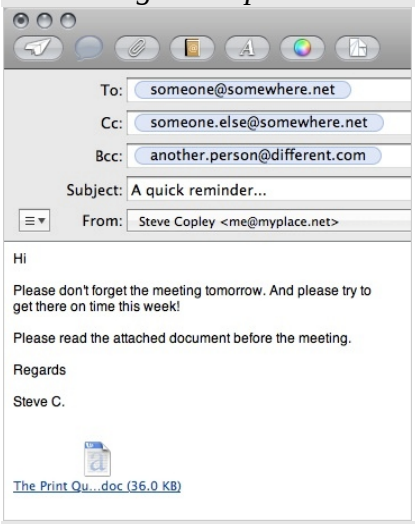
COMMUNICATING SYSTEMS

Good communication is essential to every organisation: communication between organisations, and communication between parts of a single organisation (e.g. between offices in different countries).
A wide variety of communication systems are used...

Before the Internet, most business communication was via telephone, fax, telex (a way of sending text messages that printed out on a printer), or by using mail - the old-fashioned paper version!



E-Mail

E-mail is a system that allows **messages** to be **sent** and **received** by **computers**. E-mail is the **most common** form of electronic communication.

E-mail messages are **text-based**, but **other types of file** can also be sent as '**attachments**'.

E-mails that are received wait in a user's **inbox** until the user is ready to read them. (Unlike a telephone call, the user is free to ignore e-mails until they have time to deal with them.)

An e-mail message usually has the following parts:

To send and receive e-mail, you need to have an e-mail address.

*An address is made up of two parts: a **username** and an **e-mail provider**, with an '**@**' symbol in the middle:*

username@provider

To	The address(es) of the person who the message is for
Subject	A short sentence describing what the message is about
Message	The text of the message. This can be as long as you like

An e-mail may also include the following parts:

CC	The address(es) of people to copy the e-mail to (Carbon Copy)
BCC	The address(es) of people to copy the e-mail to without anyone else knowing (Blind Carbon Copy)
Attachments	Files linked to the message (images, documents, etc.)

Video Conferencing

Video-conferencing is a system that allows people to have **conversations** and **meetings** with other people in**different locations**, but **without leaving their office**.

A video-conference involves people sitting in front of a **camera** and a **microphone**, whilst watching other people of a **screen** and listening to them through **loudspeakers**.
Note: The camera is usually TV quality - much better than a standard webcam.

USES OF ICT IN WORKPLACE

The system uses the following hardware:

- **Video camera**
- **Monitor**
- **Microphone**
- **Loudspeakers**
- High-speed network / Internet **connection**

Video conferencing is very popular with businesses as it means:

- **No travel costs**
- **No time wasted** travelling to other cities / countries
- Can organise meetings at **short notice**

However there are some problems with video conferencing:

- **Less personal** than face-to-face meetings
- Documents (e.g. contracts) cannot be **signed**

Mobile Telephones

Mobile telephones allow people to be away from their workplace, yet still be **contactable**. This means that people can still work, even when out of the office.

Modern smart-phones can perform a wide variety of tasks:

- Make and receive **telephone calls** just about anywhere
- Send a receive **SMS** (short message service) messages
- Send and receive **e-mail**
- Send and receive **files** such as images, text documents, etc.
- **Edit** documents
- Most people would be lost without their mobile phone!

However there are some downsides to the use of mobiles:

- Workers never get a chance to 'switch off' since they can always be contacted - can be **stressful**
- Mobiles are easy to **lose**, and often contain a lot of personal and/or business information. A lost mobile could be embarrassing / damaging if the wrong people got hold of it

Internet Telephony / Voice Over IP (VOIP)

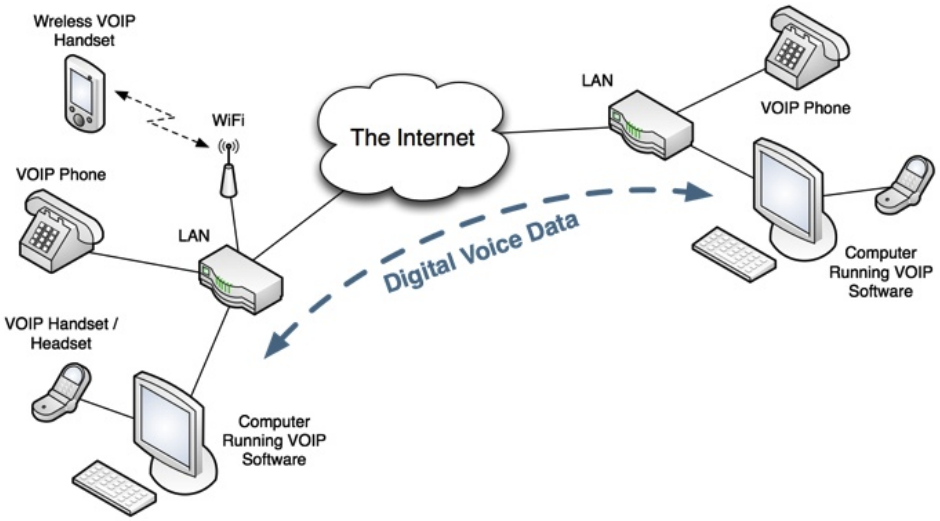
Internet telephony, or 'VOIP', is becoming very popular both for personal use, and within the workplace.

