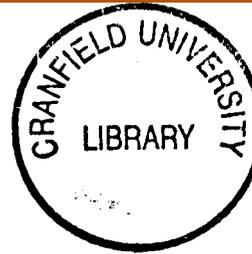




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**SWP. 1/95** **INFORMATION IN THE SUPPLY CHAIN:  
MEASURING SUPPLY CHAIN PERFORMANCE**

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## INFORMATION IN THE SUPPLY CHAIN: MEASURING SUPPLY CHAIN PERFORMANCE

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*Key words: Supply chain management; supply chain measurement; benchmarking; information management*

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### ABSTRACT

Information is one of many factors in the development of supply chain operations. It is a key factor in a number of new initiatives, such as: business process management, partnership development, efficient customer response, tighter integration of supply chain operations and outsourcing of ancillary operations.

Improvement of the supply chain takes place at different levels:

- simple efficiency (the Improvement of existing processes),
- improved quality of service (the redesign of business interfaces and procedures), and
- the radical restructuring of supply chain arrangements (more often talked about than actually done).

Progressive supply chain participants are working mostly at the second level, to improve the effectiveness and quality of service.

According to its general strategic approach and situation a business needs to measure different aspects of supply chain operations if it is to be successful. The combination of measures that might be needed in any real case will depend on the level of intended improvement, and such factors as: the characteristics of the supply chain; the nature of its constituent parts (goods, information and finance); the nature of the trading arrangements (and especially the cycle of trading activity from negotiation to final settlement). Using ideas presented here, this combination of measures can be managed more effectively, by first developing a list of candidate measures using a conceptual model, and then mapping them against a planning framework to ensure completeness and coherency.

# INFORMATION IN THE SUPPLY CHAIN: MEASURING SUPPLY CHAIN PERFORMANCE

## INTRODUCTION

### *Objectives of the paper*

The objectives of this paper are:

- to review recent supply chain developments, and to establish examine the role of information within them, especially with regard to supply chain measurement;
- to present a high level conceptual model for the supply chain incorporating the concept of information, and other critical elements;
- to develop an empirical framework for supply chain measurement, based on current practice and the concept model;
- to illustrate the application of the framework to measurement planning, using a simple example.

The paper draws on the work of a research project at Cranfield entitled "Supply Chain Information Management".

## INFORMATION RELATED CHANGE IN THE SUPPLY CHAIN

The management of information in the supply chain is one of today's key issues for logistics managers. We all know that "cheap information can substitute for expensive inventory" but how many of us have been able to put numbers to this argument. What else can we do with improved information management in the supply chain?

By looking at examples of current good practice we can see a number of trends, all of which are based in the advancing use of information technology and information systems. Two are particularly important and are engaging the attention of management teams around the world.

### ■ **Business process management**

Underpinning the increasing use of technology and systems is an increasing focus on business processes: by getting away from the organisational viewpoint and understanding how we deliver quality and value to our customers, we can markedly improve the performance of a business'. This is possible through a combination of technology acquisition, systems thinking, and cultural change.

### ■ **Partnership**

We can also see a great deal of literature dealing with business partnership and - predictably - the role that information plays in achieving it. Different kinds of partnership can be identified, for example based on customer-supplier relations, joint marketing effort, and even

on shared technologies and product standards. The sharing of information (and shared information systems) is at the heart of a fully developed partnership.

#### Efficient customer response

Business has become replete with acronyms, The field of logistics is no exception. One that comes to the fore (and about which we may be hearing much more in the future) is “**ECR**”: *efficient customer response*. Four recent authoritative studies of the US grocery industry all indicate that the industry’s present means of conducting business is poor and will have to change. Industry players are joining forces with the ultimate goal of ECR, which implies continuous replenishment by the supplier at the distribution centre and continuous replenishment by the supplier and the distributor at the store, so that all their parts and practices will eventually fit smoothly together. Already established in the USA, a comparable initiative is beginning in Europe (although it is often argued that Europe is already ahead of the USA no doubt we shall learn more of this in due course).

Implementing full ECR will take several years, depending upon a firm’s starting point and its ability to develop the necessary knowledge, talent and systems. The tools for implementing ECR already exist, although pricing strategies, information technology and promotion practices still need to be revamped.

#### Ancillary operations

Efficient response may be a very visible aspect of supply chain management, but in supporting the primary activities of a business we need also to pay attention to the provision of ancillary supplies such as packaging and arrangements for sub contracting or outsourcing transportation and other supply chain services. Experts suggest that the complexity of real supply chains, including ancillary activities, are such that shorter communications lines are needed and a separation of commercial and operational communication because each needs to be managed differently. Commercial information is filtered, but operational information needs to be complete and precise to avoid confusion and errors. The benefits can be substantial but there will be an organisational impact. The separation of operational and commercial communication will lead to a shift of tasks and responsibilities.

