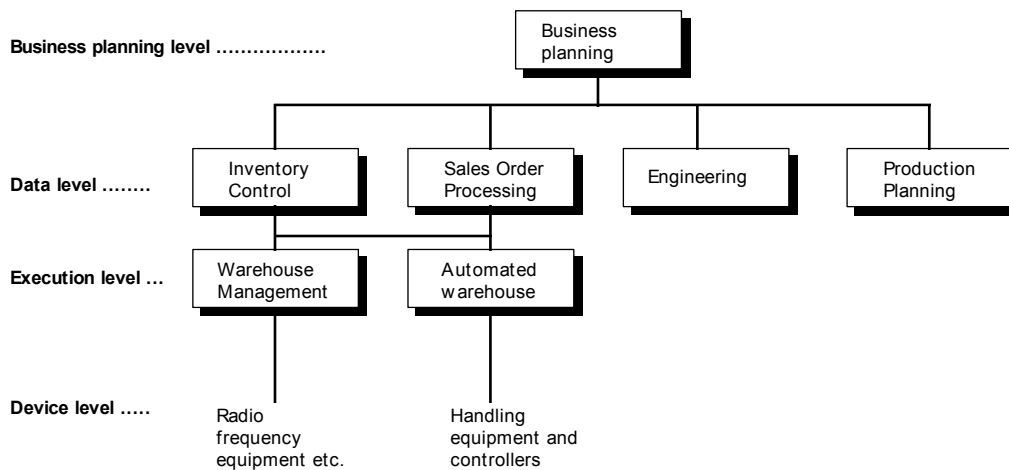


Figure 2 Business control Hierarchy

Inventory control sits at the data level where the day to day business is organised. Activities here are data driven and are primarily concerned with short term planning and recording of events. Inventory control is concerned with maintaining the correct level of stock and recording its movement. It deals mainly with historic data.

Warehouse management sits at the execution level and is concerned with the activities within the warehouse and for making the best use of the resources (capital and human). To do this properly requires good quality information derived from accurate monitoring and measurement of the warehousing process. This monitoring and measurement also

provides the basis for feedback to the inventory control system, thus enabling corrective action to be taken.

In most cases a warehouse management system needs to be linked to an inventory control system but the converse is not true.

Warehousing is primarily about the physical control of goods and materials. However, a fundamental principle of materials management is that material flow and information flow must go hand in hand. Not only must a warehouse manager know where an item of stock is but he or she must also know everything about that item as it applies at a given point in time and place. The monitoring and measurement of stock has to take account of both physical location and time. The loss of information on one of these results in degradation in the other.

The monitoring and measurement of inventory is not simply a question of stock checking. It is about knowing, at all times, everything that is needs to be known about the stock to ensure the effective management of the warehouse and the reliable feedback of data for management of the business, including inventory control, purchasing, sales order processing and invoicing. Monitoring means knowing about the progress of goods and materials as they are processed through the warehouse.

The best systems monitor the process rather than just the stock. This means that monitoring and measurement take place after each action has occurred, thus highlighting errors immediately. If errors are eliminated the idea of a periodic stock check becomes superfluous.

WHAT HAS TO BE MONITORED AND MEASURED?

There are a number of ways in which stock information can be categorised in order to describe the properties, status, quantity and location of a product, but for the present purposes it is convenient to split stock information broadly into three main categories, as shown in Figure 3.