Instead of using the normal telephone network (designed to carry voices using analogue signals), VOIP systems send voices through the Internet as **digital data**, just like any other Internet data (e.g. e-mails, files, WebPages, etc.)

In other words, VOIP systems use your **Internet connection** to send and receive **phone calls**.

*'Internet Telephony' means a telephone system that uses the **Internet***

*'VOIP' means **Voice Over IP**, where IP means **Internet Protocol** - the system that the Internet uses to transfer all data*



VOIP systems can work in several ways:

- **VOIP software** can be installed on a computer. Calls are then made using a **headset** (headphones / microphone) or by using a special USB **handset** (looks just like a normal phone)
- Special **VOIP telephones** can be plugged directly into the network (or can connect wirelessly using Wi-Fi)

VOIP systems have a number of **advantages** over a normal telephone system:

- **No telephone line** is required
- Call **costs are very low**, especially for long-distance calls
- Can include **video**

They also have some **disadvantages**:

- Require **special hardware** and an **Internet connection**
- **Not as reliable** as normal phones, so cannot be relied upon for **emergency** calls (911, or 999)
- **Call quality** depends on the speed of the Internet connection

Fax

Fax is short for '**facsimile**' which means '**copy**'.

A fax machine is a device that can send a **copy of a paper document** over the **telephone network**.

- The sending fax **converts** the **light/dark areas** of the printed document into **noises**.
- These noises travel through the **phone system** and are received by another fax machine.
- The receiving fax machine **converts** the **noises** into **printed marks** on a piece of paper - making a copy of the original document.

Faxes are:

- **Low quality** - images are especially poor
- **Slow** to send (compared to e-mail)

Faxes have been used for many years as a quick way of sharing documents. However, now most people have access to a computer, e-mail attachments are more commonly used.

One reason that faxes are still used is that most businesses would accept a document such as a **contract** that had been **signed**, and sent by **fax**. (Electronically signing e-mail attachments is not yet widespread.)

PUBLICITY AND CORPORATE IMAGES

Businesses and organisations use computers and software applications to **publicise** ideas / products / people / etc.

The techniques used are the same as those described in the Communicating page of this site:

- **Image editing**
- **Desktop publishing**
- **Multimedia editing**
- **Website design**

However the *type* of document produced for businesses and organisations is often quite different to the sort that you might create at home...

Corporate Identity

Businesses and organisations usually develop a corporate 'identity' - an image that they use for all documents, websites, etc.

A corporate identity might consist of:

- A **logo** to be used on documents, e-mails, website, etc.
- Set of **colours** / themes
- Set of **fonts** to be used for all documents
- A **jingle** (short tune) for TV / radio advertising
- A **mascot** / character to represent the organisation

Every communication the business or organisation has with the public, or with other organisations, will use the corporate identity. This makes the organisation or business very recognisable.

Business Cards

Business cards are used by people who want to give their **contact details** to someone else.

A business card has a person's name, telephone number, e-mail address, etc. pre-printed on it so nothing needs to be written down.

Business cards use the logo / font / colour / style of the corporate identity so that the person receiving the card recognises it immediately.

Letterheads

A letterhead is a **header** / **footer** used for printed **documents** such as letters.

Letterheads usually contain details such as the organisation's **name**, **address**, **telephone** number, **website**, etc.

Often organisations will order boxes of paper with the letterhead pre-printed on it. This paper can then be used in **printers**, or for hand-written letters.

Letterheads use the logo / font / colour / style of the corporate identity so that the person receiving the document recognises it immediately.

Flyers

USES OF ICT IN WORKPLACE

A flyer is a small, **single sheet**, printed document used to **advertise** an event, a product or an idea.

Flyers are often handed out to the **public** to raise awareness of the event / product / idea.

Information such as **date**, **time**, **location**, **contact** details, etc. are placed on the flyer for people to refer to later.

Flyers use the logo / font / colour / style of the corporate identity so that the person receiving the document recognises it immediately.

Brochures

Printed brochures are designed and produced to give **details** of an organisation / product / event.