#### The width and breadth of longer term integration

Longer term as well as short term issues have to be taken into account, partly because (as is hinted above) realising the full benefits of logistics initiatives can take much longer than expected’. The extent of the information exchanged within a supply chain partnership is also wider than might be expected, as in the automotive industry. A review of supplier-customer relations in the US automobile industry contrasted the “exit” relationship where a customer that has a problem with a supplier finds a new supplier and the “voice” relationship where the customer works with the original supplier to solve the problem’. A rich flow of information is needed for the voice strategy, which also requires a high degree of commitment to the relationship. The research shows an impressive increase in the amount of information that suppliers provide to customers: statistical process control charts, cost breakdown of each production step and production scheduling information.

#### An ever finer focus on details

The *logistical precision* of what we are trying to manage is also deepening, so that the combination of buyer, supplier and product or market segment has to deal with uniquely to further improve supply chain performance. This leads to additional complexity that can only be dealt with if information systems are in good shape and fully supportive of the idea.

The term “Logistically Distinct Business Method” has been coined to describe this. A consequence is that the level of service and the general performance of the supply chain is not just geared to the participants but also to the needs of the end customer. We must not make the mistake of using the most highly refined logistics operation to service what is essentially a “cheap and cheerful” market, it is argued and with good reason!

#### Turning ideas around

Some of what is going on today takes conventional wisdom, and turns it completely around. For example, what about the concept of the “bad customer”?\* In certain markets suppliers pick and choose whom they sell to and the buyers strive to be the best possible kind of customer- with consistency of ordering, minimising changes to orders, and timely payments. Smart suppliers are reducing their customer base to get rid of ‘bad’ customers. At a simpler level businesses are challenging the need for traditional documents such as invoices and orders, when in an ideal world we ought to be able to do without them and make do with a single document -typically the delivery note.

#### Summary

The basis for supply chain and logistics improvement is far deeper than simple cost reduction and response improvement. The current wave of thinking is challenging our basic assumptions about how supply chains operate and setting completely new patterns of behaviour. Most interestingly, the roles that are adopted by the traditional players are changing. Companies that once provided basic transportation services are seeking to add value by providing information systems and management services; companies that once provided basic communications facilities are striving to put applications capability into place so that supply chain operators can just “plug in and go”. There are attempts- especially in Europe- to combine the management of different modes of transportation to achieve a single service based on road, rail and other forms of transpon.

## THE ROLE OF INFORMATION IN SUPPLY CHAIN IMPROVEMENT

### *Information technology push*

Just a few years ago any analysis of the expected benefits of information technology would be tightly focused on reduced costs and improved efficiency. For example, a survey EDI literature about four years ago found a clear concentration on cost reduction, the elimination of errors and simplification of administration. There was a hint of improved customer service and improved market share, but no real evidence that it was happening'.

We can all relate to the reduction of costs and the improvement of response time as basic, well-intentioned objectives for supply chain improvement. However, where the expected benefits are not simple and not directly related to financial gains, justifying an investment in new technology and business change becomes an act of faith, not just a decision based on an attractive discounted cash flow analysis. If we are seeking radical change, discounted cash flow analysis will not work because there will be no certainty in the calculations. This difficulty in justifying the investment leads to constrained thinking and an unwillingness to experiment. It is only when a business has an agreed strategy that strategic investment becomes acceptable.

### *Business pull*

It therefore behoves any business to be quite clear about what its strategy if it wants to be a low-cost provider then a financial analysis of the benefits of information technology investments will be a pre-requisite, to show that the cost will be balanced by increased revenues or increased margin. If however a business is intending to differentiate its services and charge premium prices, a financial analysis alone will not be sufficient. It may not even be relevant because the important requirement is that new systems directly support the business strategy, by providing differentiating features or exceptionally high levels of service. Such strategic systems will be funded from strategic development funds, not from operational revenues.

### *Some examples*

#### ▪ **Improving merchandise flow**

By sharing information with suppliers, JC Penny has been able to improve the speed at which merchandise flows. For example every week 200 catalogue division suppliers receive updated forecasts of needs by size and colour for the remainder of the season. Suppliers are also able to develop products that customers desire.”

#### ▪ **Successful outsourcing- the providers' view**

The contract warehousing and distribution industry has had a reactive rather than a proactive image when it comes to information technology (IT). However, changes in computer technology and a growing emphasis on networking are both putting the IT spotlight on the distribution sector. Distributors are realising that they are the natural hub in the supply chain, linking manufacturers to retailers in every day operational sense. As a result, they are in a pivotal position to build these electronic networks of the future.”

■ **Successful outsourcing - the buyers' view**

A survey involving 30 customers and 20 logistics service providers in Europe shows that alliances are being formed following corporate restructuring by manufacturers, either by focusing on fewer factories with distant outsourced regional distribution centres or by focusing on core competencies and outsourcing logistics. As more transporters, warehousemen and forwarders pile into the market for integrated logistics services success will come from a focused strategy, an emphasis on adding value, and good information systems to provide accurate measurement of performance. It will also take on secondary manufacturing activities such as assembly, price marking, labelling, reconditioning and recycling.<sup>14</sup>\*

■ **Sell-one-make-one**

This approach represents a highly developed form of supply chain management and channel integration, and it is claimed to provide unmatched competitive capabilities. For example, Sony has made considerable progress in developing “fluid” production and distribution operation. Sony calls its system sell-one-make-one (SOMO). The key elements of the “fluid” operations approach include:

- inventory visibility
- management of flow, not replenishment
- flexible distribution
- just-in-time manufacturing
- inter-functional cohesion, and
- advanced information systems.