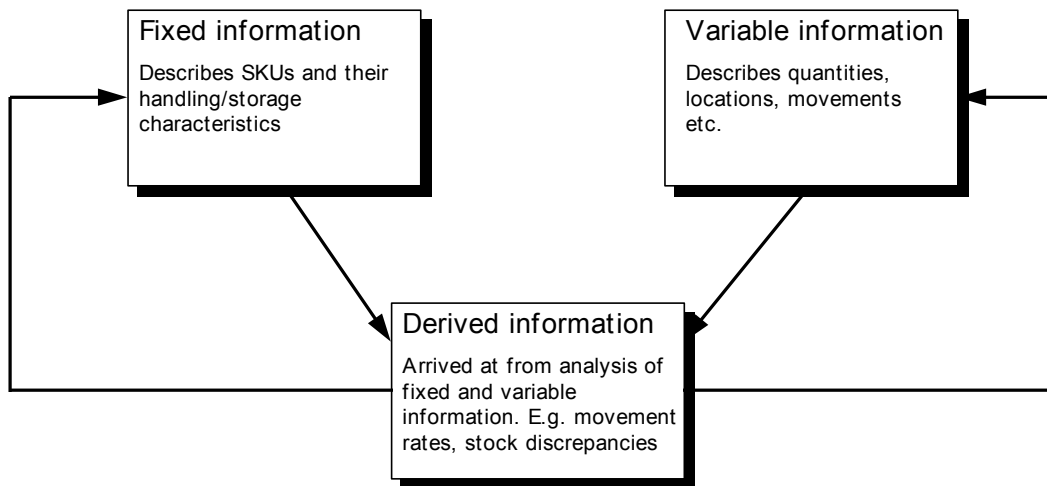


Figure 3 - Inventory information

Fixed information - This describes those aspects of a stock keeping unit (SKU) which will not change or will not change often. These include-

- ↪ Product code
- ↪ Description
- ↪ Batch No or similar (if appropriate)
- ↪ Size
- ↪ Weight
- ↪ Storage/handling type (e.g. pallet, tote, carton)
- ↪ Minimum pick quantity
- ↪ Picking priority (e.g. FIFO)
- ↪ Preferred store area or zone
- ↪ Secondary store area or zone

Variable information - This describes those aspects which will be highly dynamic and which may change frequently during a working day. These are associated with the warehouse process and include:-

- ↪ Unique identity of each unit load in stock (e.g. pallet number)
- ↪ Location of each unit load
- ↪ Quantity of SKUs in each location
- ↪ Movement of each picked item
- ↪ Load status (e.g. available, quarantine, QC hold)

Derived information - This is information which can be determined by analysis of the fixed and variable information. It will vary from organisation from organisation, depending on management requirements, but is likely to include:-

- ↪ Movement rate per SKU (i.e. analysis of fast, medium and slow movers)
- ↪ Stock discrepancies (compared with master record in inventory control system)

- ∞ Space utilisation in the store
- ∞ Operator productivity

A point to note about the derived information is that it may lead managers to change some of the fixed and variable information. For example, movement rates may change thus indicating a change of preferred store area, and stock discrepancies may require an amendment to the quantity of stock recorded in a location.

STOCK COUNTING

Although the information needed about inventory covers far more than just stock counting, this particular requirement is worthy of a few extra words, if only for the fact that for many organisations it is such a time consuming and disruptive process.

The first point to make is that with effective systems monitoring and managing the warehouse process, the formal periodic (usually monthly or annual) stock take is not necessary. Provided there is sufficient monitoring of the process, there is no need to stop everything to do a stock take, and barely any need for additional resources. There are two main options to replace the commonly found periodic count. These are often referred to as perpetual inventory counting:-

Cycle counting - With this method, a selected number of items are counted every day. Counting can be by SKU which allows the frequency of counting (i.e. how often an item is counted every year) to be based on the movement rate. Alternatively counting can be by location, which is arguably more accurate. Records are maintained to ensure that all items will be checked at least once per year. Any discrepancies are immediately dealt with and adjustments made as appropriate.

Residual balance counting - This method can be made to work particularly well if a "real time" warehouse management system is in use, as described below. Every time an operator visits a location to carry out either a pick or a putaway, he or she reports on the number of items remaining in that location. The number reported is compared with the master stock record and if discrepancies are found, appropriate action can be taken immediately. A record is maintained of the locations visited and systems are maintained to count, at regular intervals (but at least once per year) the items in those locations

which have not been visited during normal day to day operations. There are a number of variations to this method such as only reporting if stock is zero, only reporting when stock falls to a threshold level or only reporting after a set number of visits to the location, where the number of visits is a function of the movement rate of the SKU in that location.

HOW DO WE GATHER THE INFORMATION?

