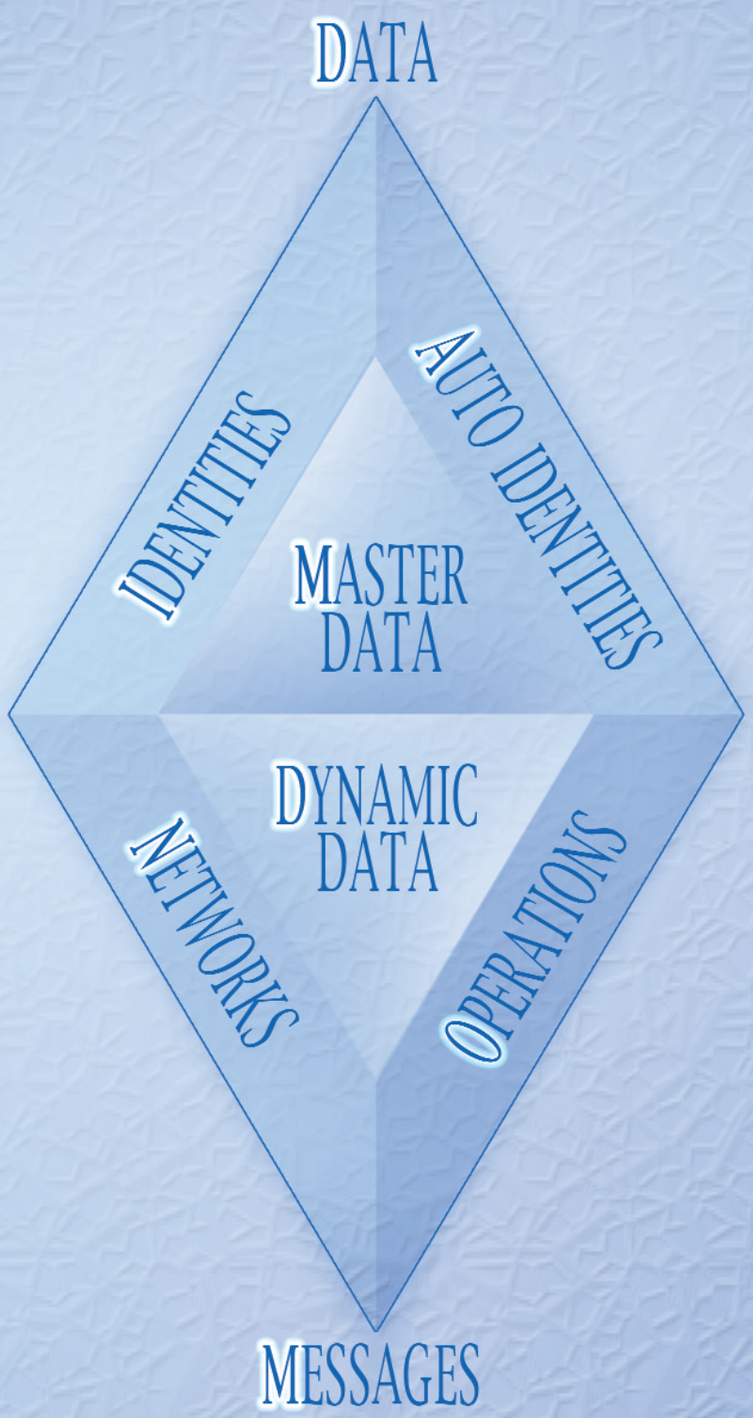
D·I·A·M·O·N·D

A General Theory Of Value Chain Management Data

Adding Strength And Sparkle To Your Value Chain



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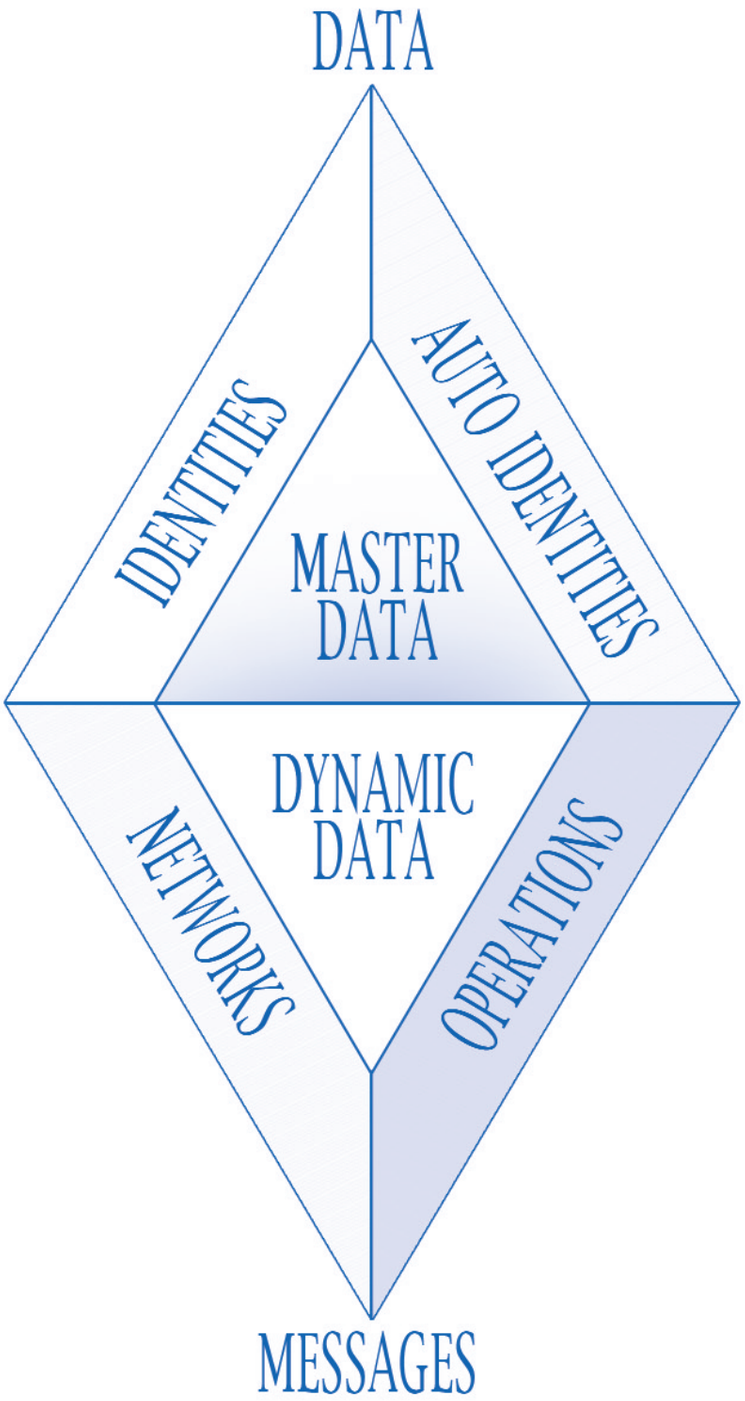

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Preface

Over the years, I have worked within and studied quite a number of diverse value chains: in the food and fast-moving consumer goods industries, in international trade sectors covering many different items, in health and defence. For any value chain to operate at all there have to be ways to identify the participants and the products, to store and use data about these, and to communicate messages and data among the participants. However, for a value chain to operate well (with strength and sparkle), identities, data and communications should be structured in a powerful, standard, global way so that all customers and suppliers across the world can operate effectively within a common framework. Most organisations have gone some way towards this objective, but few have gone as far as they should in order to maximise the benefit to themselves and to their value chain partners. Most do not have the cutting edge of a genuine value chain DIAMOND – they have flaws, i.e. they have not systematically applied global standards for communicating **D**ata within messages, for determining **I**dentities, for capturing **A**uto Identities linked to synchronised **M**aster Data across all their value chain **O**perations, enabled by e.business **N**etworks and analysed via **D**ynamic Data Bases. This publication shows how this should be done through the application of a general theory of value chain management data, and it indicates many of the standards which should be employed. It also proposes areas for further research and development.