A “fluid” operations system provides companies with a competitive advantage by furnishing an operating profile that is well controlled, low-cost, flexible, and responsive to market needs and directions.<sup>13</sup>

■ **Forecasting the impossible**

Most companies still treat the world as if it were predictable, when in fact inaccurate forecasts lead to serious stockouts or price markdowns. “Accurate response” is a new approach to forecasting which takes into account missed sales opportunities and distinguishes those products for which demand is relatively predictable from those for which demand is relatively unpredictable. Use of this information enables companies to realise the power of shorter cycle times and flexible manufacturing more effectively. A definitive article in the Harvard Business Review explains accurate response clearly, with examples based on clothes retailing.”

■ **Order fulfilment time success story**

A report on the success of retailer Tesco in the UK, and the way in which the company's method of working with its suppliers has been transformed, reveals EDI at the heart of Tesco's relationship with many of its suppliers, TEDI initially covered orders and invoices, but has since been expanded to deal with forecasting data and provisional orders. For Tesco, the time between ordering from a supplier and receiving delivery, which was ten days in 1984, is now mostly down to between 24 and 48 hours. The amount of stock held, and availability and freshness of products, can be monitored.<sup>15</sup>

■ **Innovative inventory management at the heart of partnership**

The Procter & Gamble and Wal-Mart story is perhaps the most often quoted, in terms of supply chain restructuring and innovative thinking about inventories. The two companies are as close today as they ever were, and the partnership is critically dependent upon information sharing, mutual performance assessment and open **accounting**.<sup>16</sup>

■ **Open book accounting becomes the norm**

The result of a survey of 27 manufacturing companies indicates that many customers require some **supplier cost data**. Foreign subsidiaries, especially Japanese firms, required wider details of the costs underpinning component prices than their UK counterparts. The survey indicated that where these data are used in a constructive manner, rather than just to pressure supplier margins and effective cooperation, effective cooperation in the generation of efficiencies is possible.”

■ **Customer management**

Customer service is a key differentiator today. Effective logistics is the key ingredient to achieving this quality. Issues such as activity based costing, assessing the important cost drivers and the careful generation of an effective cost model are central to balancing costs to maximise customer service (and also to understanding the contribution to profit of each **customer**).<sup>18</sup>

■ **Balancing trade-offs**

One review discusses **changes** in the operating task as a result of the introduction of new systems and techniques. There is a consequent trade off between the operating performance and the provision of individual customer service. Similarly supply chain integration has initial implications to the flexibility available to the customer, but there are ways by which integration can actually provide improved **operating performance**.<sup>19</sup>

■ **Benchmarking**

“Benchmarking” is the comparison of one business’s performance with that of others. Sometimes it happens within large organisations with many divisions; in other cases it is done with competitors or across different industries. Xerox started using the benchmarking technique in 1979 to analyse unit production costs in manufacturing, and the resulting changes in operations were so successful that top management directed all units and cost centres in the corporation to use benchmarking.

Investigating non-competitors rather than competitors is advantageous. Non-competitors are more likely to cooperate, and in the case of Xerox its benchmarking experiences with LL Bean led to the incorporation of certain LL Bean practices in warehouse operational and modernisation practices. On the other hand, LL Bean has benefited from seeing the benchmarking process, which it has now adopted as part of its own **operating process**.<sup>20</sup>

Benchmarking whole supply chain operations is less common than the analysis of relatively confined areas of business. A common approach is to survey the attitudes of customers, but this leads to a limited view of the **actual performance** achieved and it is not necessarily easy to see where **improvements** can be made and how information technology and systems can contribute”.

These examples all show how information in the supply chain is becoming increasingly important and that the role of information in supply chain measurement is a key component of recent strategic

developments in many organisations. The JC Penny case and the Harvard work on accurate forecasting are both focused on new ways to measure and communicate demand; the success of third party services is clearly based on the visibility and clarity of service level measurements, and Sony's approach to flow management is critically dependent on the availability of a wide range of measures.

Tesco has a clear vision of cost and time information, and Wal-Mart and P&G seem to be willing to share anything and everything. The trend to sharing financial information is unlikely to abate and is at the heart of some partnership initiatives; P&G use activity based costing as a key tool in exposing issues to be resolved at the interface with their partners, by analysing the cost of ~~the~~ *interface* rather than each business individually, and they are not alone.

One of the most common ambitions is to benchmark. This requires that we understand very clearly what we are trying to achieve, and what we need to measure to succeed. Trading-off one thing against another is the name of the game, and without proper measures and controls in place we will be unable to manage our affairs, except perhaps in the short term.