For those who see inventory monitoring as being merely the measurement of stock holding, the list of information to be collected will appear daunting; and indeed it is if only manual recording methods are used. Whilst there are still many, quite substantial organisations who still use card index or similar paper systems for at least some of their inventory monitoring it must be said that for all but the smallest of organisations, the task can only be performed satisfactorily with some form of computerisation. The more comprehensive the computer system, the more it becomes possible to automate the monitoring and measuring of the warehouse process, and the more readily information becomes available.

There are a number of options with varying levels of sophistication, as described in the following paragraphs.

Spreadsheets and database packages - These are generally stand alone local solutions to the problem where no other special warehouse computerisation exists. Databases in particular can be used easily to hold the fixed information about each SKU and both spreadsheets and databases are very good for analysis to develop the derived information. However, the use of these tools for recording the variable information such as location control requires significant effort and a strict adherence to the disciplines of data entry. Even if the disciplines can be maintained, the information can never be up to date and at best, given the pressures which most warehouse managers and supervisors are under, it is likely that the information will be a day or two old. The time when the information is most needed (during peak periods) is also the time when managers and supervisors will have the least time to spare with the result that disciplines will slip and information will be out of date. Also, spreadsheets in particular are very prone to human error.

THE LOGISTICS BUSINESS LTD

Old Court House, 19, The Crescent, Bromsgrove, B60 2DF

Tel: +44-(0)1527 889060 Fax: +44-(0)1527 559192 Email: Info@logistics.co.uk Web: www.logistics.co.uk

Additions to inventory control software - Many organisations add modules to their inventory control software, often residing in the organisation's main business computer. These modules usually allow the selection of put away locations and perhaps some product tracking but are almost always very limited in their ability to provide the variable and derived information. Many organisations introducing these features will claim that they add warehouse management capabilities to the inventory control, but this is very rarely the case. A good warehouse manager, faced with such a system, will almost certainly need to add further information systems of his or her own (perhaps using spreadsheets and databases) if proper monitoring is to take place. A common limitation of these systems is that put away locations are chosen by the user and recorded by the system. The system does not usually determine the best put away location based on monitoring of the process.

Warehouse management software - The only way to ensure that the monitoring and measurement is carried out effectively is to introduce a proper warehouse management system. The reason for this is that warehouse management systems are designed to monitor the process of the warehouse operation, they measure what has happened as soon as it has happened and provide immediate access to the new information. Such systems are supplied specifically to manage warehouse operations and can be tailored to meet the specific needs of each organisation. Warehouse management systems sometimes run on the same machine as the inventory management system but are more likely to be quite separate from it. However, there is usually a means of communicating with the other management systems to enable information (such as sales order requirements for picking) to be exchanged and warehouse stock to be compared with that recorded in the master record on the inventory system. There are two basic sub-sets:-

Batch with paper lists - Such a system will provide batches of instructions for put away, picking and replenishment in the form of paper lists. This has the disadvantage that confirmation of actions has to be carried out by manual data entry and hence information will not be right up to the minute. There is therefore some time delay in the process monitoring. To this extent the same need for discipline applies as to the use of spreadsheets and databases. However, despite these limitations a paper based warehouse management system will hold the

fixed information, record the variable information and provide the derived information to the accuracy of the latest up date of actions carried out.

Real time with radio frequency communication - The use of radio frequency equipment with a warehouse management system ensures up to the minute information and minimisation of operator errors. Operators are provided with radio data terminals (RDTs) and the system sends one instruction at a time to each operator in the form of a radio signal which is received by the appropriate RDT. No further instructions are sent to the operator until he or she has confirmed completion of the current task. With such systems, which are now becoming more and more common, inventory is monitored and measured continuously and information updated within seconds of actions being carried out. This is commonly known as real time monitoring and control and allows the process of warehouse management to be monitored and measured with great accuracy. If such systems are combined with some form of automatic data capture, such as bar code readers, stock discrepancies are very few and far between. Real time warehouse management systems greatly facilitate the process of residual balance counting as described above.

