Chapter 1: Management Information Systems and Data Analytics

会计师被数据和信息包围着，并且信息的规模会越来越大。在本章中，我们将着眼于信息系统了解它们在组织中的角色以及它们的成本和收益。我们还需要掌握互联网、内部网、无线技术和网络在信息传递中扮演的角色。不同层级管理人员对信息的需求是不一样的，那么对应建立的信息系统也会不一样。我们需要去了解层级的信息系统的特征与区别。大数据作为当今信息的主要来源，大数据的特征我们也需要掌握。

Learning outcomes

- Explain the role of information systems in organisations.
- Discuss the costs and benefits of information systems.
- Discuss how can information be shared.
- Discuss the principal controls required in generating and distributing internal information.
- Discuss the controls and procedures which may be necessary to ensure the security of information.
- Define and discuss the main characteristics of the five information system.
- Describe the characteristics of big data.
- Explain the uses and benefits of big data.
- Discuss the challenges and risks of implementing and using big data.

1.1 Information Systems

Information systems – consist of computer hardware and software, and communication networks to collect, store, process and communicate information.

Information systems provide the information required to assist management in the following areas:

- Planning
- Control of the organisation
- Decision-making

1.1.1 Strategic Planning

This is the **highest level** of management in an organisation, and it is usually **carried out by the board of directors** or an equivalent body. This management level concerns with setting goals and objectives for the organisation **over the long term** (typically **5-15 years**).

Strategic planning may include the following:

- Deciding which products or markets to be in.
- Investment decisions.
- Planning for environmental changes.
- Identifying the competitive advantage of the organisation.

1.1.2 Tactical Management

Tactical management, or management control, usually is carried out by a **middle level** of management. It involves taking the strategic plan and making it happen. The time for planning usually is **one year**. Tactical management includes the following tasks:

- Ensuring that resources are obtained and used effectively and efficiently.
- Implementing strategic decisions, often by way of a long-term plan;
- Preparing annual budgets, and comparing actual results with budgets monthly; and
- Recruiting staff.

1.1.3 Operational Management

Operational management focuses on the **day-to-day** running of the business, and operational managers will be responsible for departments within an organisation. Operational managers are involved in the following:

- Routine planning such as staff rotas.
- Programmed decisions based on internal, transaction-based information.

1.1.4 Costs

Costs of information systems include:

- Development costs analysing current business processes and how they will be automated in a new system.

- Initial set-up costs - hardware, software licensing and installation costs.
- Data conversion of historical information.
- Staff and user training and IT support.
- Modifications and system upgrades.
- Communication charges(通讯费用).

1.2 Information Technology

1.2.1 Internet

The term Internet describes the global network of computers and devices connected with an Internet Protocol (IP) address.

1.2.2 Intranet

Intranet refers to a subset of the internet that is an organisation's private network that only authorised users can access.

1.2.3 Wireless Technology

Wireless technology is a communications technology used to transmit and receive data between two devices without a physical connection.

- Wi-fi
- Mobile phone
- Bluetooth

1.2.4 Network Technology

A computing network is a group of two or more devices that communicate by physical or wireless connections. Networking technologies connect multiple computers and devices and share information. For example:

- Local Area Network (LAN)局域网 – a group of computers connected across short distances (e.g. using a router).
- Wide Area Network (WAN)广域网 – for example, the Internet, connects computers worldwide.
- Storage-Area Network (SAN) 储存区域网络– a dedicated high-speed and high-performance network that connects shared pools of storage devices to several

servers.

- Virtual Private Network (VPN)虚拟专用网 – users access a private network across the internet to send and receive data as if their devices were connected to the private network.

1.3 Principal Controls

1.3.1 Purpose of Controls

Controls and procedures over the distribution and generation of internal information need to be in place to ensure that:

- Reports are only prepared when the benefits of the report exceed the cost of producing it.
- Reports should only be sent to relevant managers.
- Information is not duplicated.
- Only relevant information is included in the report.

1.3.2 Types of Control

The principal controls over the distribution and generation of internal information are:

- The **format** of the reports to be generated should be agreed upon in advance.
- **Distribution lists** should be provided for all reports.

1.4 Confidential Information

1.4.1 Security

Information security – protects the interests of those relying on information from harm resulting from hacking, operational error, sabotage and other threats.

1.4.2 General Security Controls

Training all staff in computer security procedures is essential in creating:

- An appropriate attitude of mind (e.g. integrity, carefulness, security-aware); and
- Strong security culture within the organisation.