## MEASURING THE SUPPLY CHAIN

Underlying the evidence about the importance of supply chain measurement is the need to understand what we are trying to achieve in our business.

### *A taxonomy of strategic benefits*

At Cranfield we have always worked with the idea that there are three levels of benefit in the application of information technology”:

- Efficiency:**            “*doing things right*”
- Effectiveness:**      “*doing the right thing*”
- Evolution:**           “*doing something else*”.

To these we might add two others at the extremes: purely defensive and purely experimental supply chain activity:

- Defensive:**            reacting to moves made by competitors.
- Experimental:**       trying to understand new opportunities.

The latter category is particularly important for any business that wishes to be at the leading edge of good practice. However, here our main focus is on the central three levels of benefit.

- **Cost and time savings: efficiency in the supply chain**

Some management attitudes are constantly focused on the need to optimise: to improve productivity, to reduce costs and to increase the margin of profit. Investment in information technology will be aimed at achieving this, and no more. Activity Based Costing will be a primary means of measuring current cost levels, identifying potential improvements and gains actually achieved in the event.

This is all very well in stable markets which rarely change, but it is disastrous in a market which is evolving and constantly presenting new challenges. A business that ignores a changing environment will not survive competitive threat. *Efficiency* is therefore a legitimate business strategy in mature markets where the competition is known and where most of the competitive advantage has already been worked out. By any analysis the business of supply chain management is not mature nor is it stable; we must therefore set our sights higher than simple efficiency. Those who concentrate only on the measurement of time and costs will fail to see problems and opportunities until it is likely to be too late.

- **Quality improvement: effectiveness in the supply chain**

Where management is more outgoing and concerned with quality, excellence and image, we can see the signs of *effectiveness* thinking. Information technology will be used to improve the business image and the level of service provided to customers. It is at this level that much current improvement effort is aimed. Here we need to measure customer service levels and assess their feelings about how well we are doing.

- **Radical evolution of the supply chain**

Radical change in business about extending markets and re-defining them, even making new markets. This is just not possible where managers are preoccupied with efficiency and effectiveness matters. Old systems have to be discarded, and the business has to change

markedly if the fullest benefit of new technologies is to be realised. Even the concept of the customer can be challenged (as we have noted already) in order to find completely new ways of doing business.

At this level we need to find some things that will change, in order to preserve the sanity of management and the workforce, and to find some measures which will still be valid and which will give us the information we need about the achievement of objectives. Here we need the widest possible view of what could be measured, so that we can pick and choose the focal points for management's attention through what will be a very difficult period.

### *Intuitive measures of supply chain performance*

A quick brainstorming session with a group of senior logistics and supply chain service managers recently led to list of "candidate" measures of supply chain performance shown in the table<sup>23</sup>.

Such a list as this is useful to get our thoughts moving, but it is not structured. These measures are in part subjective and part quantitative. In applying them, they also raise the question of the *boundary* within which they are to be used: is it just one company, or is it many? Is it to take account of just one product line, or many? Where does the supply chain start and where does it end?

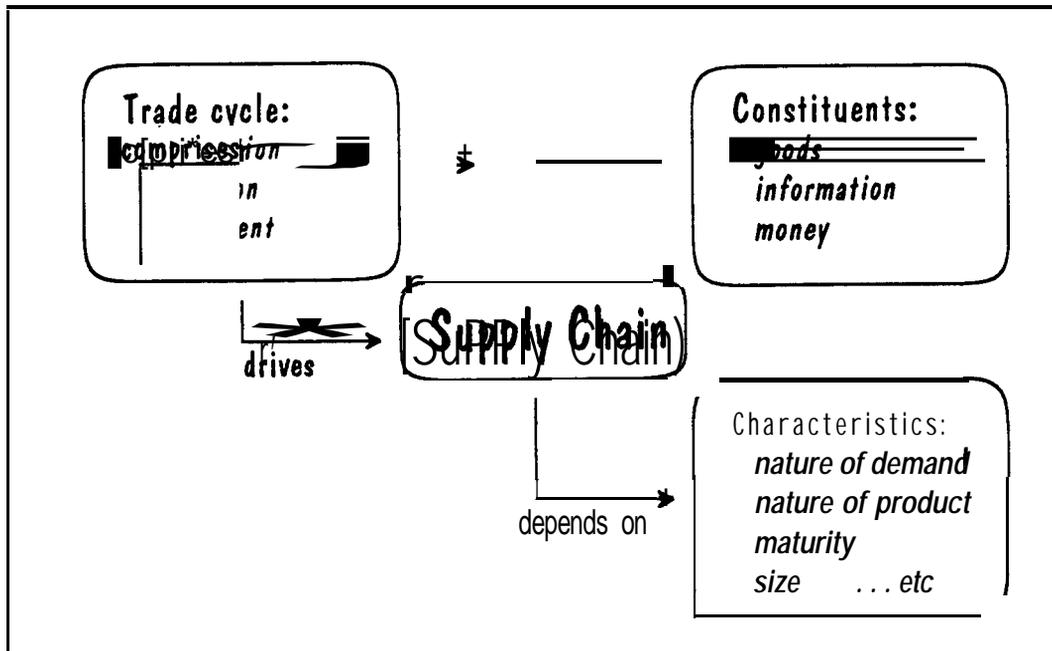
What is needed is a wider framework of possible measurement, to fill out our understanding of what could be measured and what needs to be measured, if we are to succeed in achieving improvement. What we need is a fairly rich mixture, possibly centred on cost and time improvement (the popular quality management maxim of "cost, time and quality comes to mind"), but including a wider variety of other candidate measures.