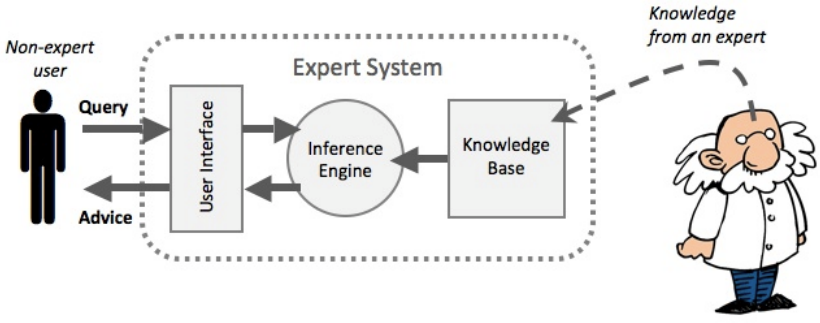
Brochures normally consist of **several pages**, combining **text**, **images** and other graphical elements. Glossy card may be used for brochure covers to give a more 'quality' feel.

Brochures use the logo / font / colour / style of the corporate identity so that the person receiving the document recognises it immediately.

EXPERT SYSTEMS

What is an Expert System?

An expert system is computer **software** that attempts to **act like a human expert** on a particular **subject area**.



Expert systems are often used to **advise non-experts** in situations where a human expert in unavailable (for example it may be too expensive to employ a human expert, or it might be a difficult to reach location).

How Do Expert Systems Work?

An expert system is made up of three parts:

- A **user interface** - This is the system that allows a **non-expert user** to **query** (question) the expert system, and to **receive advice**. The user-interface is designed to be a **simple** to use as possible.
- A **knowledge base** - This is a **collection of facts and rules**. The knowledge base is created from **information** provided by **human experts**
- An **inference engine** - This acts rather like a **search engine**, examining the knowledge base for information that **matches** the user's **query**

The **non-expert user** queries the expert system. This is done by **asking a question**, or by **answering questions** asked by the expert system.

The **inference engine** uses the query to **search** the **knowledge base**and then provides an answer or some **advice** to the user.

Where Are Expert Systems Used?

Medical diagnosis (the knowledge base would contain medical information, the symptoms of the patient would be used as the query, and the advice would be a diagnose of the patient's illness)

Playing **strategy games** like **chess** against a computer (the knowledge base would contain strategies and moves, the player's moves would be used as the query, and the output would be the computer's 'expert' moves)

Providing **financial advice** - whether to invest in a business, etc. (the knowledge base would contain data about the performance of financial markets and businesses in the past)

Helping to **identify items** such as plants / animals / rocks / etc. (the knowledge base would contain characteristics of every item, the details of an unknown item would be used as the query, and the advice would be a likely identification)

Helping to **discover locations to drill for water / oil** (the knowledge base would contain characteristics of likely rock formations where oil / water could be found, the details of a particular location would be used as the query, and the advice would be the likelihood of finding oil / water there)

Helping to **diagnose car engine problems** (like medical diagnosis, but for cars!)

Can Expert Systems Make Mistakes?

Human experts make mistakes all the time (people forget things, etc.) so you might imagine that a computer-based expert system would be much better to have around.

However expert systems can some problems:

- **Can't easily adapt** to new circumstances (e.g. if they are presented with totally unexpected data, they are unable to process it)
- Can be **difficult to use** (if the non-expert user makes mistakes when using the system, the resulting advice could be very wrong)
- They have **no 'common sense'** (a human user tends to notice obvious errors, whereas a computer wouldn't)

MANUFACTURING PRODUCTS

Computer-controlled manufacturing has revolutionised the way products are made. Modern factories are full of **robots**; everything is automated.

In a modern factory the only people you will see are a few engineers who are responsible for keeping the robots and other machinery running smoothly.

This is very different to old factories, where everything was done manually by human workers.

What is an Industrial Robot?

When you think of the word 'robot', you might picture a human-shaped robot with arms, legs and a head - the sort you see in sci-fi films. However this is *not* how the sort of robots used in factories look.

Robots used in factories are called **industrial robots**, and they come in a wide variety of shapes and sizes.

The most common type of industrial robot looks a little bit like a human**arm**. The robot has **joints** (like our **shoulder**, **elbow**, and **wrist**) and some sort of manipulator / device on the end of the arm (where our hand would be).

The robot's **joints** are powered by very strong **electric motors**. These motors are controlled by a **computer**.

*A scene from an old factory - no robots in sight! This type of manual labour is **repetitive** and **boring**.*

In a new factory, the same tasks are performed by robots

The robot's manipulator / device depends upon the job that the robot has to do. It could be:

- *a **gripper** (like a hand, for picking things up)*
- ***suction pads** (for lifting sheet metal or glass)*
- *a **paint spray gun** (for painting things)*
- *a **welding gun** (for joining metal together)*

How Are Robots Used in a Factory?

Robots in factories are used to:

- **lift heavy items** into from place to place
- **assemble** parts together to create things
- **join** parts together using **glue**, or by **welding** (melting metal)
- **paint** things

Robots often work in groups, one robot holding a part, whilst another robot does something to it.

Watching robots work is fascinating - they move so quickly and confidently, that it seems almost like a choreographed dance!

Watching robots work is fascinating - they move so quickly and confidently, that it seems almost like a choreographed dance!