Warehouse automation - It is worth mentioning warehouse automation, if for no other reason than that it is the logical extension to the real time warehouse management system for process monitoring. For automated systems to work well (and despite a small number of notable failures most do work very well) disciplines must be imposed and monitoring of inventory and many other aspects of the warehouse operation take place continuously. Information is updated in real time and the computerised system enables management information to be readily available. Users of automated systems recognise that conventional periodic stock checks are impractical and rely much more on the ability of the system to monitor the process and not the stock. It is not suggested that automation should be considered merely as a means of monitoring and measuring inventory but thinking about the process of automation helps to emphasise what inventory monitoring is about.

WHAT MAKES A GOOD WAREHOUSE MANAGEMENT SYSTEM?

A good warehouse management system does not necessarily mean fully computerised in real time. It is important that the solution is appropriate to the problem. However, the best way to provide easy monitoring is certainly with some form of computerisation.

The better the monitoring of the process and the faster the information processing, then in principle and everything else being equal, the better will be the utilisation of space and resources in the warehouse; the fewer will be the errors and the better will be the customer service. What is more, managers and supervisors will have easy access to the information they require to do their job. A sure sign of a system failing to meet the demands being placed on it is the appearance within the warehouse of stand alone manual or semi-computerised systems set up and run by individuals for their own benefit to help them undertake their duties.

Given all the considerations of methods of monitoring inventory, most organisations seeking to make improvements in this area would be advised to implement a warehouse management system, ideally but not essentially with radio frequency communication.

More detailed information on the features warehouse management systems and benefits of implementation are described by Tomlinson (Ref. 1) and Burton (Ref. 2). The following paragraphs will give some guidance of what to look for.

- ∞ **Job sequencing** - either through the controlled use of paper lists or through the use of radio frequency communications. Good systems will allow upgrade from one to the other.
- ∞ **Control of picking** - to determine pick sequence by location and manage pick sequence for FIFO or other requirements.
- ∞ **Job verification** - ability to check that each activity has been completed.
- ∞ **Location control** - sometimes managed by the inventory control system but much better managed by the warehouse management system. Random location control allows the system to optimise the use of the warehouse space, subject to user defined constraints on use of product zones.
- ∞ **Automatic replenishment** - where appropriate the system should automatically issue movement instructions to move stock from back up locations to picking locations.

THE LOGISTICS BUSINESS LTD

Old Court House, 19, The Crescent, Bromsgrove, B60 2DF

Tel: +44-(0)1527 889060 Fax: +44-(0)1527 559192 Email: Info@logistics.co.uk Web: www.logistics.co.uk

- ↳ **Performance monitoring** - provision of derived information such as picking rates and error rates from analysis of picking, discrepancies etc.
- ↳ **Supervisory Functions** - Quarantine, QC hold, area flushing, perpetual inventory counting
- ↳ **Reporting** - ability to provide comprehensive user defined reports based on any of the fixed, variable or derived information.
- ↳ **Interface with other management information systems** - ability to receive and send data from and to other business systems including inventory control, purchasing and sales processing.

INVENTORY CONTROL AND WAREHOUSE MANAGEMENT WORKING TOGETHER

The differences between warehouse management systems and inventory control systems have already been discussed but for maximum benefit the two should work together. Some of the benefits of this are:-

- ↳ better information
- ↳ reduction of errors
- ↳ rapid highlighting of any errors that do occur
- ↳ higher levels of business integration
- ↳ reduced inventory in the warehouse.

Ideally there should be a fixed link between the two systems. If both are running on the same computer this link may take the form of access to a common database. If the two are running on separate computer systems the link may be by an automatic, periodic update of the appropriate files, where the period could be anything from a few seconds to a few hours or a day. An alternative, but less effective approach is to exchange data with floppy disks or other media. However, this has the disadvantage that it requires operator intervention and the likelihood of delays in updating records.

Whatever option is chosen, the task is to ensure that the two systems each update the other with changes to data that both require, and to ensure that the warehouse management system receives timely instructions on goods in and goods out requirements.