<i>Throughput efficiency</i>
<i>Time waiting</i>
<i>Throughput and frequency of orders</i>
<i>Information movements per consignment</i>
<i>Billing transactions per consignment</i>
<i>Number of changes of custody</i>
<i>Reliability</i>
<i>Timeliness</i>
<i>Number of complaints, errors and problem</i>
<i>Cash flow efficiency</i>
<i>Cost per sale</i>

### *A high-level taxonomy of the supply chain itself*

In order to put more structure into place, it is helpful to have a fundamental model of supply chain structure with which to organise our thoughts. A conceptual model has been developed and a simplified overview is presented here<sup>24</sup>. It comprises the following key elements:

- the supply chain itself, as an abstract entity
- the trade cycle which exercises the supply chain
- the characteristics of the supply chain
- the constituents of the supply chain: goods, information and money.



A high level taxonomy of the supply chain

### The trade cycle

Trade takes place in cycles and there may be radical differences between the different points in a supply chain performance analysis is often based on the a “steady state” but this is not necessarily the case, especially in today’s business

Typically, a cycle of trade goes through three stages:

- In the early stages a trade negotiates. The time that it takes to complete the arrangements for trading can be a critical factor in achieving business success when many areas of the global economy are so subject to change that trade are very volatile.
- In the middle stages execution. This could be the delivery of a single consignment with further activity until completely new terms are negotiated. Or, it could be an extended period of time during which steady and consistent trading takes regular placement and fulfilment of orders.
- In the final stages a trade has settled. This brings us back to the question of the financial arrangements, but we might remember that these are best negotiated at the beginning.

Let us note that the most appropriate measurements of supply chain performance will be different within each of these three stages, and that the achieved level of performance might vary over time. It would be wrong to expect equal performance at the beginning and end of the cycle. If one understands the differences at different points in the cycle, then the overall cycle can be managed better and the benefit of the whole cycle of trade optimised.

### *Characteristics of a supply chain*

The characteristics of a supply chain include such things as:

- *Size:* the length and breadth, in terms of the business activity involved.
- *Power:* where is the power, and how is it deployed?
- *Maturity:* mature supply chains have to be dealt with differently from formative ones.
- *Attitude:* participants may be adversarial or cooperative; they might be truthful or not.
- *Demand:* the nature of demand is critical it might be constant or not.
- *Product:* the product might be perishable, life threatening, or critical to sustaining life.
- *Volume:* some supply chains are full of slow or static goods, others are lean and mean.
- *Consistency:* some might be erratic and others might be variable.

We can see the benefits of good information management at every point in this list. Good use of systems will leverage our ability to cope with size and volume they will shift the basis of competition with competitors or render partnerships more effective.

*To be complete, any measurement of a supply chain needs to take account of all these characteristics. Where one supply chain is being compared with another (as in benchmarking), it is critical & important to do so to achieve comparability. Where performance is being tracked within one business year on year (or month on month), any change in these characteristics could invalidate the measurements, if the change is not noted and accounted for.*

### *Constituents of the supply chain*

Each of the above supply chain characteristics may apply differently when assessed against the three main constituents of the supply chain: *goods, information and money.*

For example, the most modern hi-tech goods might be shipped through quite traditional means, supported by traditional letters of credit. The banks may be cooperative but the shippers adversarial, and the supply chain itself might be entirely contained within one multi-national conglomerate or be comprised of hundreds of small companies.

Good information management will help to track the movement of goods and improve the timeliness and efficiency of operations. Improved use and management of information in the supply chain is a primary current opportunity, and it is intimately connected with the provision of measurement data.

*In measuring supply chain performance we can not divorce the goods from the information and the money. In the last analysis improvement will always be seen in financial terms even if over a long period of time. We must understand the performance of each, and work to harmonise and synchronise the management of each of these primary constituents of the supply chain. In the case of the banks, they need to understand what their contribution really is, and understand the costs of providing it; generally they do not.*

### *Getting a grip on things*

This examination of current practice, and the essential conceptual elements in a supply chain leads to a potential requirement for much more sophisticated measurement than we are used to. There are

different dimensions, including strategic context, nature of the trade, and the nature of chain itself can vary dramatically internally and as it is seen by participants and users.