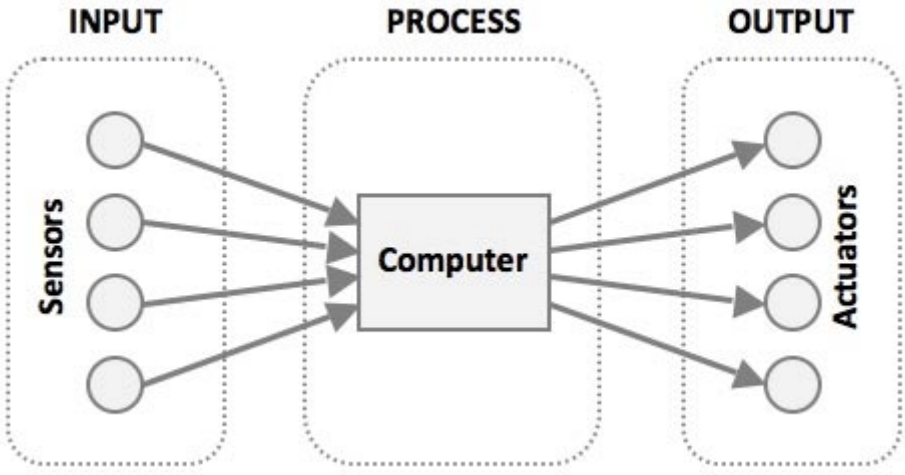
Spray painting *things (a hazardous job for a human - most paint is toxic)*

Welding *metals parts together (needs skill and accuracy)*

Stacking *boxes for shipping (tedious and hard for a human to do all day)*

How Do Computers Control Robots and Production Lines?

The basics of computer control are explained in the **Controlling Real-World Things** section.



In the case of factory production lines the control system consists of:

Sensors

Sensors (**inputs** to the computer) **detect** what is happening on the production line, and **send data to the computer** so that it can decide what to do.

Examples of sensors would be:

- **Switches** / buttons - detect if something is touching them
- **Pressure** sensors - detect if something is pressing down on them
- **Light** sensors - detect if something is present (blocks the light)
- **Temperature** sensors - detect if items are hot/cool enough
- **Liquid level** sensors - detect how much liquid is in a container
- **Cameras** - detect the shape / colour of objects

Process

The **control software** running on the computer is the process. It takes the data from the **sensors**, checks if anything needs to be done, then turns on/off various**actuators** to make things happen.

For example, in a *soft-drink factory*, the production line involves filling bottles with fluid (drink!)

1. The computer would make sure that a bottle was in place (using data from a **pressure** sensor, a**light** sensor, or a **camera**) and then turn **on** the fluid control **valve**.

2. The data from a fluid **level** sensor would be checked to see if the bottle was full. When it was full, the computer would turn **off** the fluid control**valve**.
3. These steps would then be **repeated** for the next bottle, and so on.

In a typical production line, there will be hundreds of sensors and dozens of actuators, all connected to computers (often a large network of computers)

Actuators

Actuators (**outputs** form the computer) are the devices that **make things happen** on the production line: robots picking things up, conveyor belts moving, etc.

Examples of actuators would be:

- **Motors** - used to make almost everything move, from the joints of robot arms, to the motion of conveyor belts.
- **Valves** - to turn on/off the flow of paint, etc.
- **Relays** (electrically operated **switches)** - turn on/off devices like welders

Why Use Computer-Controlled Robots?

The **robots** used in factories are very **expensive**. Many of the larger ones can cost as much as $500,000. And some factories have dozens of robots.

So why would a factory owner spend so much money on these expensive machines?

There are a number of reasons that robots are used:

- Robots can work **24 hours** a day, **every day**, with **no breaks**
- Robots **don't need to be paid** a wage (so money is saved)
- Robots are **extremely accurate** compared to humans, so product**quality is high**
- Robots can perform tasks more **quickly** than humans, so **more products** can be made
- Factories with robots don't need to be heated or even have the lights on, and they don't need food (so **lower day-to-day costs**)
- Robots can work in very **dangerous** / **unhealthy** conditions (e.g. with dangerous chemicals)
- Robots **don't get bored** / hate their job!

There are some downsides to the use of robots in factories:

- Robots are **cannot easily adapt** to unusual conditions like a human can (e.g. if an item on the line is not in the correct place, a human worker would notice and correct it)
- People are made **unemployed** because robots are doing their jobs (however some **new jobs** are created - looking after the robots - and some employees can be **retrained**)
- People are **deskilled** (this means that, because the robots are doing the complex, skilled tasks that the people used to do, the people are left doing simple, boring jobs)
- The robots are very **expensive**, and it can take several years to pay for them (paying with the savings made by not paying any wages)

BOOKING SYSTEMS

Computers are often used to **book** (reserve) air flights, seats in the cinema, rooms in a hotel, tables in a restaurant, etc.

In all of the above examples, there are a **limited number of items** (seats on a plane, rooms in a hotel, etc.) which need to be **allocated**.

It is very important that any booking system **prevents** the same item being booked twice (**double-booking**).