When I showed an early draft to a colleague, he wondered why I was writing this document, since the conclusions were "obvious". The reason for producing this publication is to clarify and disseminate the obvious for the many areas of national and international activity where the obvious is not yet "blinding". Too many organisations and value chains lack this sparkle. For example, major consultancies and government departments continue to confuse the "classification" of products with their "identification" (e.g. the UNSPSC classification system is not a substitute for the EAN identification system). That is, expenditure can be analysed by category of item, but individual items cannot be effectively managed and/or tracked. Too many e.exchanges have been set up to synchronise master or catalogue data for trading partners without a proper understanding of standard identification of products and trading locations, and without effective work by each partner on "cleaning up" their own master data structures. International trading is largely governed by ineffective identification of consignments rather than by the systematic identification of traders, countries, items and their logistics units, along with well-structured master data. Too many ID systems define the same item in different ways and too many organisations have a variety of incomplete and overlapping master data files and data bases. Too often, individuals and businesses are identified in a variety of different and incompatible ways, resulting in poorer service to them and to official bodies at a high total cost. Too often, safety and security initiatives are pursued separately from improvements in value chain management. There is also a lack of awareness of the global standards which have already been developed for value chain data, and even a lack of awareness within standards bodies of how their standards pieces ought to fit into the entire value chain management standards jigsaw puzzle.

Therefore this publication is aimed not only at the "sad" people like me who enjoy developing and using standards, but also at senior management, researchers and consultants in all sectors of the global economy who should know better. The aim is to strengthen the fundamentals of modern value chains and thereby to promote sparkling performance. In particular, if the principles described in DIAMOND are followed, organisations will be able to achieve not only speed, certainty and low total cost across their value chains, but also greatly enhanced safety and security.

A. Introduction and Overview

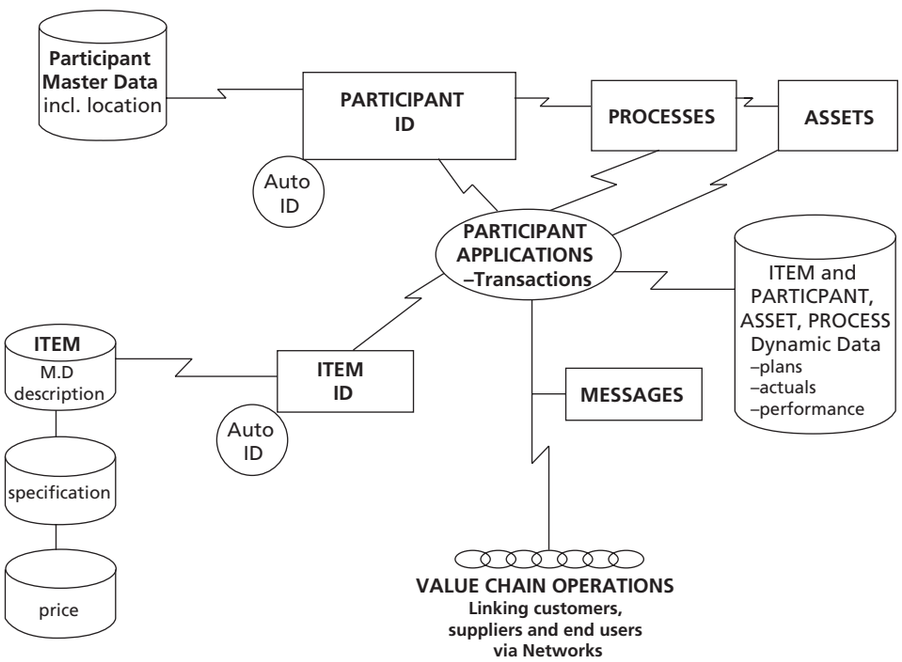
The objective of value chain management is to achieve the highest practicable and sustainable level of service to the end user and to each of the key participants in the chain or network at an acceptably low total cost and at acceptable levels of risk. The end user is the final customer, client, consumer or operator in the chain for whom the products or services are provided. Total or whole-life cost includes all the resources expended to provide that product or service, including prices paid, R&D, operational costs, training, support, maintenance and enhancement, inventory, waste, capital employed and capacity utilisation, disposal, etc. The service level is measured not only by, for example, the percentage of orders or requirements met in full on time, but also by the associated degree of risk involved, i.e. the level of safety and security (e.g. patient safety, or security of supply of parts and fuel for a machine, or ammunition and food for a soldier). Value chain management can be ongoing or can relate to the completion of a specific project. Service to the end user is composed of the level of performance and timeliness, of speed and certainty at an acceptable total cost and at acceptable levels of risk.

Running a value chain cost-effectively demands clarity about decision-taking and also about the supporting data – who is to take which decision on the basis of what information; what data are to be shared, with what timeliness and accuracy; what messages need to be communicated; what factors in the value chain need to be individually identified, and so on. Costs increase with the levels of uncertainty – "uncertainty is the mother of inventory" – and of waste and excess distribution and production capacities, etc. Uncertainty arises both from the natural dynamics of markets, consumers, customers, suppliers and technologies and also from the failure of organisations to collaborate well (see Reference C). We need to understand the difference between the two, to manage the former and to minimise the latter.

While there is a wealth of information and experience relating to individual components of value chain management data, this paper argues that there is not yet comprehensive and widespread agreement on, or understanding of, the overall application and integration of these. It therefore proposes the general principles described below.

Value chain management data should be considered as having five main forms (summarised in Diagram 1).

Diagram 1: Key value chain management data



1. Identities

There needs to be a system of identification of:

(a) the value chain Participants and their Locations;

(b) the Items (products and services in their various forms);

(c) the Processes (rules, treatments, recipes, etc); and

(d) the Assets.

This should be achieved via the smallest practical number of globally accepted systems of numbering, preferably employing unique and non-meaningful identities. That is, the coding system should not have inbuilt meaning, since "meaningful" numbers/codes imply human recognition rather than computerised data, require extra digits, and hence introduce a potential lack of accuracy and higher costs of operation. Meaning should be derived from associated Master Data Files. While there will be essential differences in what needs to be identified in order to support the effective management of each value chain, the principles to be followed are very largely identical for all value chains. These are given in Section B on page 6.

2. Auto-Identification

The ID numbers above should be expressible in a form which can be automatically captured, wherever cost-effective, for example by laser scanning of a printed symbol (barcode), radio frequency identification of a tag (RFID) or by reading a smart card with a Personal Identification Number (PIN).

3. Master Data Bases

The descriptions and key characteristics, including classifications, of the Identities – participants/locations, items, processes and assets – should be held in structured Master Data Files that are accessed via the ID numbers or Auto IDs (e.g. as in electronic point-of-sale scanning in a supermarket via EAN numbers), which are linked to product and price Master Data Files. Other related forms of Master Data are Technical Specifications/Designs, Product Life Cycle Data, and Financial Data (Prices/Costs). Master Data are semi-static, i.e. they have a time structure which defines when they are applicable – now, in the past or in the future. Thus the description of an item may last for a long time (until further notice), while a price will have a more limited duration (from dd/mm/yyyy to dd/mm/yyyy).

Individual components of a complex product (such as an aero engine) may be changed throughout its life as maintenance or enhancement takes place. No two engines may be precisely the same. Therefore the configuration records need to be updated as the change tasks are completed. Master Data then comprise both the current state of the item and, where appropriate, its history of change.

4. Dynamic Data Bases

These contain data about Events relating to Identities (transactions, use, movements, treatments, etc) which occur across the value chain. An Event changes an existing State into a new State or Outcome via an Activity or Transaction. An actual State can be compared with a desired or expected State in order to measure performance or achievement, or in order to determine the need for further action, such as maintenance of a machine or replenishment of inventory. Dynamic Data promotes management action.

Dynamic Data should be stored in a structured (e.g. relational) data base alongside expected or planned activity so that performance can be measured, volumes of activity can be tracked, exceptions monitored and actions initiated.

Too often, Master Data and Dynamic Data are confused with each other, and lumped together. Both need to be inter-related via common Identities.

5. Messages

These contain the combination of data elements (such as quantities, names, dates, etc) which will enable individual and joint management of the value chain by the participants, e.g. transactions such as orders to produce, move, deliver or pay; invoices; statements; plans; etc. Data elements should be standard across Master and Dynamic Data Bases as well as Messages.