We should therefore be able to manage our affairs more effectively if we can find a simple way to bring these disparate things together.

## A DETAILED MEASUREMENT FRAMEWORK

### Supply chain characteristics and constituents

First, we must recognise that each of the supply chain constituents may have a quite different nature and therefore different characteristics.

In order to understand the kind of supply chain that we are dealing with, especially in optimising steady state ~~supply chain characteristics~~ can be measured within the following framework, separating ~~goods, information and money~~. The actual measures to be used will vary from simple ones (for example the volume of money is just cash flow) to more complex ones (the ~~information in the supply chain~~ would have to be dealt with by subjective assessment):

Characteristic	Goods	Information	Money
Size (length and breadth)			
Distribution of power			
Maturity			
Attitude			
Demand			
Volume			
Consistency			

### Supply chain characteristics and trade

In order to get a finer level of understanding of the dynamics of the supply chain process we can focus in and measure the same characteristics at different stages in the execution: ~~negotiation, execution and settlement~~, because they might change from one to the next:

Characteristic	Negotiation	Execution	Settlement
Size (length and breadth)			
<b>Distribution</b> of power			
Maturity			
Attitude			
Demand			
Volume			
Consistency			

### Time, cost and quality of constituents

At the basic operational level ~~supply chain~~ performance can be measured in three ~~time, cost and quality~~. For example, for each of goods, information and money we can measure these three performance characteristics and this is the main focus of much benchmarking activity:

<b>Component</b>	<b>Time</b>	<b>cost</b>	<b>Quality</b>
Goods			
information			
Money			

***Time, cost and quality of trade cycle***

For each stage in the execution of **trade**, we can measure the same key characteristics:

<b>Stage in trade cycle</b>	<b>Time</b>	<b>cost</b>	<b>Quality</b>
Negotiation			
Execution			
Settlement			

***Width and depth***

And so we come to the key question of the size of a supply chain. We need to know the basic volumes and quantities involved, at the level of key entities such as consignment, key documents and participants. This is critical operational information, especially for the service providers. To the volume data, we can add measures of activity, and basic ratio measures (such as the number of orders per customer, or the number of consignments per warehouse).

<b>'Real' entities</b>	<b>Volume/ Number</b>	<b>Active time</b>	<b>Idle time</b>
Consignment			
Change of custody			

<b>"Information" entities</b>	<b>Volume/ Number</b>	<b>Ratios</b>	<b>Lifecycie</b>
Order			
Payment			
Error			

<b>"Organisational" entities</b>	<b>Volume / Number</b>	<b>Ratios</b>	<b>Proportion of total</b>
Customer			
<b>Supplier</b>			
Service provider			

Within these framework **existing** and additional "candidate" measures can be analysed and positioned, and different measurement profiles can be developed for different situations.

## AN ILLUSTRATION

Using the framework, it is possible to understand more easily the things that need to be measured and managed. An assessment of what is possible and what is sensible can be achieved in two stages:

- First, each of the primary elements of the supply chain model can be visited to establish a first list of measures on a rational (and hopefully complete) basis.
- Second, the resulting candidate measures can be mapped to the sub-frameworks to see how complete and balanced they really are, in the widest possible context. This is done very rapidly, by inspection.

For example, consider the case where an air carrier is considering developing its involvement in a particular market sector – say, the supply of fresh flowers. How compatible is the airline business with this business? Will its capabilities and control systems be appropriate? How would it measure the contribution that it makes? The planning process is illustrated in the paragraphs below.

### *Example: exploration of the conceptual model*

#### *Characteristics*

The nature of the product is highly perishable, so the performance of the supply chain will centre on the speed with which delivery can be achieved – not just airport to airport, but door to door. Demand will be variable, and different from one part of the world to another. Providing the best possible information about likely demand will be an important contribution to overall success. The length and breadth of the supply chain will be great, leading to great benefits if it can be optimally utilised. Without a single view of what is going on, there is likely to be a great deal of waste and lost product: flowers that are past their best, and flowers in the wrong place at the wrong time.

*An airline is – potential & – in a very good position to deal with this problem of garnering information about demand and consolidating it. They have networks in place, and their culture already understands about the variable nature of demand (for airline seats) and the importance of information about it (passengers and their patterns of behaviour).*

#### *Constituent parts: goods, information and money*

Because of the timescales and the nature of the product, the timeliness of information about demand, availability, shipments and delivery will be critical. It is not allowable that we learn about actual sales weeks after they have happened, we need to know within hours or even minutes of their happening. There needs to be a tight relationship between the movement of consignments and the movement of information about them.

The flow of money is the converse of the flow of goods. Initially the money coming into this supply chain is mostly cash, from individual buyers of flowers. Getting the money back down the supply chain will involve increasing delays, to the disadvantage of the original supplier. This arrangement can only work with extensive staged credit facilities, and the only people who benefit from this are the banks! Any organisation with an overview of the whole supply chain and some financial competence has the opportunity to provide not just information and transportation services, financial services which minimise the cost of credit.

