1 Introduction to Information Management

Today business organisations create and use vast quantities of information as never before. Information has become a valuable asset to businesses. Information supports day-to-day business operations, decision making and almost any business function in a business firm. Enterprises invest in information technology as they have proven to deliver an economic value to the business. This economic value can be expressed through an increase in competitiveness, higher productivity, increased revenue, etc.

If information presents value, it can be considered an asset. Although one cannot feel, smell or touch information, it is a critical element to almost any modern business. Information can be an asset or a liability, depending on the adopted information strategy or external factors. For example, pharmaceutical companies are subject to stringent government legislation. They make significant information technology investments simply to stay in business. Masses of clinical data needs to be stored and managed to comply with regulatory requirements. On the other hand, storing too much or too little information could cause an adverse effect on a business. Sales information is an obvious asset for decision making and business growth, however storing information without proper analysis turns into a liability.

1.1 Data and Information

The notion of information is the basis for building an effective understanding of the place that information systems occupy within a business and more widely within the knowledge economy. It is especially important to understand distinctions between data, information and knowledge and realise how they help organisations achieve their business objectives.

Let us get back to basics and consider a few fundamental terms. Businesses collect and store all sorts of data, whether they are necessary facts about their daily operations, customers, or products. Raw, unprocessed streams of facts are usually referred to as *data*. Entries of numbers, text, images or other forms of computerized output are considered data. Raw data, however, is a relative term as data processing may have a number of stages, so the output from one processing stage can be considered to be raw data for the next. After, data is processed and shaped in a meaningful form useful to a person or computer, it turns into *information*.

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Figure 1. Data vs. Information: Sales Receipt to Sales Forecast.

The difference between data and information is determined mainly by how they are used in a business context. An individual entry on a sales receipt, which has a product name, quantity and price, does not become "informative" to the business unless it has a purpose or a meaning. For example, the fact that three cans of curry sauce have been sold at a grocery store, may not be very useful to many. However, the difference between data and information becomes clearer when data is transformed into information for a business purpose. For example, sales entries of the same curry sauce are analysed per quarter and this information becomes useful to compare quarterly sales to the target figures. When individual data entries are processed some utility value or meaning is added to raw data to transform it into business information.

1.2 Organising Data

In order to be useful to business and effectively support business processes, data used throughout a business is organised using a *data model*. A data model provides a set of principles for organising data. Generally, data items are arranged into a hierarchy comprising of data elements and data structures. A data item is considered to be atomic or the simplest element of data organisation that cannot be divided any further. For instance, in a data model for organising customer records it is not recommended to keep names of individuals as a single data item. It is typical to have separate data items for first and last names of an individual, i.e. to keep each element as simple as possible. At a first glance at data (see figure 2) it may not be obvious that name records such as `Jackson Taylor` and `Taylor Jackson` are not the same.

Name
Jackson, Taylor
Taylor, Jackson

Non Atomic Data Item

Last Name	First Name
Jackson	Taylor
Taylor	Jackson

Two Atomic Data Items in a Data Model.

Figure 2. Choice of Data Model Elements.

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The hierarchal nature if a data model is based on the fact that data element is grouped of data items and consequently a data structure is a logical collection of data elements.

Figure 3. Constructs of a Data Model.

For decades the most popular data model used for data storage within organisations has been file-based. In this data model logically organised constructs of fields (data items), records (data elements) and files (data structures) are used to organise data. In context of a file-based model a record can be considered a data element. The structure (or so called *syntax*) of a typical record comprises of a set of data items that generally represent a meaningful entity. For example, businesses typically store their customer data. A customer record may consist of data items such as customer name, address, contact telephone number, etc. A collection of customer records form a data structure stored in a file. Organising records together in a specific file means that there exists some sort of a relation between data elements. For example, a particular business organisation stores data about its customer orders in a file-based form. Various order records may be stored in different files to create categories that are meaningful. For instance, individual files may contain order records placed in different years or handled by different sales consultants. Therefore a particular data model itself adds some sort of meaning to the data.