Each of the above five aspects of value chain data is described in more detail below, along with their inter-relationships. All these should be defined in a form which is as business-orientated and as independent of particular technologies as is practicable. In this way, processes, identities and data should not need to be changed as technology (inevitably) evolves. If the above five requirements are implemented systematically, not only will there be most of the data required for managing a value chain well (with speed, certainty and low total cost), but there will also be the requisite data and techniques to achieve safety and security, i.e. not only the provision of the right item to the right place at the right time at an acceptable cost, but also the key controls to ensure that the right items are used in the right place in the right way by the right person.

B. The Principles Governing Value Chain Management Data

I have argued in earlier papers that value chain data should be considered within the following contexts:

1. The best sequence of decision-taking for strong and sparkling organisations seeking to achieve cost-effective management of their value chains is:

   i Define quantified objectives.

   ii Construct simple and standard shared processes across each defined value chain. Confirm a structured matrix of processes and value chains, using proven building blocks.

   iii Redevelop organisations, along with the appropriate cultures. Organisations are of necessity normally based on functions and on teams, but should be redesigned to support cross-functional processes which have been well implemented and fully involve appropriately motivated staff – through a culture which judiciously balances competition and collaboration.

   iv Develop balanced Key Performance Indicators (KPIs) and Targets which support the objectives within the organisation.

   v Define standard value chain data and communications. Define data architectures and supporting e.business components, i.e. standard identification, data elements, master data, dynamic data bases and messages.

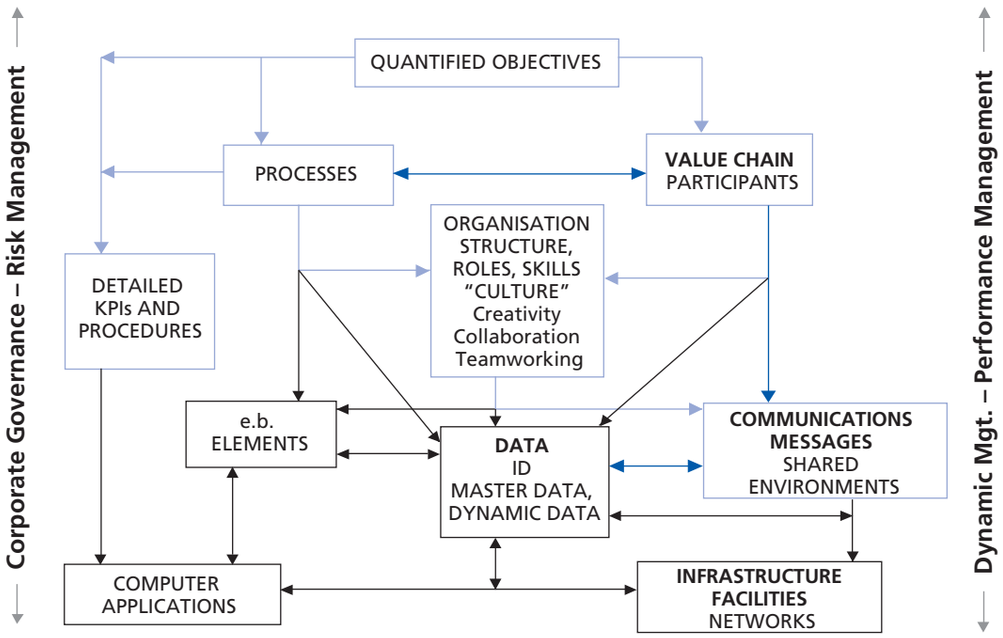
   vi (Re)develop computer applications to support the above.

   vii Design supportive Information Systems and Technology facilities and infrastructure.

Too often, reorganisations take place to support ill-defined objectives, without first redesigning processes and value chains – and, worse, computing and information system changes are implemented without first simplifying and standardising processes and data. It is vital to follow the above sequence: business process architecture – data architecture – applications, network and IT architectures.

(See Diagram 2 and References A and B.)

Diagram 2: 21st century value chain



The sequence of decision-taking is vital. First, quantify objectives. Then, define the main business processes and associated value chains to support the objectives. Thereafter, define the organisation. Too often, there is a reorganisation to try to achieve targets (KPIs) which are in fact sub-objectives, without fundamentally addressing the main processes. Of great importance are the skill base and the culture of the organisation, which must relate powerfully to the processes and value chains to be managed. Then the value chain communications need to be re-examined. At this stage, standard messages and electronic Shared Working Environments need to be supported by standard data elements, Master Data, ID and Auto ID, and Dynamic Data Bases.

Thereafter, computer applications can be best defined. And, finally, following these actions, the computing infrastructure and facilities can be defined and implemented to support all the above.

Too often, reorganisations precede redefinition of processes. Worse still, computer systems and facilities may be defined in isolation from the necessary prerequisites, particularly processes, identities and data.

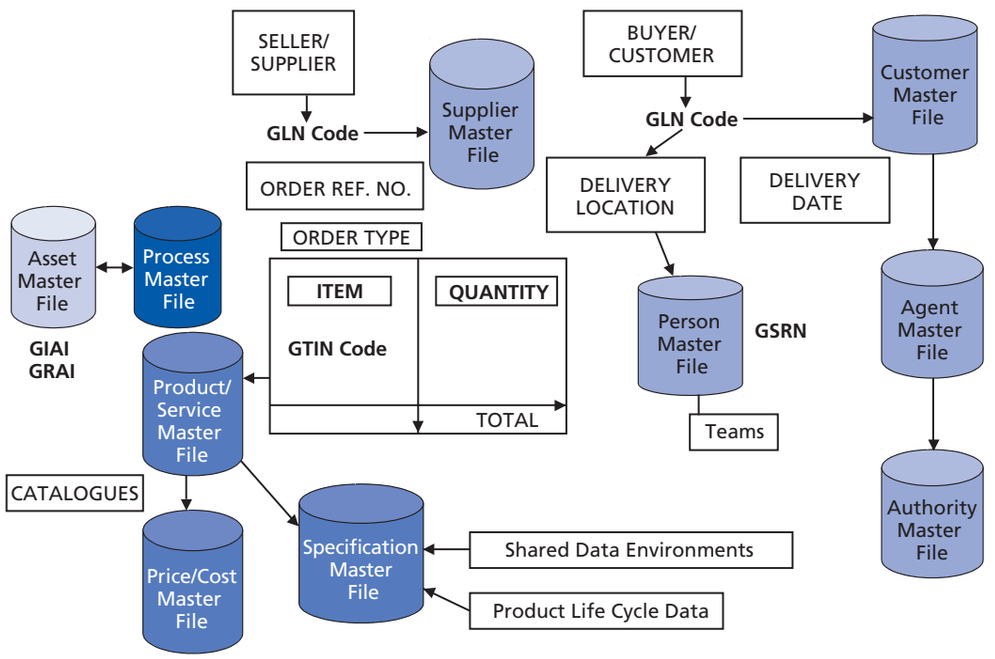
In the real world, reiteration is essential, but within the above framework and sequence, and always related to the overall objectives and vision.

The entire 21st century value chain needs to promote high levels of performance and the capability to cope with and to promote change. All of the above need to operate within a framework of effective corporate governance and risk management.

2. Business and administrative processes should be as simple and standard as is practicable across the key value chains in order to achieve optimum speed, certainty and low total cost. The more simple and standard these joint processes, the easier it is to apply e.business cost effectively. As this last is progressed, the greater the degree of speed, certainty and low total cost that can be achieved. Applying e.business before redeveloping processes and data is inevitably unprofitable (see References B and C).

3. Processes and data definitions should be independent of particular technologies, so that these do not need to be altered every time that technology changes. Event Data should be distinguished from Master Data, and the two should be linked by standard identities, such as EAN codes for items and for locations (see Diagram 3 and References B and E which cover the principles of Simpl.e.business).

Diagram 3: Principles of Simpl.e.business



1. Messages and their data elements should be based on business processes and should be independent of any technology.

2. Business processes should be simple and standard across all industries and organisations, so far as is practicable and cost-effective. Thus, standard orders to deliver or produce, treat, process, pay, etc (one or more products or services) to/at one location on one date/time can cover the majority of value chain transactions and activities, especially when related to similarly structured delivery/receipt notes, invoices, plans to order/deliver/produce/process, and to records of past transactions, events, etc, e.g. a plan to order the specified items for delivery on the stated dates to each of the defined locations.