*Again, an airline is potentially in a good position to deal with this. They understand about foreign exchange and the way in which composite services (flights) can be reliably costed and priced (the*

itinerary). These **competencies** are **exactly** what is needed to deal with complex supply chain settlements.

### **Trading cycle**

One imagines that the flower trade is steady. Established groups of growers work with known wholesale buyers and there are long-standing relationships. In this situation it is worth investing heavily in optimising the supply chain for the execution of trade, rather than for negotiation. Further, much trade in flowers is achieved by auction. Negotiation is - in effect - minimal at an auction. Any buyer can choose to bid for any lot, under the auctioneer's standard terms of **sale**. Settlement is a different matter, as we have noted.

*This works to the advantage **of** an airline, which itself has an over-riding need to optimise its operations and which has a rapid cycle **of** negotiation with passengers, lasting just a **few** minutes for journeys that will take many hours.*

### **The measurement requirements**

By summarising this analysis we can see that the air carrier would be particularly interested in measuring the following things:

- Volatility of demand over time*
- Time to receive and process orders*
- Time to initiate shipment*
- Time to deliver (door to door, **and for** each step in the overall process)*
- Overall lag between **demand** and **supply***
- Wasted product*
- Volume of product and **cash** in the **supply** chain system*
- Extent **of** credit in the **supply chain** system*
- Cost of negotiation*
- Cost of shipment (**overall, and for** each step)*
- Cost **of** settlement*

With this measurement data to hand, the carrier would not only have a controlling influence on the overall supply chain, they would also know precisely where costs were incurred and how they might be reduced, and where time might also be trimmed back. But is the measurement plan complete?

### **Example: Checking completeness and consistency**

In the consolidated table below, the above measures are mapped to the sub-frameworks so that we can make a judgement about the real extent and completeness of the candidate measures. Clearly, only a small portion of the framework has been populated, but it is not for us to judge whether this is good or bad.

The final judgement would have to rest with those directly concerned. No analytical method like this can produce the right answer: it can only help to make a more informed and rational judgement, on the basis of completeness and coherency. However, a cursory inspection of the mapping raises questions such as: Does the airline understand the prevailing attitude to the goods, and should this be changed (first block)? Does some work need to be done to understand the trading cycle (second block)? Can the cost of money be targeted in order to gain a competitive position (third block)? And so on, until all concerned are satisfied that a viable, complete measurement plan is agreed.

Consolidated measurement framework, with an illustrative mapping			
<b>Characteristic</b>	<b>Goods</b>	<b>Information</b>	<b>Money</b>
Size (length and breadth)			
Distribution of power			
<b>Maturity</b>	???		
<b>Attitude</b>			
Demand	• Variability of demand over time		
Volume	• Volume of product and cash in the supply chain system		• Extent of credit in the supply chain system
Consistency			
<b>Characteristic</b>	<b>Negotiation</b>	<b>Execution</b>	<b>Settlement</b>
Size (length and breadth)			
Distribution of power			
Maturity			
Attitude		???	
Demand			
Volume			
Consistency			
<b>Component</b>	<b>Time</b>	<b>Cost</b>	<b>Quality</b>
<b>Goods</b>	• Time to initiate shipment		▪ Wasted product
Information	• Time to receive and process orders		
	• Overall lag between demand and supply		
Money		???	
<b>Stage in trade cycle</b>	<b>Time</b>	<b>cost</b>	<b>Quality</b>
<b>Verification</b>		• Cost of negotiation	
Execution	▪ Time to deliver (door to door, and for each step in the overall process)	• Cost of shipment (overall, and for each step)	
Settlement		• Cost of settlement	
<b>'Real' entities</b>	<b>Volume / Number</b>	<b>Active time</b>	<b>Idle time</b>
Consignment			
Change of custody			
<b>'Information entities</b>	<b>Volume / Number</b>	<b>Ratios</b>	<b>Lifecycle</b>
Order			
Payment			
Error			
<b>'Organisational' entities</b>	<b>Volume / Number</b>	<b>Ratios</b>	<b>Proportion of total</b>
Customer			
Supplier			
Service provider			

## SUMMARY

This paper has presented a review of current practice in supply chain management, with a view to learning more about the role of information, and especially the information that describes performance: the supply chain measures.

Drawing on a conceptual model and the work of a sponsored research project at Cranfield, a framework has been developed which, it is thought, will help managers to plan more effective measures which recognise the sometimes dramatic differences between one supply chain and another.

## POSTSCRIPT

The illustrative analysis of the “fit” between the airline business and the supply of fresh flowers is based on an analysis of the critical areas that have to be managed and the measures that would help to achieve successful management. It begins to show how a business with certain competencies (based on its ability to control one kind of business) might be able to succeed in entering a different business (because it understands similar critical areas and has measurement and other systems in place).