In a data model data model individual data item is characterised by some sort of a format, typically referred to as its *data type*. Data type indicates not only acceptable form of a data item, but also its format and possible range. Furthermore, data type declares the appropriate operations that are possible on a data item. For instance, a typical data item in a customer record data structure is a telephone number. The data type choice for this item may be difficult. If we declare it to be an integer, in many cases the first zero in the telephone number may be lost. However, if we declare it to be a string of characters, the it will be possible to store not only the digits, but additional characters such as "(" ")" indicating where the country code is placed in the number. A string data type will allow storing of additional non numeric characters. However this may make sorting telephone numbers by area code challenging as values + *(44)2075646* and *02075646* are equivalent.

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Over the years a series of standard data types have emerged. Data types commonly used by business information systems include numbers, text, date and time and others. Standard data types, such as text – a series of characters composed of characters from the alphabet and other symbols, numbers – integer, decimal, float and other types of numbers, and time including dates, seconds, minutes and hours, are among most commonly used in business information systems. Computers and other electronic devices store data using strings of characters coded based on a standard character set. Although invisible to an average computer user, encoding character set represents a standardised coding scheme. For instance, text consists of symbols or letters, each letter or punctuation mark has a corresponding sequence of symbols from the encoding set uniquely representing this text element for hardware and software manipulation. ASCII – American Standard Code for Information Interchange – has become a default standard character sets used on most personal computers and workstations. The ASCII coding scheme, based on the English alphabet, provides encoding for 128 symbols. In ASCII the capital A is represented by the binary string or word 10100001. Although it is difficult to imagine that a few decades ago computers supported only English alphabet, most modern internationalised encoding standards evolved based on ASCII.

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In recent years it became impossible to store data only in standard data types. Modern information systems have to cope with multimedia such as graphics, audio and video data. This lead to the development of new data types to allow encoding of a wider range of data in digital form. For example, data elements of a photographic image are pixels. In fact the term *pixel* originated from *picture element*. Typically a good 4 by 6 inch print requires an image resolution of at least 800 by 1200 pixels, what is essentially a grid of individual pixels each with its own colour code and other properties. To devise a data structure for storing images we need to consider pixels as individual data elements with data items containing colour corresponding to each pixel. Although quite a straightforward to visualise, it is not the most efficient data structure to store and many image compressing techniques have been developed to minimise the hard disk space occupied by multimedia data.

Whether we are considering text, numbers or multimedia, data has to be represented in some way for storage using computer hardware. Data in its various types are stored by hardware using binary representation. A unit of the quantity of data stored is typically expressed using bits. Eight bits make up a byte, which we are more accustomed to by now. Over the years capacities of hardware used in modern computing have grown exponentially and will continue to do so. Typically hardware storage capabilities are expressed in kilo-bytes, mega-bytes and giga-bytes:

- Kbytes: 1 thousand bytes – 10^3,
- Mbytes: 1 million bytes – 10^6,
- Gbytes: 1 billion bytes – 10^9.

1.3 Information Everywhere

Where is information which makes the business run? Well, the answer is *probably everywhere*. Information can be in a variety of forms and is stored in various channels. Almost any business is now operating a database – a structured approach to information storage. The corporate database often becomes the centre of business operations and decision making. Some or all of the business areas can draw on the information stored in the central database as shown in fig.4.

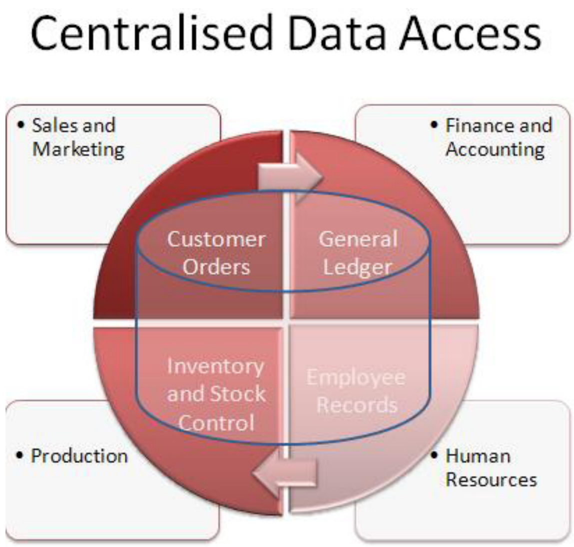

Figure 4. Database at the centre of business functions.