Staffing arrangements should include the following:

- Authorisation for access and change routines to programs.
- Segregation of duties.(职责分离)
- Thorough vetting(彻底审查) of job applicants before being employed.
- Application of appropriate procedures for cleansing of security access for staff that have been terminated.
- Risk analysis on sensitive staff.

1.4.3 Physical Access Controls(物理访问控制)

Physical access controls that prevent unauthorised people from accessing computer systems include:

- Security guards and cameras;
- Time controls;
- Electronic door locks.

1.4.4 Logical Access Controls(逻辑访问控制)

Once someone has gained physical access to a computer system, the next level of security would be logical access controls. Controls may include:

- System password.
- Usage logs(s使用日志) (usually computer generated).
- **Call-back security（回拨安全）** (dial-back security) is used to authenticate users who access systems remotely.

1.4.6 Hacking

Hacking – deliberate unauthorised access to a system and the data within that system.

Most people consider hacking an external threat (e.g. via the Internet). However, the majority of hacking is carried out internally by employees.

Hacking usually takes one of two forms:

1. **Authorisation attack(授权攻击)** – password cracking using computer programs which work through dictionaries and other sources to generate passwords for repeated sending to the system until the correct password is found.

2. **Trapdoor/backdoor attacks(后门攻击)** – utilising existing weaknesses within the program code of the system. Sometimes these are deliberately programmed into the system by the programmer who.

Measures to combat hacking include:

- Physical security;
- Logical security;
- System logs and audit trails(审计跟踪);
- Sentinels(哨兵) ("watchdog" programs which check for unusual activity);
- Data encryption(数据加密);
- Strong quality control and risk analysis procedures in developing programs and websites.

1.4.7 Testing Systems Security

It is of no use to have security systems in place unless they work and are known to operate effectively. Using in-house staff to test the system may be one option, but they may have a vested interest in it.

Many external organisations (e.g. large accountancy practices and consultancies) offer "attack and penetration" services to their clients. They attempt to access the computer system

2.1 Principal Sources

2.1.1 Internal

The principal internal sources of management information from within the organisation are:

- **Accounting** system.
- **Inventory** system.
- **Payroll** system.
- **Purchase processing** system.
- **Sales processing** system .
- **Qualitative information systems** (e.g. customer satisfaction).

2.1.2 External

External information is likely to be used for strategic purposes. As indicated previously, this includes information about competitors, markets, and the economy.

3.1 Accounting Information Requirements

3.1.1 Strategic Planning and Control Information

Information for strategic planning typically:

- Addresses objectives at a high level, not detaile.
- Includes much external information.
- Addresses ad hoc information needed one time only for special projects rather than regularly.
- Will contain forecasts covering a longer time horizon.

Examples of information for strategic planning include the following:

- Economic and market forecasts;
- Analysis of competitors.

Examples of strategic control information are:

- Profits by business segment;
- External factors influencing the organisation;
- Present and potential market studies;
- Investment appraisal.

3.1.2 Tactical Planning and Control Information

Information to support tactical planning, on the other hand, will:

- Contain more detailed information.
- Be mainly internal, although some external information may be used.
- Be provided regularly (e.g. monthly analysis of revenues compared with budgets and variance analysis).
- Contain forecasts over periods up to 12 months.

The most obvious example of information used for tactical planning is the annual budget.

Examples of tactical control measures include:

- Analysis of sales by product/customer/geographical location.
- Inventory levels.
- Cash flow projections.

3.1.3 Operational Planning and Control Information

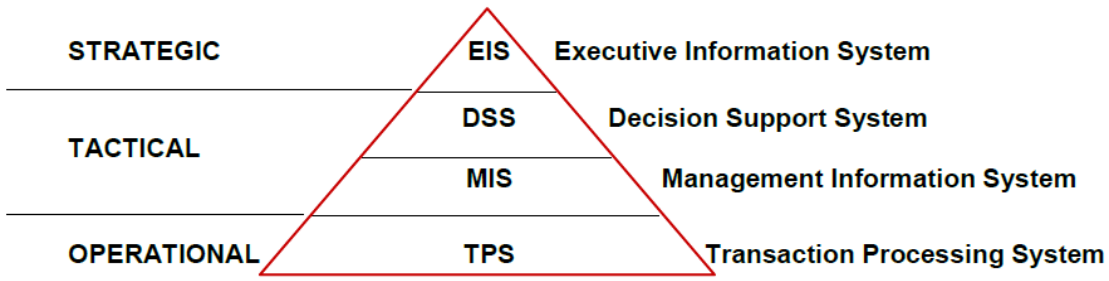
Operational planning typically requires transaction-based data. This is almost entirely internal, covering short-term periods.