WORKING WITH LIMITED SYSTEMS

Whatever the organisation and whatever the system, it is certain that there will be some limitations. Even if the system has been perfectly specified and well implemented, it is more than likely that over a period of time changes will take place in the business which cannot easily be accommodated by the system and unexpected constraints will arise.

In most organisations the warehouse system will be less than perfect and in many it will very limited, so what then can be done to get the best out of these.

An important principle to follow is that benefits come from information, not data. In all organisations it is easy to generate data. A good system turns this into management information which can be used to help make decisions. For example, the value of items sold is sound data, but it is not of much use for understanding the operation of the warehouse. However, understanding what these sales quantities mean in terms of unit loads moved and then looking at these as fast, medium and slow movers is valuable information which really helps the warehouse manager make decisions on how and where to store goods. The old axiom that "knowledge is power" is as true in a warehouse environment as anywhere else.

Analysis of data can provide information to help pinpoint weak areas so, if the system is inadequate, attention must be given to developing information in other ways. The following are a few basic guidelines on how this might be achieved.

- ∞ Make responsibilities clear - who is responsible for recording and analysing data to help measure the operation in materials handling terms.
- ∞ Impose procedural disciplines. In the extreme case of a fully automated warehouse, disciplines are imposed by definition. With real time warehouse management systems disciplines are imposed by giving one instruction at a time. In a less than perfect system it is easy to break rules unless strict standards of management are applied.
- ∞ Simplify paperwork and concentrate on recording the data that really counts. Use simple computer tools such as spreadsheets to help turn the data into information. This should be aimed at monitoring process operations as far as this is possible.
- ∞ Concentrate on being sure of information on the fast movers. When you are satisfied with this move on to the medium and then slow movers.
- ∞ Think of the information in terms of quality management, as a means of generating improvements.
- ∞ Record errors and start work to eliminate the source of these. Start with the most frequent error and work to find its cause. Change procedures if necessary to eliminate the error and then move on to the next one.

CONCLUSIONS

Inventory monitoring and measurement is vital for the successful operation of a modern warehouse. It is an essential part of an organisation's management information system. Some key points to remember are:-

- ∞ Inventory monitoring and measurement is not the same as inventory control.
- ∞ Inventory monitoring and measurement is much more than stock checking.
- ∞ Inventory monitoring and measurement is concerned with warehouse management and knowing all about the stock in the warehouse in terms of location and time.
- ∞ Good systems monitor the process to identify errors as they arise. Good systems are NOT primarily concerned with recording historic data.
- ∞ Information needs to be up to date. The more quickly changes can be monitored, the more accurate will be the measurement of the warehouse performance.

- ∞ Rapid update of information will help minimise errors and improve effectiveness.
- ∞ Some form of computerisation, over and above the inventory control system, is highly desirable and the higher the level of computerisation the more the monitoring and measurement process can be automated.
- ∞ Most benefits will come from the implementation of a computerised warehouse management system with data transfer facilities to other parts of the management information system, including the inventory control system.
- ∞ If the existing system is limited concentrate on knowing about the fast moving products and looking for the source of errors. Make sure procedural disciplines are imposed and deal with the problems one by one.

References

1. Tomlinson S J - *Warehouse Management and Measurement Software* - Warehouse & Distribution Efficiency '94 Conference, National Materials Handling Centre, Cranfield, Bedford, 1st-3rd February 1994
2. Burton R - *Implementation of Warehouse Management Systems at Marstons* - Warehouse & Distribution Efficiency '94 Conference, National Materials Handling Centre, Cranfield, Bedford, 1st-3rd February 1994

Selected bibliography

1. Gattorna J L (Ed.) - *The Gower Handbook of Logistics & Distribution Management, 4th edition* - Gower Publishing Company 1990
2. Howard K - *Inventory Management in Practice* - MCB University Press Limited 1984
3. Jessop D - *Storage and Supply of Materials, 5th edition* - Pitman Publishing, 1991
4. Rushton A and Oxley J - *Handbook of Logistics and Distribution Management*, - Kogan Page Limited 1991
5. Waters C D J - *Inventory Control and Management* - John Wiley & Sons Limited, 1992