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The Sales department stores data about customer orders. Finance and Accounting use sales data to generate invoices and process payments. The Marketing department draws on the customer data and sales information for effective marketing campaigns. Human Resources store information about company employees, their skills and professional development needs. The central database facilitates keeping track of stock and production levels for manufacturing and production areas of business. Centralised information helps even a small business run effectively and rely on real-time information.

Although most think of a database as the main source of information in a business, a significant amount of information is actually unstructured and decentralized. Unstructured data sources include documents, spreadsheets, emails, presentations, intranet and web pages. Information is sometimes said to be distributed across different sources and areas of business. Decentralised information is located on employees' laptops, mobiles, desktops, personal devices spread across departments, local and regional offices. The figure below summarises most of the channels of business information.

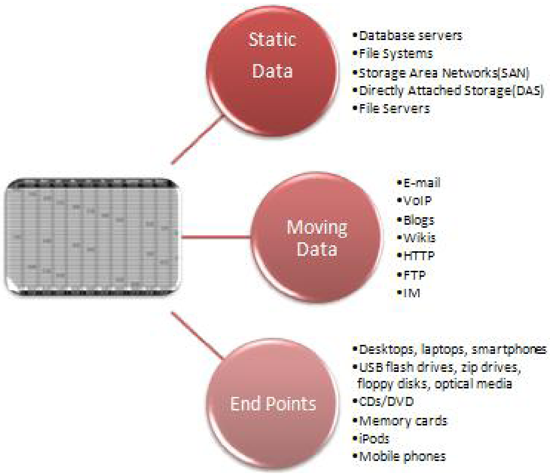

Figure 5. Where is Data in an Enterprise?

In many organisations data sources have a tendency to exist separately. Employees of different departments may have developed their own ways in keeping track of data, but as this process continues for a significant time, decentralised data may impose some problems. Without an organisation-wide plan and data administration procedures in place business may encounter such problems as:

- **Data redundancy** – whereas data becomes duplicated and stored at several locations in more than one file.
- **Poor Data Availability** – data becomes isolated and available only to the owner of a particular file in a file system. Sharing of data and its visibility to employees becomes reduced.

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- **Poor Data Security** – data spread across business in various forms and locations reduce the ability of a business to set proper security controls and ensure authorised access to information.
- **Error-Prone Data** – when same data exists at multiple locations it become more vulnerable to human errors introduced by different employees and mistakes tend to go unnoticed for longer.

1.4 Strategy and Information Systems

Traditionally business organisations are divided into three levels. These are *operational, management* and *strategic* levels. They exist in nearly all businesses irrespective of their size or sector of operations, although in small companies some levels may converge.

At the *operational level* decisions are made to ensure smooth running of operational processes or day-to-day business. At this level it is necessary to oversee that resources are used efficiently, inventory is up to date, production levels are as planned, etc. Decision making at this level requires information almost entirely internal to the company, although it may be extremely detailed and real-time.

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Information for decision making at *management level* has a typical timeframe ranging from weeks to several month or a year. Middle management usually controls medium term scheduling, forecasting and budgeting operations. These rely on internal as well as occasional external information. For instance, setting the quarterly budget requires the knowledge of current expenditure as well as external pricing information.

Senior management will focus on general, or *strategic*, issues related to overall business development in the long term. At this level decisions tend to relate to issues with long term such as restructuring, major financial investments and other strategic undertakings related to company's future rather than present. Information necessary for decision making at this level is comprehensively gathered not only from the internal sources of the company itself, but also involves external information, such as data related to economic situation or sectors as a whole.

Businesses that heavily rely on information develop an information strategy to establish how to manage information for business advantage and to comply with government regulations. An *Information Strategy* is a planning document usually created at the strategic level by the Chief Information Officer (CIO), possibly together with a Chief Technology Officer (CTO) and IT manager.

An information strategy is developed to support the overall business strategy of an organisation and explains how information should be captured, processed, used and disposed of throughout its lifecycle. Although the structure of an information strategy varies from business to business, there are some common areas included in most information strategy documents shown in table 2.