3. Diagram 3 allows for most different types of order, each of which would be uniquely and sequentially numbered. An order is a transaction, as is a consignment or shipment. These should not be confused with the logistics units making up an order such as a case or container. A customer with a unique ID (GLN global location code number) orders from a supplier who is similarly uniquely identified. The order is for one or more items (each traded item identified by a unique EAN-GTIN number) to be delivered to one location at a specified date/time. All descriptive information about the customers and suppliers and the items is held in Master Data Files and retrieved via the Code (ID) numbers when necessary.
4. If there were third parties concerned in the transaction, such as Agents (e.g. banks, insurance companies or transporters), they would be similarly identified and cross-referenced. So too would be any Authorities (such as Customs or Inspection Bodies) and Persons (Individuals or Teams).
5. Similarly, Processes or Assets could be added in a standard way. For example: "I, Doctor A, order you, Radiographer Z, to X-ray Patient M using Process K, on Device (Asset) No. 3."

   Any requirements to include Prices (as in some orders and all invoices) would be met by the ability to access the appropriate price master file, which would already have been synchronised (pre-aligned) among the trading partners. Access to technical specifications including designs, drawings and product life cycle data would be similarly achieved. Master Data Files could record all changes to a specific Item, Asset or Process (or any other Master Data) to preserve a change history as well as an up-to-date specification.
6. Where agreed messages supporting defined joint processes, all based on global standards for Identities and Data Elements, are exchanged as defined above following Master Data Synchronisation, they can be processed and actioned automatically with maximum speed, certainty, value and security. I have called this Automatic Data Interchange (ADI). Too much modern computing technology assumes that organisations will welcome non-standard data from unknown sources supporting unstructured processes. This is to be avoided.

4. Master Data relate to the relatively stable descriptions and key characteristics of the Value Chain Identities, of which there are four.

   - The value chain **PARTICIPANTS** and their **LOCATIONS**:
     - i customers/buyers;
     - ii suppliers/sellers;
     - iii agents, such as transporters and financial institutions;
     - iv authorities, such as government departments and agencies, and inspection bodies;
     - v individuals/teams, including employees, citizens, patients, end users and consumers.
   - The **ITEMS** (products and services) being traded, and their various Logistics Units, such as cases, pallets and containers – including key item characteristics, both of unique Items and of types of Item: prices and costs: technical specifications, product structures, bills of materials and designs.
   - The **PROCESSES** (methods, recipes, diagnostics and treatments) by which decisions are taken and work is done.
   - The **ASSETS** which are used across the value chain – the physical capital employed, but not traded, across the value chain, e.g. machines, equipment, vehicles.

   Master Data should ideally be created and communicated by the original source of such data (e.g. the product manufacturer), rather than being recreated by each subsequent user.

   Master Data should be pre-aligned between value chain participants prior to the communication of transaction data, in order to eliminate errors and to improve speed and certainty of communication and subsequent action. This also enables the many transactions to become simple streams of ID codes and quantities, since all the descriptive information has already been agreed and stored by the participants in their Master Data files.

   Changes in Master Data need to be communicated and acted upon promptly and in a disciplined manner. Although it is practicable to develop cross-reference tables to allow each organisation to relate one set of identities and definitions to another, this is a difficult and expensive approach to sustain. One of the great virtues of Master Data is that one does not need to define everything about an Item in order to begin

structuring the key associated data. One can start with the basic Master Data such as description and key characteristics (dimensions, weight, price, etc) and add more detail if and when it is required (see References A and E).

5. As much data as are practicable should be capable of being automatically generated, communicated, processed and actioned. Naturally, it is desirable for certain data to be utilised intuitively and well on computer screens by individuals, but this should be largely for tasks to which people add creative value, and not for repetitive data capture or interrogation, or error correction (see References A and E).

6. While it is normally advisable to capture data as they are generated, careful thought needs to be given as to whether to communicate data in "real time" or to batch it to fit with the data-processing and management schedules of both sender and receiver, in order to improve the cost-effectiveness of the overall value chain. Economic optimisation does not always require data to be communicated immediately they are generated.

7. Structured communications as defined above from known participants supporting agreed joint processes improve not only the speed, certainty and total cost of value chain operations, but also overall security and safety.

C. The Key Components of Identification and Data

It is vital to understand the distinction between each of the five following components of value chain management data, and also how they relate to and support each other.

1. Identity

i This should be a unique, non-meaningful number. For example, the EAN code for an Item (GTIN) is usually 13 numeric digits – 2 for the country numbering authority issuing the right to number within the EAN system, 5 for the company doing the numbering of its products, 5 for the particular item, and finally 1 overall check digit for verification purposes. It is important for all parties in each value chain to agree the level of detail at which an Item should be identified, e.g. variants required for production control, distribution management and retail operations need an accepted degree of consistency.

(For complete coverage of EAN systems visit the website www.ean-int.org. Note that EAN/UCC is due to be renamed GS1.)

Banks have unique systems for numbering accounts to ensure that money comes from, and goes to, the correct place across the globe. Tracking assets for accounting and maintenance purposes requires each individual asset to have its own unique identifier (UID), comprising an Issuer code and a unique serial number from that issuer. Unfortunately, too many systems do not have unique IDs. For example, in the UK there are many more National Insurance (NI) numbers on file than there are people who could validly use a number. Note that effective verification systems are essential. Obvious errors in IDs have to be rejected automatically and promptly.

Where meaningful alphanumeric codes are used for identification purposes, code maintenance becomes more difficult. While such codes are normally used to aid human recognition, that is also their main source of error. People find such "meaningful" codes easier to interpret; but people are the principal causes of inaccuracy. Also, meaningful codes are longer, and longer codes are more error-prone. These should be largely unnecessary with modern Auto ID and computerised data retrieval systems.

Where each item (or logistics unit) has a high value and/or needs to be tracked individually, each item (or Object) will have a separate number, e.g. an aero engine control unit. Where items are of low individual value or significance, all items which are identical (of the same Class) can have the same number, e.g. a 4-finger Kit Kat for sale in the UK. Information about the item should be stored in a Master Data file. Physical quantities of the same items can be held in a Logistics Unit (e.g. in a case, or a number of cases held on a pallet, or a number of cases or pallets within a container). Unique Class identities can be given to particular Logistics Units, or they can be identified via a Serial Shipping Container Code (SSCC, within the EAN system). Where a product lasts for a long time and is changed during its life, Product Life Cycle Data are held to provide the original specification, all the amendments, and also the current status (within the ISO/STEP production information model – see www.tc184-sc4.org). This is particularly relevant for plant and machinery which are maintained and enhanced over time. Clearly, rules for data retention are of great importance for all value chain data.

As stated above, Identities can also refer to Logistics Units, such as a case, pallet or shipping container. These need to be distinguished from the Consignment (or shipment/vehicle load), which will be composed of one or more Logistics Units containing one or more Item IDs. The ID of a Logistics Unit can be cross-referred to a master file containing data about the contents, e.g. the EAN number of each item contained therein plus corresponding quantities. Here, there is a key role for Auto ID

systems to track items across a value chain (see Section C2 below). If Logistics Units are being effectively identified and tracked, it is not necessary to identify a consignment/shipment in detail – it is only necessary to know which Logistics Units make up the consignment and to track the largest of these which cannot be tampered with en route (often the containers holding the individual cases). (See Appendix 2 on the International Value Chain.) A consignment is therefore similar to an order or delivery, each of which only requires a non-meaningful sequential number for control purposes.

In summary, decisions on what to identify need to be taken carefully and systematically, in conjunction with the roles and uses of Auto ID, Master Data and Dynamic Data Bases.

ii As much of the related data about an Identity as is practicable should be held in Master Data files. It may also be necessary to print one or more of the following on items in order to facilitate human recognition:

- Batch Production Code/date of manufacture – this allows the item to be related to data held by the manufacturer about the particular time and circumstance of manufacture.
- Best Before Date/Use By Date – guidance to the end user or consumer to support quality standards.
- Instructions for Use – e.g. how to take/apply a medicine, or how to prepare a foodstuff.
- Ingredients or Warnings – e.g. "40% alcohol", "highly toxic", "contains nuts".