So How do Booking Systems Work?

If we were talking about a single, small cinema, where you had to queue up to buy tickets at the front door, the reservation system would be very simple: We could just use a piece of paper and tick off seats as they were reserved.

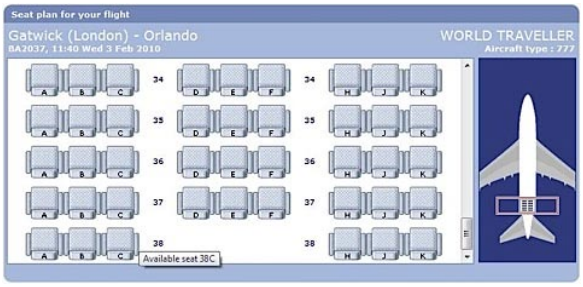
However, most booking systems are much more **complex** than this. A typical booking system must cope with booking requests from **many**different sources, all arriving at the **same time**. For example, flights can be booked by customers online, by travel agents in dozens of different offices, by businesses, etc.

How do booking systems manage all these bookings without making any double-bookings?

All Booking Systems are Real-Time

The Key to all booking systems is the fact that they are **real-time**systems.

A real-time system is one where every **input is processed immediately**, so that the resulting output is ready *before* the next input is processed.



In the case of a booking system...

- The **inputs** are booking requests
- The **processing** involves checking if bookings are possible, and if so making the bookings
- The **outputs** are booking confirmations / rejections

Because a booking system is real-time, when a booking request arrives, the previous booking has already been fully processed. This is what prevents double-booking.

An Example...

Imagine that two people are using an airline's website to try and book seats on a flight. Both people try to book seat 38C and the same time...

Even though the booking requests are made at the same time, one request will be received by the airline's computer just before the other (since requests come into the system through a 'queue')

This is what happens:

1. *Input:* **Please reserve seat 38C**
2. *Process:* Has seat 38C already been booked? No... so book it
3. *Output:* Booking *confirmed* for seat 38C
4. *Input:* **Please reserve seat 38C**
5. *Process:* Has seat 38C already been booked? Yes!
6. *Output:* Booking *rejected*

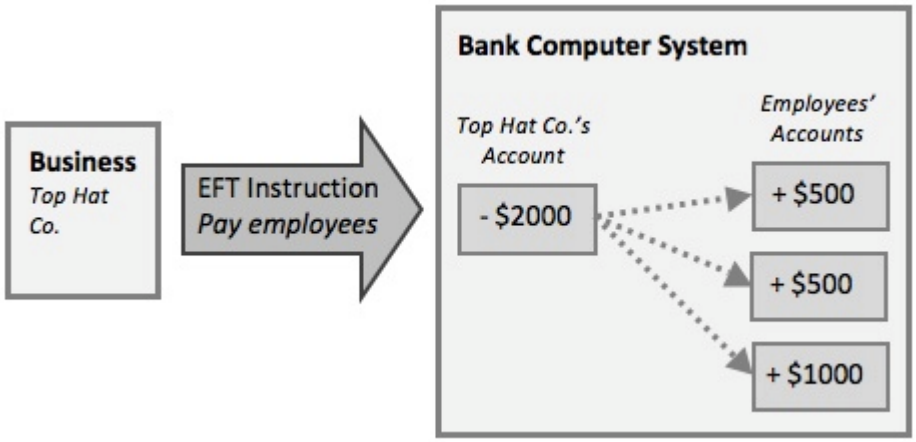
BANKING AND PAYMENT SYSTEMS

Electronic Fund Transfer (ETF)

EFT is a system that allows **money transfer** instructions to be sent**directly** to a **bank's computer system**. Upon receiving one of these instructions, the computer system automatically transfers the specified amount from one account to another.

Transfer instructions can come from **other banks** or from **businesses**.

A very common use of EFT is when a large business pays its employees'**salaries**. On pay day, the businesses tells the bank to move money from the business account to the employees' bank accounts...



Other examples of where EFT is used are discussed in some of the following sections...

*If money is **transferred** from one bank account to another, nothing is**physically** moved - no piles of cash are picked up and moved from one place to another.*

*The amount of money in a bank account is simply a **number** in the bank's **computer system**.*

When money is transferred between accounts, all that happens is one number in the system gets bigger and another gets smaller.
*Obviously the EFT system has to be very **secure** - the bank can't allow just anyone to sent transfer instructions (otherwise we would all be sending messages to bank computers to move money into our accounts!)*

*The EFT system uses very strong**encryption** for all messages and the encryption **keys** are only given to trusted partners (other banks and big businesses).*

Using Cash Machines (ATMs)

ATMs can be used to for a range of banking services...

- **Withdrawing** cash
- **Depositing** money
- Checking the **balance** of accounts
- **Transferring** money between accounts
- **Paying bills**

A customer identifies him/herself and their bank account by using a **bank card**. The card is inserted into the ATM where it is read by a **magnetic strip reader** or a **smart card reader**. The customer also types a secret**PIN** into the ATM's **numeric keypad** to confirm that they are the

real owner of the card

ATMs can be used by customers of other banks as the ATM can use**EFT**...