Construct	Purpose
Overview of Information Resources	Summary of resources, their utilisation by internal staff and external stakeholders, key projects, budgeting, etc.
Information Architecture and IT Structure	Description of the IT infrastructure, key projects, itemisation of data sources and their purpose.
External Factors	Analysis of the competition, the economy, government policy and technological advances.
Opportunities	Analysis of new business opportunities arising from information and technologies.
Risk Analysis	Description of internal and external threats, analysis of compliance with regulations, summary of information usage by competitors.
Schedule	List of milestones and review dates to indicate if the strategy is executed well.

Table 2. Typical Constructs of an Information Strategy Document

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To provide specific guidelines to their employees, contractors, trading partners and other external stakeholder on the processing, storage and communication of various types of information, business firms usually create an *information policy* document. This document is extremely important when an organisation handles security sensitive data or is subject to government guidelines related to information processing. It defines sensitivity levels of information and lists who has access to each level. The aim of the information policy is to make sure that information assets of a company are appropriately protected from threats or disclosure.

Figure 5. Business Information, Strategy and Management.

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1.5 Data Processing Software in an Enterprise

Business organisations use a wide variety of software tools to help the business run. From spreadsheets to complex enterprise resource planning systems, information processing tools help business firms derive value from their information assets. The table below attempts to list various types of software and their business purpose. Although the scope of this text does not allow consideration of all software applications in a modern business, the list below gives you a glimpse of how sophisticated data processing mechanisms could be.

	Examples	Purpose	Types of Data Managed
Spread sheets	Desktop Spreadsheets	Offer a powerful data entry and analysis tools, automatic recalculations and other analytical capabilities	Operational
	Web-based Spreadsheets	Adds online collaboration capabilities, allowing simultaneous communication and collaborative editing by multiple users	Operational
Database Systems	Database Management Systems (DBMS)	Permits to efficiently manage, secure and analyse data, as well as interface to other software applications	Operational, Management
	Data Warehouses	Aggregates data from multiple operational databases, processes and supports enterprise-wide operations	Operational, Management, Strategic
	Online Analytical Processing (OLAP)	Supports business intelligence through multidimensional data analysis	Management, Strategic
Communication and Collaboration	Intranet, Blogs, wikis, Social networking	Support information dissemination across business	Operational
	Email, Video Conferencing	Communication and Collaboration	Operational
Specialised Systems	Enterprise Resource Planning (ERP)	Provide an integrated approach to enterprise data management by integrating financial information, sales, manufacturing, human resources, etc. Offer complete information solution to enterprise overall performance.	Operational, Management, Strategic
	Customer Relationship Management (CRM)	Consolidate customer data from different sources and help streamline dealings with customers	Operational, Management, Strategic
	Knowledge Management Systems(KM)	Provide functionality of knowledge discovery and knowledge repository	Operational, Management, Strategic

Table 3. Examples of Data Processing Software in an Enterprise

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Information, represented in people, knowledge, experience, and innovation, has become a driver of competition. Making the information work for a business is one of the managerial responsibilities. As you can see, managing information is not an easy task.

1.6 Summary

Information is the backbone of operations and survival for any modern business. Information is distinguished from data as a result of data processing operations. After *data* is processed and shaped in a meaningful form useful in business environment, it turns into *information*. In order to be useful to business and effectively support business processes, data is typically organised using a particular *data model*. A data model determines how data items are arranged into a hierarchy comprising of *data elements* and *data structures*. Data items are characterised by a *data type*. Standard data types include numbers, text, date and time units, with more complex data types are now available.

In order to distinguish various types of information processed and generated in a business organisation it is necessary to distinguish between *strategic, management* and *operational levels* in an organisation. Information required by each level differs in its origin (external or internal to organisation), time frame (long, medium or short term), level of detail, etc. How a business aligns its information assets with its business objectives is stated in the *information strategy* document. Whereas practices on information capture, use, risks and security are typically specified in an *information policy*.

Ever-increasing complexity of modern business has lead to the emergence of a wide range of software designed to help business derive value from their information assets. Such software ranges form spreadsheets to integrated Enterprise Resource Planning Systems (ERP) with more and more emphasis being put onto collaboration and communications features of modern software.