Examples of operational control measures include:

- Variances (e.g. materials and labour);
- Receivables/payable levels;
- Payroll details;
- Customer complaints;
- Output records.

3.2 Information Systems

The four main types of information systems that support the different levels of an organisation may be summarised as follows:



3.2.1 Transactions Processing Systems (TPS)(交易处理系统)

Transaction Processing Systems (TPS) are used by operational staff to **capture data and make processes more efficient, improving the accuracy and timeliness of information.** Data is primarily high-frequency and short-term, and IT allows much of the transaction processing to be performed automatically, with limited human input.A transaction takes place when goods or services are exchanged for some form of

payment. For example:

- Purchasing an airline ticket from an airline's website.
- Buying groceries from a supermarket.
- Withdrawing cash from a bank ATM.

Transactions processing systems use one of two approaches to process the data:

1. **Batch processing** – individual transactions of the same type are collected (into "batches") and stored for later (periodic) input to the computer.
2. **Real-time** systems processing – transactions are processed immediately as they occur.

3.2.2 Management Information Systems (MIS)(管理信息系统)

Management information systems – systems which convert data from internal and external sources into information used by management at all levels and across all functions to enable them to make timely and effective decisions.

An MIS is, therefore, any system for:

- Obtaining data;
- Processing it to produce useful information; and
- Distributing this to the relevant managers or members of staff.

Information from an information system is used for three purposes:

- Planning
- Controlling
- Decision-making

Information systems come in many different shapes and sizes. For example:

- In a small, owner-managed organisation, the MIS will be **informal**; the owner will obtain most of the information that he needs:
    - from discussions with the staff; and
    - by observing what is happening.
- In larger organisations, specially designed information systems will be needed.

Especially in larger organisations, care should be taken to plan the needs of an information system before it is developed, to avoid the risk of the following problems:

- Poor communication of information to appropriate personnel.
- Bad decisions are being made because of inaccurate data.
- Information is provided late.

3.2.3 Decision Support Systems (DSS)(决策支持系统)

Decision Support Systems – a computer-based information system that supports managers in decision-making, often utilising analytical modelling techniques.

Decision support systems assist in complex decision-making. Such systems typically **analyse large amounts of data and provide information about the likely outcome of decisions** based on rules and assumptions programmed into the system. In addition, the variables used in the computations of outcomes can be changed by users to reflect the conditions that might affect the decision.

3.2.4 Executive Information System (EIS)(执行信息系统)

Executive information system – a system designed to assist the **decision-making of senior management** of an organisation by providing summarised information from both internal and external sources relevant to meeting the strategic goals of the organisation. It is a specific type of decision support system.

An EIS typically provides senior management with **high-level information about the company's performance**.This information may be extracted from a central database, using reporting tools. The systems may also be linked to external data sources (e.g. financial information from Internet sites).

Charts, tables and other graphical tools often accompany numerical data in a "dashboard" that helps managers **visualise performance**. In addition, many such systems have "drill down" facilities whereby clicking on a number in a report will provide a more detailed analysis.

An EIS often allows users to design the layout of reports relevant to them. This overcomes the problem experienced in many information systems whereby senior managers receive standard monthly reports that are not relevant to their concerns.

3.2.5 Enterprise Resource Planning Systems (ERP)(企业资源计划系统)

Enterprise resource planning system – a software system which provides a seamless

flow of information across an entire organisation using a shared database

Before ERP systems, different departments (e.g. warehouse and finance) would have separate systems. These systems were not linked. An ERP system is designed to integrate the main functional areas of business processes into a unified "enterprise-wide" approach and to serve the whole organisation.

The "modules" which may be found in an ERP system typically include the following:

- Accounting and financial;
- Inventory control;
- Supply chain management;
- Material requirement planning;
- Customer relationship management

Implications of the introduction of an ERP system for the management accountant include:

- A reduction in gathering and processing routine information. In a supermarket, for example, sales are recorded when barcodes are scanned at the checkouts.
- A change in the work of the management accountant, who can now spend more time as a business advisor because the system automates many routine tasks he once performed.

3.2.6 Customer Relationship Management Systems (CRM)

Customer relationship management (CRM) – the practice, strategies and technologies used to manage customer interactions and data, to improve customer service, retain customers and drive sales growth.

At a basic level, CRM software consolidates customer information and documents for easy access and management.

CRM captures, analyses and distributes all relevant data from customer and prospective customer interactions to everyone in the organisation. This distribution of information helps an organisation better meet customer, product and service needs.

Characteristics of a sound CRM system include:

- Easy import of data from existing databases.
- Ease of use (e.g. an intuitive interface and good user support).
- Adaptability(适应性) (as the business should grow).
- Improved customer satisfaction.
- Easy reporting and tracking features.