If a customer of **Bank A** uses her debit card to withdraw cash from an ATM belonging to **Bank B**:

1. Bank B gives her the cash
2. **Bank B now is owed money by Bank A**
3. Bank B sends an **EFT instruction** to Bank A asking for money to be transferred from the customer's account to Bank B.
4. **Bank B has now been paid back**

Electronic Payments for Goods (EFTPOS)
Banks allow goods to be paid for electronically, using a system called**Electronic Fund Transfer at Point-of-Sale** (EFTPOS).

Internet Banking
It is now very common for bank customers to access their bank account from **home** using **on-line banking** services.

Customers use a computer and connect to the bank's **secure (encrypted) website** where they **login** (usually with a **username** and a**password**)

Customers can use the on-line banking system to...

- Check the **balance** of bank accounts
- **Pay bills**
- **Transfer money** between accounts (using **EFT**)
- Apply for **loans**, or other services

Compared to traveling to your actual bank, Internet banking has a few**advantages**...

- More **convenient** - can be used **24 hours a day**, **7 days a week**
- Saves **time** and **money** since you don't have to travel anywhere to use it
- **Data** can be **downloaded** and analysed (e.g. in a spreadsheet) which can help with planning budgets

But there are some **disadvantages** too...

- Requires you to have a **computer** and **Internet** access to use it
- Some people prefer to speak to a **person** (personal service)
- If your account is **hacked**, or your username / password is stolen (e.g. if your computer has malware) money could be stolen from your account

Telephone Banking
This is similar to Internet banking, but does not require a computer, only a normal telephone.

The system works by you calling the bank's telephone banking number then...

- You enter your **account number** (using the phone's number keys)
- You enter your **PIN** / secret code
- You then hear various **options**: (*"Press 1 to find your balance, Press 2 to transfer money..."*)
- You **pick an option** (using the phone's number keys)

- And so on...

Customers can use the telephone banking system to...

- Check the **balance** of bank accounts
- **Pay bills**
- **Transfer money** between accounts (using **EFT**)
- Speak to a bank representative to get financial advice

The **advantages** of telephone banking are similar to Internet banking, but there are some extra things...

- You don't need a **computer**
- You can speak to an actual **person**

The **disadvantage** compared to Internet banking...

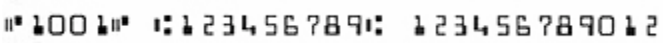
- The system can be **difficult to use** (working through all of those menus)

Processing Cheques (Cheque 'Clearing')

Banks have to deal with thousands of **hand-written**, paper **cheques** every day.

When a cheque arrives at a bank, the **information** on the cheque has to be **entered into the bank's computer system** so that the correct funds can be **transferred** between the correct accounts. Entering this data**quickly** and **accurately** is a time-consuming and difficult task.

To help **speed** things up, a special system of printing is used on cheques that can be read by a reader connected to the computer system. At the bottom of every cheque, printed in a **special font** using **magnetic ink**, is the bank account number and cheque number:



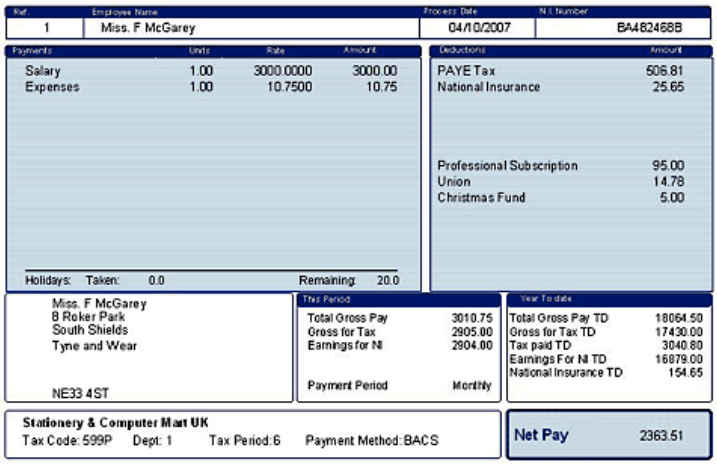
Each cheque is passed through an **MICR reader** that can read these special numbers. (A small reader is shown here, but in large banks the MICR readers are much bigger and can thousands hundreds of cheques.

The **hand-written** part of the cheque (the payee and the value of payment) can be entered into the computer system by either using a **human** to read the writing and **typing** the data in, or by using **OCR**.

PAYROLL PROCESSING

What is a 'Payroll'?

The 'payroll' of a business is the system used to calculate the **salary** (how much they are paid for their work) of each employee.