One of the features of printed data is that they may or may not be read, or they may be misunderstood. Where an Identity can be cross-referred to an accurate Master Data File, the likelihood of error can be substantially reduced by examining both printed and computer information. Nevertheless, where there is a possibility of the printed data and the Master Data differing to a dangerous degree, because the Master Data have been altered subsequent to a particular item's manufacture, the printed data must reign supreme (e.g. on a drug or foodstuff package). The rule should be to employ standard Identities linked to accurate Master Data Files wherever practicable, but where safety is paramount to use this approach supported by a cross-check with printed data ("both belt and braces") – for example when administering medicine or maintaining safety-critical systems (see Appendix 3 and Reference H).

iii Identities relate not only to ITEMS, but also to VALUE CHAIN PARTICIPANTS, including Locations, Roles, etc; PROCESSES; and ASSETS, as described in Sections A-1 and B and C above.

iv All identities may be structured from a variety of standpoints. For example, the identities of participants in a particular value chain can be viewed in terms of their legal status, or logistical role, or position as a taxpayer or recipient of benefits, or employment status, etc. Indeed, one of the main problems impeding low-cost business and e.business is that value chain participants are identified in so many different and incompatible ways, especially by government departments. Hence much time and cost are wasted by both organisations and government in re-entering the same data and in failing to recognise organisations as being one and the same entity. (See Reference D on the "Vision of a Single Window".) If a company could identify itself once to all parts of government, along with its products, countries to be traded with, customers and suppliers, the total cost of doing business would be reduced, the country would become a lower cost and higher customer service economy, government IT costs would be reduced, and modern risk assessment techniques could be applied to those companies and transactions which most merit the attention of the authorities.

For value chain management purposes, the identity of a participant needs to be related comprehensively to his or her location, so that instructions to act can be

specific to a particular location and messages can be accurately addressed. For example, the VAT Registration Number can be used by government (Customs and Excise) to identify many businesses. But not all are VAT registered and the VAT number does not identify each value chain location a business has for production, distribution, ordering, invoicing, accounting, administration, etc. There needs to be a unique, meaningless code, such as the EAN Location Code (GLN – 13 digits, similar in structure to the EAN Item Code). Effective value chain management, along with economic e.enablement, requires each location to have a unique ID, especially for structured communications and for its associated Master Data. Clearly, some Master Data are common to all the locations used by a business. These can be maintained centrally while being made available locally.

The number of other identities for participants should be kept to a minimum. For example, the VAT number could be used for all business tax payment and receipt purposes; the bank codes could be used for all commercial payments and receipts for both businesses and individuals; the company registration number could be used for all legal purposes; and the National Insurance number could be used for individuals dealing with government (subject to effective "cleansing" of the identities and related master data). Most other business IDs should be progressively eliminated and replaced by the Value Chain Management ID – EAN GLN. Other key IDs would be held in the appropriate Master Data Files to support cross-referencing; these would also hold any key participant classifications, such as type of business/government statistical codes, type of location, occupation of employee/patient, etc.

- Particularly where data relate to individuals, but also to companies, DATA PROTECTION provisions (for security, privacy and secrecy) are important. This is a topic for other papers. However, where, for example, a company agrees to a common identity for all its operations and to standardised and aligned Master Data, it should benefit from lower cost and higher speed business and governmental processes. Master Data about both people and organisations becomes much more valuable when it can be linked to Dynamic Data. Therefore greater effort must be made to ensure that both identities and data are accurate and secure. This is in no way an argument against holding such data. But the job must be done much better than it is done now. It is increasingly evident that without rigorous identification of people, companies, products and locations, there cannot be cost-effective, safe and secure operation of either businesses, public services or countries. Most people and businesses want better services at lower total costs. Their concerns are often more to do with the poor ways in which these services and supporting systems have been provided to date than with the principles of providing such services and systems. Many of the key prerequisites for success are those covered in this publication.

2. Auto Identity

This is the unique Identity expressed in an automatically recognisable form. The most common method is the scannable version of EAN numbers, which can be read by laser beams at point of sale or use, and cross-referred to item descriptions and price files (i.e. Master Data). Also of increasing importance are Radio Frequency Tags, which can be read without necessarily being in line of sight, can be written to as well as read from as an item moves along the value chain, and can carry more data than the identity number, e.g. the new Electronic Product Coding (EPC global) system, developed at MIT and now operated by EAN/UCC (see Reference I). The ability to carry more data with an item needs to be balanced against the total cost and complexity of doing so. For example, the maintenance history of an engine could be contained in a tag attached to it so that it could be repaired safely at any appropriate location, especially where access to the Master Data or Dynamic Data is not practicable, e.g. in a war zone.

Of great importance is the ability to cross-refer from the ID to the Master Data File – and indeed to the corresponding Dynamic Data Bases – which obviates the need to carry masses of data with the item, most of which are unlikely to be needed en route. The more sophisticated the Auto ID system, the greater the potential for item tracking across

the value chain, as well as for updating dynamic data in real time. Where it is important to know exactly where an item is, or precisely which item is being used, or the status of an item (e.g. whether it is available for use or not), then the additional capital and running costs of RFID systems can be justified.

The relative values and economics of Auto ID systems and the latest standards developments are not covered here, but can be reviewed with UKP.eb partners (e.g. e.centre uk, UKCeB, BSI).

The automatic identification of Items allows them to be recorded quickly and accurately as they move along the value chain. This supports the prompt and accurate linking of physical and data flows, the control of items to avoid loss, and the use of the correct item for each particular circumstance (i.e. not only speed, certainty and low total cost, but also safety and security).

3. Master Data

(See also Sections A-3 and B-3, and Diagram 3.)

i Such data are most often relatively stable and are usually best sourced from the original owner. For example, Item data, including the technical specifications, should come from the original manufacturer. Each value chain participant should synchronise relevant value chain data with their partners in advance of trading or communicating with each other. This can be done by the Electronic Data Interchange of files, by electronic catalogues or via e.exchanges. It is too easy to allow Master Data to become non-aligned both between and within value chain participants. Strict controls are necessary for data maintenance and cleansing, for broadcasting new versions and for synchronisation. The difficulties of achieving common, accurate Master Data should not be underestimated, but neither should the benefits. There have been many instances of companies' performance declining rapidly when Master Data relating to what has been produced or delivered are "out of synch" with what is supposedly in stock and/or being sold. Poor Master Data rapidly corrupt Dynamic Data.

ii Experience in successfully implementing Enterprise Resource Packages (ERPs), such as SAP, demands that organisations first get their Master Data correct. Too many organisations have great varieties of Master Data held all over the place, covering products for sale, bought-in materials, customers, suppliers, etc. The secret of success is to centralise and integrate these into one set of Master Data, and then to undertake any devolution of control with experience. Getting Master Data correct for such developments as ERP implementation also provides a sound basis for e.business across the value chain.

iii Master Data will vary to some degree according to the type of value chain. The simplest Master Data relate to the buyer, the seller, and the Item being traded.

However, a Health Value Chain, for example, would have Master Files on: Patients; Diagnoses; Treatments; Members of Staff, including roles; Locations; Items and Services employed; Suppliers and Manufacturers, plus their Locations; Authorities (Dept of Health, Safety Bodies, Clinical Bodies, etc); Agents (transporters, banks, etc).

The members of staff would Auto ID themselves, their Location and the Patient before undertaking Diagnoses and administering Treatment. This would help to ensure that these were correct and appropriate. Symptoms would be measured and fed in to Diagnoses Master Files, with associated decision support systems. The number of measurements would be increased until there was an acceptably high probability that the Diagnosis was accurate. From the Diagnosis would come the Treatment, which would also have to be cross-referred to the Patient and to the Staff Member to ensure that these were appropriate. When treatment was taking place, the Patient, Location, Staff Member and Item (be it a drug, set of surgical equipment, etc) would be cross-referred via Auto IDs and Master files to ensure accuracy, safety, accountability and traceability (see Appendix 3).

iv It is clearly important that the correct items can be made available to the appropriate locations, at the right time, at the minimum total cost. Hence the use of Items in Treatments at Locations needs to link back securely and promptly to those managing, ordering, transporting, supplying and manufacturing the required items. The successful employment of modern value chain management techniques, such as Continuous Replenishment, Co-Managed Inventory, Collaborative Forecasting, Planning and Replenishment, Collaborative Event Management, and Tracking and Tracing, depends on global standards for Messages, Data Elements, Master Data, IDs and Auto IDs for the cost-effective use of e.business in their support.

v An important topic is CLASSIFICATION, which is part of Master Data. For example, buyers wish to know who their suppliers of particular types of item are, and managers wish to know what the trends in each type of spend are. Classification or Categorisation of Items aids these types of analysis. Classification is sometimes confused with Identification, which is far more precise and is essential for modern value chain management as well as for safety and security. Classification provides broad pictures of activity and NOT the close control needed for value chain management and for safety and security purposes.