3.3 Big Data

3.3.1 Characteristics

Big data – vast data sets that may be analysed to reveal patterns, trends and associations, especially relating to human behaviour and interactions.
Structured data – data stored within defined fields within a defined record, along with similar data, according to the specifications laid down in a data model. The data model limits the data collected and how it can be processed.
Unstructured data – information gathered in various forms and ways, not in accordance with any data model, and thus may be difficult to store or analyse.
The following have been adopted as essential characteristics of big data:
Volume: a tremendous amount; more than can be easily handled by a single computer.
Variety: non-uniform, from internal and external sources, some structured, but primarily unstructured.
Velocity: fast and continuous; it has to be processed quickly to yield useful results.
Veracity: is the data valid, and can its accuracy be relied upon?
Value: Big data analysis could be costly in terms of facilities needed and staff time spent. Data specialists may have to be employed. The organisation must therefore consider the value that the analysis of big data could create.

3.3.2 Data Analytics

The processing of big data is generally known as data analytics and includes the following:

Data testing: testing models or hypotheses on existing data.
Data mining(数据挖掘): analysing data to identify patterns, relationships and correlations.
Predictive analytics(预测分析): a type of data mining which aims to predict future event, very often using statistical or machine learning techniques.

Text analytics(文本分析): scanning emails and word documents to extract useful information (e.g. keywords that indicate an interest in a product). Similarly, voice analytics (but with audio).
Statistical analytics(统计分析): used to identify trends, correlations and changes in behaviour.

3.3.3 The Big Data (DIKW) Pyramid

The big data pyramid originated in the work of Ackoff and was developed further by Jennifer Rowley. It is designed to show the stages of the transformation of the initial unstructured data obtained into material that can be used for reliable decision-making and accurate forecasting.

Level	Description
Data	Facts and figures.
Information	Identifying data relationships. The initial analysis aims to find the meaning of the data and establish what links and relationships there are between the data.

Knowledge	Understanding data relationships. Further analysis provides more detail about the context of how and why the links between the data might arise and what the specific connections and patterns are.
Wisdom	Improved decision-making from the understanding of data relationships.

3.3.4 Benefits

Analytical findings can provide information to enhance decision-making and performance management. For example:

- Marketing
- Customer service
- Competitive strength
- Customer loyalty
- Operational efficiency
- Performance measurement

3.3.5 Challenges and risks

Despite the examples of the use of big data in commerce, particularly for marketing and Customer Relationship Management (CRM), there are some potential dangers and drawbacks.

- Cost
- Time and staff resource
- Regulation
- Loss and theft of data
- Incorrect data (veracity
- Overfitting

4.1 Importance of Data Visualisation

Data visualisation is the display of information graphically, using various forms such as charts, graphs, and maps.

Data visualisation aims to present data to users in a form that is easy to understand and analyse, summarising big data in a way that even non-technical users may understand.

4.2 Tables

Tabulate of Budgeted Profits

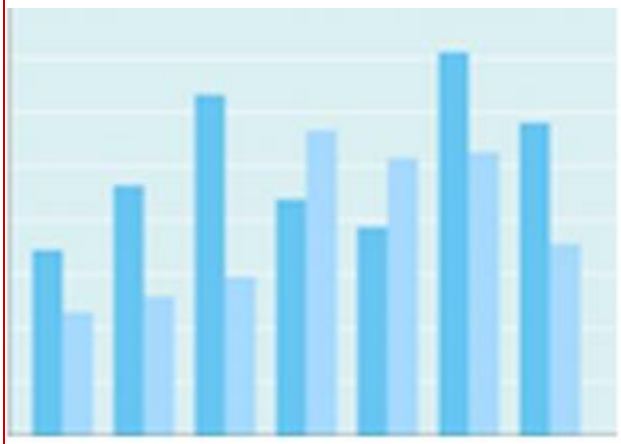
Cost and revenues of different sales levels at Winston's Football Factory

Sales volume (number of footballs)	4,800	4,900	5,000
	$	$	$
Sales revenue	168,000	171,500	175,000
Materials cost	14,400	14,700	15,000
Labour cost	7,500	58,800	60,000
Variable production overhead	57,600	9,800	10,000
Fixed production overhead	19,200	19,600	20,000
Non-production overhead	36,600	36,600	36,600
Budgeted profit	**30,600**	**32,000**	**33,400**

4.3 Charts and Graphs

Charts and graphs tables are helpful ways of quickly highlighting relationships and trends within data.

Type	Example

Line chart	
Bar chart	
Pie chart	

Scatter diagram