The inputs to a payroll system are:

- **Employee code** (used to lookup the employee's other details, e.g. name, bank account, etc.)
- **Hours worked**
- **Rate of pay** (e.g. $25 per hour)

The processing involves the following calculation:

Pay = Hours Worked X Rate of Pay

The outputs from a payroll system are:

- A printed **payslip** (given to the employee to show how his/her pay was calculated)
- A **cheque**, or an **EFT payment** directly into the employee's bank account

How is a Payroll Processed?

The payroll is usually processed **once a week** or **once a month**(depending upon how often the business pays its employees).

This means that **batch-processing** is ideal for payroll processing:

- Working hours data is collected into a **batch**
- The data can be processed in **one go** at the end of the week/month
- The **same calculations** will be performed on all the data
- **No user input** is required during the processing
- The processing can be done during **quiet times** when the computer system is not being used for other things (e.g. at night)

Many places of work automatically record hours worked by the employees using systems such as swipe-cards or fingerprint readers.

When an employee arrives at work, they swipe their ID card, and then do the same when they leave.

Hours worked = Time out - Time in
*Sometimes money may be added on to a person's pay (e.g. for working extra '**overtime**')*

*Sometimes pay is taken away (e.g. as **tax**, or health **insurance**payments)*

RETAIL (SELLING) SYSTEMS

What is a Point-of-Sale?

The **Point-of-Sale** (POS) in a store is the place that you **pay** for your purchases. It is usually where the **till** (cash register) is located.

A typical POS will have...

- A method of **inputting** the codes of goods purchased - usually a**bar-code scanner**. The codes are then used to find more information about the goods, such as price, from a database
- A system to accept **electronic payments** - EFTPOS (see below)
- A system to **update the stock-level** of goods whenever they are sold, and possibly to **automatically re-order** goods that have low stock-levels (see below)
- A method of producing a **receipt** for purchases - usually a small dot-matrix printer

Handling Electronic Payments (EFTPOS)

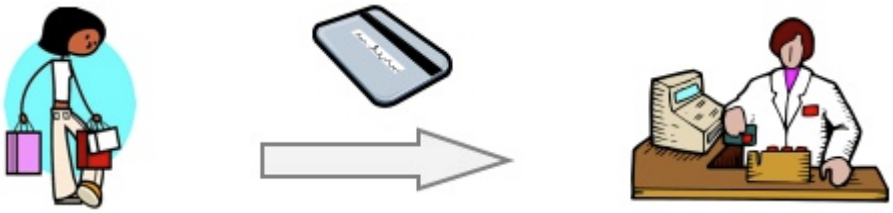
When you use a **bank card** to **pay** for a purchase in a store, the payment is made using a system called **Electronic Fund Transfer** at **Point-of-Sale** (EFTPOS).

This is how it works…

*The **EFT** in EFTPOS is the same Electronic Fund Transfer system discussed **here**.*

1

Customer gives the bank card to the cashier



2

The cashier runs the card through a **card reader** (the customer may have to enter a**PIN**). The cashier enters the**value** of the purchase

Note: A bankcard is used to provide the customer's bank account details. These are printed on the front, and also stored on the magnetic strip on the back.
A bank card does not contain any information about how much money the customer has – only the bank knows that

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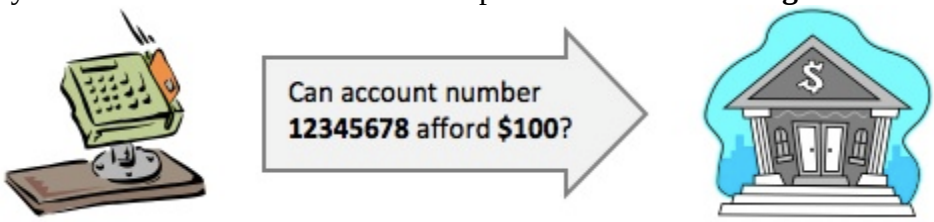
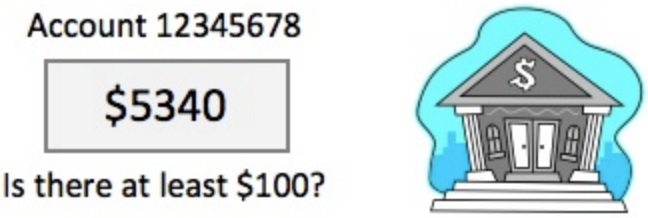
3

The store's system then**connects** to the **bank**computer and sends a**message**



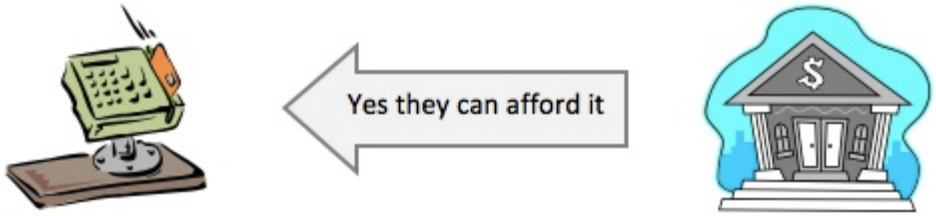
4

The bank computer uses the**account number** to access the **customer's record** and checks the **balance**