   Classification needs to be done carefully so that the needs of all key parties are met, e.g. the data analyses needed by a buyer may well not coincide with those of a clinician or engineer, nor with those of a senior manager or finance director.

   Classification is in essence another set of data elements within a Master File which help to describe an Item, NOT to identify it. Classification may be undertaken from many valid viewpoints – market or category segment; material use; technical characteristic; personal characteristic or role; etc.

   Locations, Individuals, Assets, and indeed all Master Data, may be classified.

vi Master Data are important for defining information in the past and future tenses as well as in the present tense, i.e. "as was" and "will become" data as well as "as is". This enables such questions to be answered as: "when did (or when will) these prices apply?"; "when were these components in use?"; "when was the name changed?".

4. Dynamic Data Bases

These contain the individual records (or summaries, or aggregations) of events, transactions, states, results and outcomes. Structured Data Bases enable Actuals to be recorded against Desired States, Plans, Key Performance Indicators, Targets, Budgets, etc. In this way, Performance can be measured of each Factor, Participant, Patient, Treatment, Staff Member, Location, Item, Supplier and Manufacturer, by linking ID and Auto ID to Master Data and thence to the corresponding Dynamic Data Base(s).

Dynamic Data Bases (DDBs) often contain both physical and financial values. Both types need to be well structured according to the expected use of the data for analyses, records and audit purposes. Badly designed DDBs present substantial problems in terms of both accessing data and also in achieving cost-effective response times.

Both design and tuning require a great deal of experience. There are relatively few individuals who understand well the ways in which users will want to use data, while at the same time having the skills to get the best out of current data base technologies.

A wealth of badly structured information results in a poverty of attention and understanding. Although data warehouses and data mining techniques have improved in recent years, and immense computing power is often available, it is very important when structuring DDBs, and their links to Identities and Master Data, to understand the potential relationships among data entities and also to anticipate the questions which are likely to be asked. Otherwise, answers are unlikely to be timely, meaningful or cost-effective. This involves considerable skill in deciding what data to include directly in the DDB, and what to select via the Master Data Base as required. For example, frequent analyses may be required of the value of business done per item and in aggregate per

customer or supplier. Less frequently there may be questions about physical volumes per item per value chain location.

Some of the most important advances in data base methodologies took place in the 1970s and 1980s with the advent of Relational Data Bases, based on the work of EF Codd, "popularised" by James Martin, and translated into commercial reality by such companies as ORACLE. The key principles of data base design and use now require reinforcing in the context of value chain management. There needs to be a more comprehensive and integrated approach to Data Architectures in order to define better data entities and relationships at the time of Business Process Modelling. Indeed, advances need to be made in the optimising capabilities of business modelling tools, which are too often descriptive rather than heuristic.

Every few years a software offering comes along which promises you the ability to analyse all your internal and external data without having to define identities and structure your master data and dynamic data. This is improbable if not impossible.

There are some promising benefits to be had from the use of Adaptive Intelligent Agents software and related developments, which have the ability to examine and learn from "raw" value chain data (see Reference G). This is not the place to discuss their potential. However, the use of standard, global value chain identities and data as described in this paper is fundamental to the success of all value chain management, and this will also make such Adaptive Intelligent Agents more beneficial.

5. Messages

These drive value chains by sending instructions, transactions, plans, records and information to the appropriate decision-takers. Ideally they should support standard agreed business and administrative processes and be composed of standard, technologically independent data definitions. These should follow the principles of Simpl.e.business, which increasingly underlie the work of key standards bodies such as EAN (including the Global Commerce Initiative), UN/CEFACT and OASIS (see References A and E and Diagram 3). For example, all orders to produce, pay, move, treat, etc should follow a standard process based on "the delivery (or actioning) of one or more items (or activities) to (at) one place on one date". In physical terms, deliveries can only be of one or more items at one place on one date. Therefore, orders, invoices, plans to order and records of actions should be structured on the same basis. So too should the structures of computer applications and data bases across the value chain which record and analyse events such as the fulfilment or receipt of orders/instructions. For example, each receiving location should receive data in the form of expectations of the receipt of one or more items from one supplier at a specific place and date/time. In this way, most value chain activities would be driven by a relatively standard set of messages and applications, to everyone's benefit.

At present, there are many so-called standard messages expressed in a variety of syntaxes (mainly those for Electronic Data Interchange, such as EDIFACT, and those for the Internet, such as XML and now Web Services). Unfortunately, too many of these have different business meanings, because of a failure to follow the principles outlined above. Following the principles of Simpl.e.business (simple, standard processes, identities, data elements and messages, pre-alignment of master data) would enable all messages in whatever syntax to achieve the same business outcomes. An approximate comparison of message size for a Simpl.eb order with those constructed conventionally by other means yields the following results, expressed in ratios:

Simpl.eb – 10 : TRADACOMS (UK-EDI) – 30 : EANCOM (structured EDIFACT) – 80 : EDIFACT (full) – 120 : XML (full) – 200 ++

All messages would benefit from the synchronisation of Master Data. Even without this, there are major advantages to be gained through simplification and standardisation. Of immense importance is the ability to send and receive structured standard messages supporting agreed joint processes to and from known sources containing pre-defined standard identities and data elements.

Messages relate to:

- Current Intentions, Instructions and Actions – Orders to Deliver, Produce, Treat, Move, etc at a specified place at a specified time. Invoices and Instructions to Pay;
- Future Plans – to Order, Produce, Pay, etc – to be shared with value chain partners in order to reduce uncertainty;
- Past Actions, and Results – Production, Deliveries, Treatments and Outcomes, Payments, Invoices, Inventory Levels, etc – Performance data;
- Unfulfilled Actions – orders outstanding, deliveries yet to be made, etc;
- Analyses of Data, etc;
- Structured Text.

The great majority of management across most value chains could be conducted cost-effectively via a relatively small number of standard messages. Too many electronic messages at present vary unnecessarily per industry or per country or per context. All messages should be constructed from the same standard data elements, which should be accessible via a global data dictionary or data element repository. Various initiatives are taking place to achieve this; but they remain too fragmented and industry-specific.

When more processes have been simplified and standardised, messages can become much more standard and compact. However, even with justifiable variations among processes, messages can and should become much more standard than they are at present, and, within messages, the great majority of data elements should have standard definitions (see www.unece.org/cefact;core components).

D. Further Research

There are vast areas of research which follow on from the principles described in DIAMOND. Among these are:

1. To what extent is this theory of value chain management data universally valid?
2. What identities are essential to the management of each main type of value chain?
3. How far can and should individuals and businesses be given unique, single identities for all purposes?
4. What is the best way to relate participant identities to their location codes?
5. What are the most cost-effective ways to auto-identify items, individuals and assets?
6. What data should be contained in an Auto ID and what should be held in Master Data and Dynamic Data to be accessed when required?
7. How far should we go in standardising business processes across all value chains?
8. How far can we go in developing "KISSABLE" processes, i.e. simple and standard processes to optimise speed and certainty and total cost while also ensuring safety and security?
9. What types of organisational culture best support KISSABLE processes? How should competition and collaboration be balanced, and how much data should be transparent?
10. How widely should the principles of Simpl.e.business be applied?
11. How should Master Data and Dynamic Data be cost-effectively structured and interrelated?
12. How best should Master Data be pre-aligned among value chain participants?
13. What are the best principles to follow in designing Dynamic Data Bases?
14. How do we preserve the independence of the above from changing technology while taking cost-effective advantage of technological advances?
15. How far should we go in pursuing a single set of data definitions for all purposes contained in one global core component/data element directory?
16. How best can we achieve optimal Automatic Data Interchange (ADI) – the exchange among known participants of standard, structured data, supporting agreed joint processes, contained in standard messages which can be automatically prepared, communicated, processed and actioned?
17. What are the best economic balances between capturing and communicating all data in real time rather than in structured batches, in order to facilitate optimum value chain operation?