1.7 Review Questions

1. What are the major differences between *data* and *information*?
2. Outline some characteristics of information typically required for strategic decision making.
3. Distinguish between the types of information used for operational and management decision making?
4. Describe the constructs of a data model? What is the purpose of specifying data types?
5. Describe how data elements such as letters in English alphabet are represented on computer hardware?
6. What kinds of software applications are used for handling operational data as well as generating strategic information?
7. What document specifies how an organisation handles its information?
8. What is the purpose of an *information strategy* document?
9. What problems arise when information becomes decentralised in a business organisation?
10. Give an example of how information systems support major business processes in sales, finance, production or human resources?

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1.8 Case Study: Walmart Harnesses RFID Technology to Improve Efficiency

Wal-Mart Stores, Inc. (NYSE: WMT) is a global retail giant serving 176 million customers weekly. The company operates in 14 markets from United States to Japan. WalMart uses thousands of suppliers in every merchandise category. They range from one person shops, to multi-national corporations, some sell products in just a handful of stores, others supply nationwide. The efficiency of WalMart's supply chain, yet to be duplicated, is a major factor in the company's retailing success. WalMart leverages cutting edge technology to streamline its business operations. In order to further improve its supply chain management WalMart has chosen to adopt RFID technology – tags with embedded electronic product codes (EPC) (see [1] for more detail). Essentially these smart tags are expected to replace traditional bar codes on all WalMart inventory from crate or pallet to the unit level. RFIDs provide accurate data about inventory levels and other detailed information and deliver the benefit of precise inventory management.

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Radio-frequency identification (RFID) relies on storing and remotely retrieving data from micro-chips or RFID tags for automated identification. The real-time information on products and inventory, reduction of human errors from manual operations and improvement of information integrity are some of the improvements RFID can deliver over the existing systems. RFID tags have been available for a number of years, but they have not been adopted widely due to cost issues as compared to bar coding and because of interoperability problems between tags and data readers. IT managers and technology vendors alike agree that RFID devices still need to overcome major manufacturing, pricing and standardization problems before widespread usage can begin [2]. WalMart's technology shift is expected to result in the deployment of nearly 1 billion RFID tags for tracking and identifying items from crate to pallet levels. RFID tags can gather and track a variety of data related to products and materials. Supporters of the technology say that RFID tags can store more detailed information than conventional bar codes, enabling retailers and manufacturers to track individual items.

Although adoption of the new technology has been a part of WalMart's strategic objectives for a number of years, the costs of the new technology has not been discussed widely fro either the company itself or its suppliers. The cost of technology has decreased significantly from 50-cents-per tag in 2003 to 5-cents-per-tag. For WalMart suppliers, however, the cost of the tags alone could total $50 million. Besides millions of RFID tags large suppliers could require thousands of readers at a price of at least $100 per device for all their manufacturing facilities and warehouses.

To the proponents of privacy the idea of having a unique identification tag on every product they buy is alarming. Ubiquity of RFID readers could mean that every time you pass by an RFID reader, it could uniquely identify your sweater or shoes. Hypothetically, it may be possible to link credit card records with an RFID tag on your clothes and thus monitor your every move.

Despite the criticism from consumers and suppliers WalMart continues its RFID technology expansion. According to Wal-Mart Executive Vice President and CIO Rollin Ford speaking at the RFID Journal Live the current benefits of RFID tagging system "include a 30 percent reduction of out-of-stocks, reduction of excess inventory in the supply chain, and sustainability impacts" [3].

1.8.1 Recommended Sources:

[1] http://walmartstores.com/FactsNews/NewsRoom/7894.aspx
[2] http://tompiselloroiguy.blogspot.com/2006/11/roi-of-rfid-in-supply-chain.html
[3] http://walmartstores.com/FactsNews/NewsRoom/6425.aspx
[4] http://www.ft.com/cms/s/0/6a4d57a6-70d5-11da-89d3-0000779e2340.html
[5] http://www.computerworld.com/softwaretopics/erp/story/0,10801,82155,00.html

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1.8.2 Discussion Questions:

a) What were the internal or possibly internal factors motivating the information technology development described in the case study?
b) Outline the benefits that new technology and new information may provide to the organisation?
c) Describe how the new technology might improve operations and planning for the organisation?
d) What levels of organisational decision making will the technology improve/affect?
e) In what way does the case study outline the need for businesses to make investment to drive value from its information assets?
f) Outline potential risks of introducing RFID to external stakeholders to the organisation described in the case study?

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