The analysis was just a fantasy, but it makes a good point: any business can extend itself and approach new markets if it has appropriate transferable skills. At the start of this paper we noted that *business process management* and *partnership* were two key features of today’s progressive businesses. This will continue to be the case. Activity based costing will become more widespread because it is the means whereby the cost of process execution and the apportionment of shared costs can be dealt with. Business processes which are automated with information technology will become self monitoring, and it is therefore doubly important that we have a strategy for measuring the performance of *composite* business activity so that the numbers still add up and make sense. In this way the integrity of the overall measurement of performance will be maintained, and management will have something reliable with which to manage.

In a more distant scenario, these business systems might just start to manage themselves. Already the leading practitioners of supply chain management are talking about “process monitors” which will automatically track the performance of a supply chain, and hunt up and down it to find out where problems are occurring. Soon we will have systems for managing systems, and the first businesses to identify how this might be achieved will set new levels of excellence in supply chain management and business success- which will be unattainable by human effort alone.

- 1 See "Making alliances and partnerships work" (I/S Analyzer Vol: 3 1 Iss: 10 pp. 1-14), which provides a good overview the role of IS in process management.
- 2 "Information Partnerships - Shared Data, Shared Scale", (Konsynski, Berm R; McFarlan, F. Warren, Harvard Business Review, Vol: 68 Iss: 5 pp: 114-120) discusses the shifting basis for competition and provides a categorization of information partnerships.
- 3 See "ECR '93: Playing the consumer card in supply chain management" (Partch. Ken; Supermarket Business, Vol. 48, nos. 5, pp. 29-34)
- 4 See "Co-Makership in the Delivery of Packaging Materials" (Konijnendijk, Paul; Wijngaard. Jacob: International Journal of Operations & Production Management, Vol: 11 Iss: 3 pp: 21-31) which develops this idea.
- 5 See 'Primary Supplier Relationships for All Inventory Items Can Reduce a Hospital's Operating Costs' (Johnston, David H; Hospital Materials Management Vol: 17 Iss: 4 pp: 17-18). which argues the case for longer term benefits.
- 6 "How much has really changed between US automakers and their suppliers?" (Helper, Susan; Sloan Management Review, Summer 199 1 pp: 15-27)
- 7 "Tailored Logistics : The next advantage" (Fuller, Joseph B.; O Conner, James; Rawlinson. Richard; Harvard Business Review)
- 8 "Are You a Bad Customer'." (Sheridan, John H; Industry Week Vol: 240 Iss: 16 pp: 24-34)
- 9 "EDI: managing the costs and benefits" (Andy Bytheway; Proceedings of EDI '91, London)
- 10 "Partnering for quick response at JCPenny" (Oestermeider, James E; Retail Business Review, Vol: 61 Iss: 4 pp: 4-8)
- 11 "Information Technology - And the third party" (Spibey. George; Logistics Focus, Vol. 1. Nos. 3, pp.4-6)
- 12 "Logistics alliances: The European experience" (Laarhoven, Peter van; Sharman, Graham; The McKinsey Quarterly, Number 1 1994)
- 13 "What is 'fluid distribution'?" (Copacino, William C; Traffic Management, Vol. 32, Nos. 4, pp. 35)
- 14 "Making supply meet demand" (Fisher, Marshall L; Hammond, Janice H; Obermeyer, Walter R; Raman, Ananth; Harvard Business Review, May-June 1994 pp 83-93)
- 15 "Profit through partnership" (Anonymous; International Journal of Retail & Distribution Management Vol: 21 Iss: 5 p. VII supl.)
- 16 For example, see "Pritchrtt on Quick response" (Anonymous; Discount Merchandiser. Vol.: 32. No: 4, pp. 64-6572)
- 17 "Accounting cost data disclosure and buyer-supplier partnerships - A research note" (Munday, Max; Management Accounting Research, Vol: 3 Iss: 3 pp: 245-250)
- 18 "Logistics' mandate : Customer Satisfaction" (Anonymous; Transportation & Distribution, Vol. 34. No. 12, pp. 28-33)
- 19 "The Impact of Supply Chain Integration on Operating Performance" (Armistead, Colin; Mapes, J.; Logistics Information Management : Information in the supply chain, Vol. 6, No. 4. pp. 0-14)
- 20 "How to measure yourself against the best" (Tucker, Frances Gailher, Zivan, Seymour M.. Camp Robert C.; Harvard Business Review, Vol. 65. Nos. 1, pp. 8- 10)
- 21 See: Christopher M, "Logistics and Supply Chain Management", Pitman 1992, pp80-103 for a detailed discussion of measurement techniques at this level.
- 22 For a discussion in the context of EDI see: Bytheway and Dyer, "EDI: Persuading Senior Management", Proc Compat '90. Madrid 1990

- <sup>23</sup> Documented in: Bytheway A J, Lee P and Bentley A, "Supply chain measurement: a revised framework", **Cranfield** project working paper, April 1994
- <sup>24</sup> A more detailed version of this model is documented in: Bytheway A J. "Supply Chain Concept Model", Cranfield ~~project~~ working ~~paper~~, July 1994

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