I am sure you can identify a few more suitable topics for research.

E. Conclusion

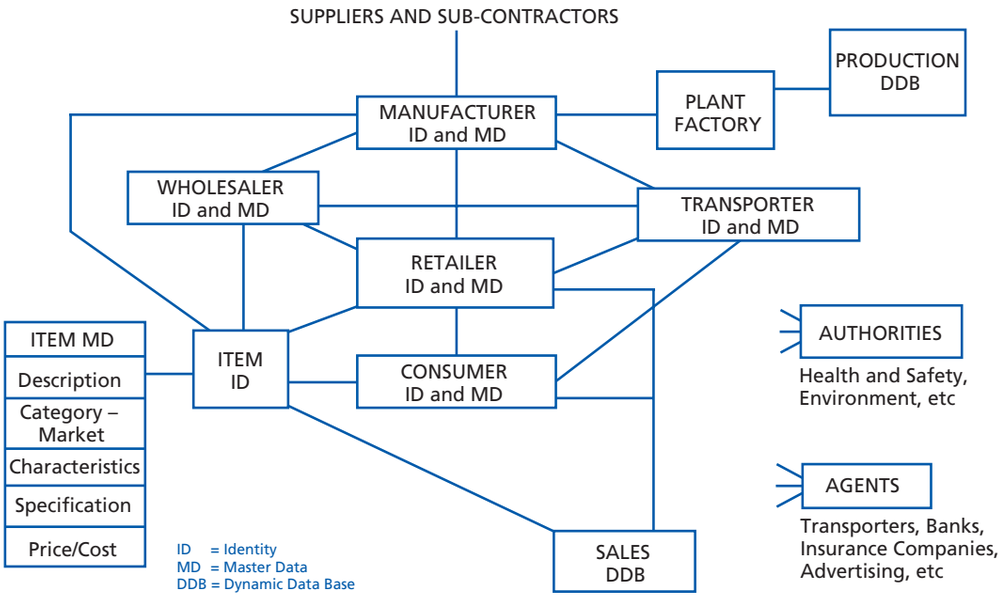
Although requiring much hard work, time, resources and collaboration, it is argued that successful and cost-effective value chains, both private and public, depend on major progress being made towards more standard and comprehensive Processes, Identities, Auto-IDs, Messages, Data Elements, Master Data and Dynamic Data Bases. Businesses and governments need to address all these matters in a much more integrated way than hitherto. This is not to say that many benefits cannot be realised by progressing on one or more of these fronts at any given time. However, realising full and ongoing benefits requires a comprehensive understanding of how all these factors (the facets of the DIAMOND) interrelate, along with sustained vision, direction and implementation.

UK Partners for electronic business (UKP.eb) include the main authorities for such standards in the UK, and provide the key channels to and from the international standards bodies, such as ISO, EAN, UN/CEFACT, SWIFT. Appendix 4 indicates the main types and sources of standards at present. There are many gaps and duplications to be addressed before we achieve the global, cost-effective application of the General Theory of Value Chain Management Data described here, and therefore before key value chains gain the desired DIAMOND-like strength and sparkle.

APPENDIX 1

Fast-Moving Consumer Goods Value Chain

Key Identities and Data



This is one of the simpler value chains. Items tend to be completed at factories (even allowing for "postponement" and sub-contracted "completion") and not be amended thereafter. The value chain normally consists of the manufacturer, wholesalers and retailers, and consumers. Complexity increases substantially when suppliers to manufacturers are introduced, since these will come from a myriad of industries and countries.

The most relevant data about events and transactions are normally available from time of final manufacture or packing to time of purchase from the retail outlet by the consumer. It is rare to have data about real consumption of items by consumers, e.g. we can know how many jars of coffee have been sold at the checkout, but not when they have been consumed.

Where Master Data and Dynamic Data are well structured, relevant information can be accessed where necessary across the value chain, thus promoting both cost-effective value chain management and also safety and security, e.g. via item tracking and tracing facilities.

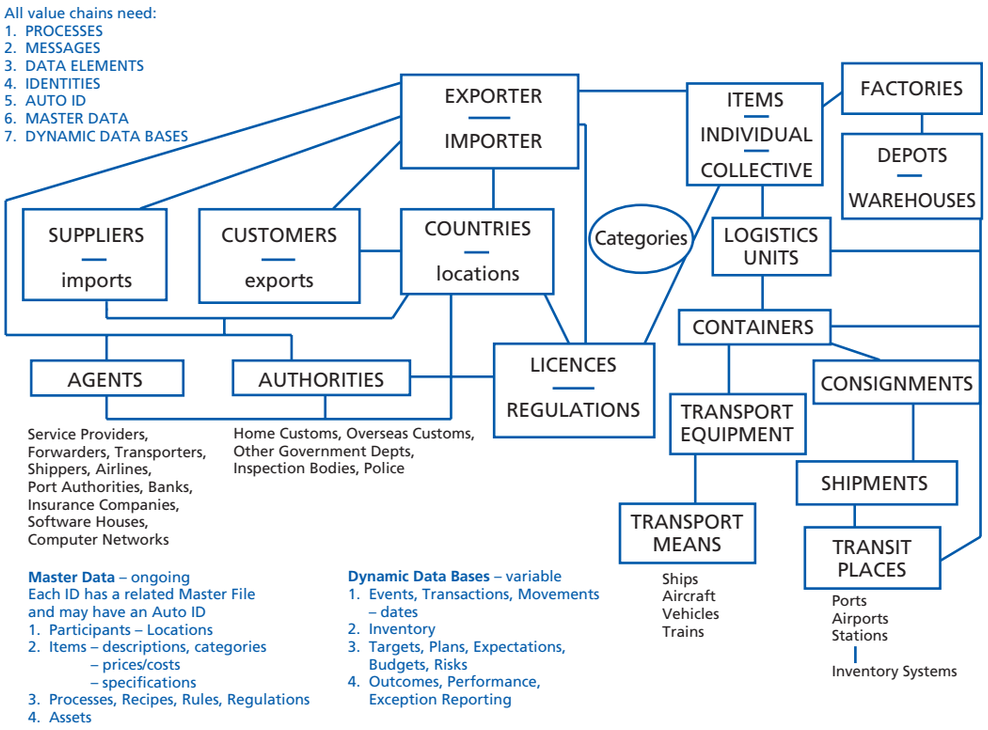
Even in a relatively straightforward value chain, uncertainty increases progressively at each stage in the value chain unless all participants are willing to adopt standard identification of themselves, their traded items and trading locations, to synchronise their master data about these items (including prices) and locations, and to share data on consumer transactions as well as their plans to order, deliver, etc.

Value Chain Managers need to manage both ongoing operations and also events which generate volatility, such as new product launches and promotions. Since each stage in the value chain operates under substantially different constraints, forecasting is very difficult. Failure to share data about both end-user/consumer sales and also individual business plans often results in poorer customer service and high costs (inventory, waste, write-offs, excess production and distribution capacities) as a result of the Forrester Effect coming into play (see "KISS" – Reference C).

Details about Logistics Units have been included in Appendix 2 on the International Trade Value Chain, although they are also applicable here.

APPENDIX 2

International Trade Identities



According to the General Theory of Value Chain Management Identities and Data, the management of any value chain, including international trading, with optimum value, speed, certainty, total cost, safety and security, requires standard definition and implementation of the following: PROCESSES, MESSAGES, DATA ELEMENTS, IDENTITIES, AUTO IDENTITIES, MASTER DATA, DATA BASES.

In the case of international trade, the key IDENTITIES are:

1. The VALUE CHAIN PARTICIPANTS, namely:

   (a) the TRADER (EXPORTER or IMPORTER);

   (b) SUPPLIERS and CUSTOMERS, and their LOCATIONS;

   (c) AGENTS, the third parties who provide services;

   (d) AUTHORITIES, the government and official bodies who have a legitimate interest in trade.

   All the above have a variety of LOCATIONS (factories, warehouses, offices, inspection sheds, transit places, ports, airports, etc) which perform defined functions.

2. The COUNTRIES involved in international trade – participants keep data about these.

3. The official LICENCES and REGULATIONS of the countries, which can relate to themselves, to other countries and to products/items.

4. The PRODUCTS or ITEMS being traded. These may be defined as individual items, or as collective types of goods. There may be further CATEGORISATION of products. The identification of items serves two basic purposes – one is for official control and the other is for managing movement across the value chain, which demands the identification of individual items.

5. Most often, Items are packed into LOGISTICS UNITS – a number of the same Items within a box or case. One or more types of Logistics Unit are then packed into CONTAINERS. There may be a number of Containers in a CONSIGNMENT, and there may be a number of Consignments in a SHIPMENT. It is essential to identify separately and clearly each IDENTITY that is to be used. Note that a Consignment is in effect the Delivery of all or part of an Order.

6. It may also be necessary to identify TRANSPORT EQUIPMENT (such as silos, tanks, conveyors, etc) and TRANSPORT MEANS (ships, aircraft, vehicles and trains).

7. All Identities should have a unique, non-meaningful number. Where appropriate and economic, Identities should be converted into forms which can be automatically recognised as they pass along the value chain, such as scannable EAN symbols on Items and radio frequency tags on Containers. All descriptive data about each Identity should be held in a MASTER DATA FILE, accessed via that number. Value chain participants should synchronise their Master Data Files in advance of communicating transactions. Master Data about Items may include not only the key descriptions and characteristics, but also prices and/or costs and technical specifications.

   Variable Data are stored in DYNAMIC DATA BASES. Such data relate to Events, Transactions, Inventory Levels, etc, together with expected values (including Targets, Plans, Budgets, etc), and consequently measures of performance and exception reports.

8. Authorities can share with Traders both Master Data and Dynamic Data, communicated in an agreed structured form. This is in effect a Single Window – submission of data once to all relevant authorities so that:

   (a) risk analyses and security assessments can be conducted in advance of trading;

   (b) relevant data can be provided once only to all authorities in a cost-effective manner;

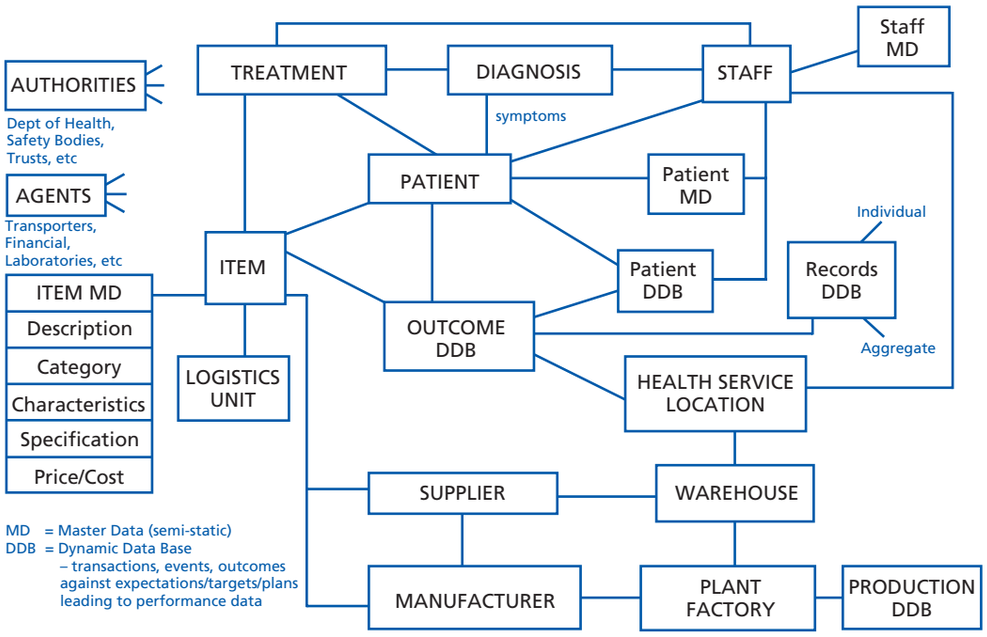
   (c) transactions can then be much simpler and hence lower cost. They will have the maximum likelihood of being processed without error or delay;

   (d) Dynamic Data Bases can then be analysed to promote both security and safety.

APPENDIX 3

Health Value Chain Identities and Data

Interlinked use of Identities, Auto ID, Master Data and Data Bases improves ability to manage value chains with optimum speed, certainty and total cost, while also improving safety and security



Each Patient is given a unique ID. The Patient sees a Clinician/Staff Member, who also has a unique ID. The Clinician establishes symptoms and uses a decision support system (neural network) to establish diagnosis of illness and treatment. Treatment includes particular Items, i.e. drugs/dosages/modes of administration, surgical packages, etc.

IDs can have Auto IDs (e.g. scannable symbol on drug package) along with printed product description, instructions for use, use by date and batch code, RFID tag on wheelchair or other reusable equipment to indicate status/availability for use. Staff use Auto ID to identify themselves and their Patient, Location and Items to be used in the Treatment.

All IDs are linked by computer to Master Data to confirm appropriateness, and to Dynamic Data Bases to record treatments, events and outcomes. In this way, safety and security are enhanced.

At the same time, the IDs for Staff, Locations and Items (including Logistics Units) are used to manage the overall Health Value Chain, from ordering from wards, pharmacies, clinics, hospitals, etc, through to purchasing and logistics agencies, intermediate suppliers and ultimately to the original manufacturers.

In this way the total cost is minimised and speed and certainty of supply are optimised, via Value Chain Management techniques, supported by Master Data, Dynamic Data Bases and Messages, and enabled by e.business.

APPENDIX 4

Standards for Value Chain Identities and Data

- A brief survey of a vast topic
- For more information please contact the UKP.eb partners

	FMCG	INTERNATIONAL TRADE	HEALTH	ENGINEERING	DEFENCE	BANKING	GOVERNMENT
BUSINESS PROCESS MODELLING	UMM.UML	UMM.UML TTFA	Various	IDEF UML	IDEF Q.MAP etc	UML	Various
DATA							
1. IDENTITIES 1.1 ITEMS 1.2 PARTICIPANTS (a) Businesses and organisations (b) Locations (c) Individuals	EAN/GSI EAN/GSI	EAN/GSI Various EAN/GSI UN.LOCODE	EAN/GSI SNOMED Various NHS No.	ISO Various – sector specific NCAGE	NATO EAN/GSI Various NCAGE Military No.	National – Acct. No. Sort Code. International – IBAN BIC PIN	Various NCAGE Various tax nos Company No. Local govt. code NI No. Post codes, etc National IDs
2. AUTO ID	EAN/GSI EPC		EAN/GSI Various	Various	Various	CARDS and PIN	
3. MASTER DATA – classification	Simpl.eb UNSPSC EAN/GSI	Simpl.eb, Various	Various	Various	Various NATO		
4. DYNAMIC DATA	Proprietary	Proprietary	Proprietary	Proprietary	Proprietary	Proprietary	Proprietary
5. MESSAGES	EAN/GSI GCI	UN.CEFACT UN.e.Docs EDIFACT, eb.XML		STEP		APACS BACS SWIFT	Various

Web References

FAST-MOVING CONSUMER GOODS www.e-centre.org.uk; www.ean-int.org; www.gci-net.org

INTERNATIONAL TRADE www.unece.org/CEFACT; www.sitpro.org.uk

HEALTH www.nhsia.nhs.uk

ENGINEERING www.ukceb.org.uk; www.steptools.com

DEFENCE www.mod.uk; www.nato.int

BANKING www.corpcoms.apacs.org.uk; www.swift.com

GOVERNMENT www.dti.gov.uk/bestpractice/infosec; www.e-government.cabinetoffice.gov.uk; www.govtalk.gov.uk

www.bsi-global.com and www.iso.org for the following International Standards Organisation Committees:

Biometrics – IST/44
Information and documentation – IDT/2
Product Data Interchange – AMT/4
Coding of picture, audio, multimedia and hypermedia information – IST/37
Automatic identification and data capture techniques – IST/34
Health Informatics – IST/35
Banking, Securities and other Financial services – IST/12
Cards and Personal Identification – IST/17
Information Technology for Learning and Education – IST/43
Geographic Information – IST/36
Software Engineering (including UML) – IST/15
Security Techniques – IST/33

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Douglas McGuffog designed the cover.

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