5

The bank computer sends back a confirmation or rejection**message** to the store's system



6

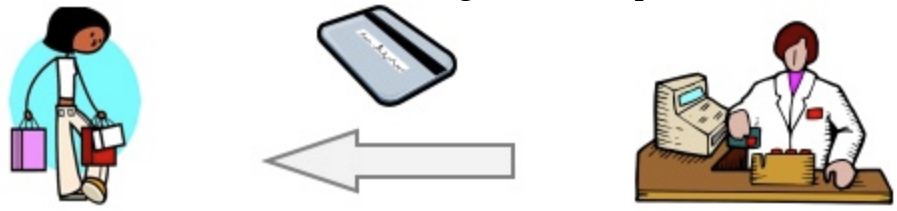
The cashier now confirms the purchase and an **EFT message** is sent to the bank

7

The bank computer **subtracts**$100 from the customer's account and **adds** $100 to the store's account

8

The cashier gives the card back to the customer along with a **receipt**



'Chip & PIN' Payment System
Most bankcards no longer rely on a magnetic strip to store customer account details. Instead the cards are **smart cards**. The cards contain a small amount of computer **memory** with the account information stored inside.

Smart cards are more **secure** (since the data is encrypted) and more**reliable** than magnetic strip cards.

When a customer wishes to pay for goods in a store, the customer inserts the bankcard into a **smart card reader**, and then types in a **PIN** to confirm that they are the true owner of the card. Once the PIN is verified, the customer can remove the card.

One of the reasons this system has proven popular is the extra level of**security** it provides for users: **At no time does the bankcard need to be handled by anyone other than the card owner**, so with this system there is less chance of the card being stolen or copied.

The nickname for the tiny memory device inside the bankcard is a '**chip**', and the system uses a **PIN** as identity proof, so the system is nicknamed '**Chip and PIN**' in the UK.

*PIN stands for **Personal Identification Number**.*

*A PIN is usually a four digit **secret code** used to confirm a person's identity (e.g. when withdrawing cash from an ATM)*

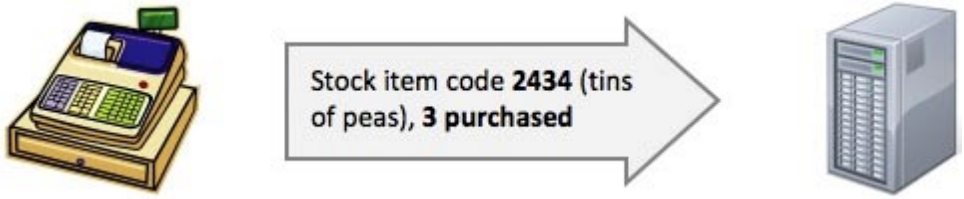
Note: You should not say 'PIN number' since that would mean 'Personal ID Number number'!

Automatic Re-Ordering of Stock
In many stores, the **POS** system is linked to the **stock control** system...

*'**Stock**' means the things that you have in your store / warehouse.*

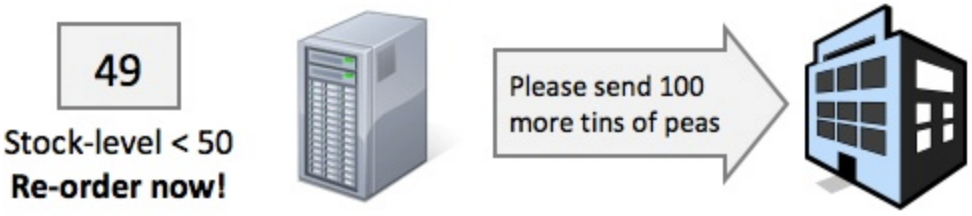
*'**Stock Control**' is the system that keeps track of what you have in stock*

1
When goods are **sold**, the**POS** system send the details of the sale to the **stock-control system**

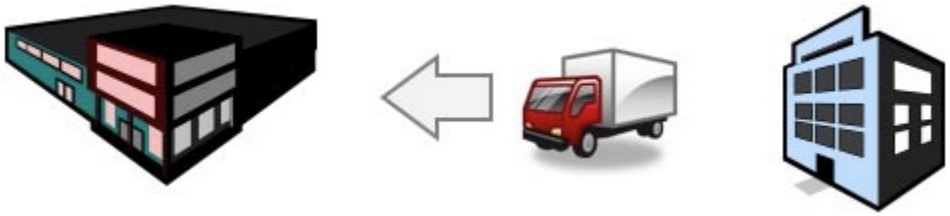


2
The stock-control system**updates** the **stock-levels** in the **stock database** for the purchased goods

3
If the **stock-level falls below**a pre-set value, the stock-control system sends an **order**to the **suppliers**



4
The suppliers send a **delivery**to the store.



5
The stock-control system**updates** the **stock-levels** in the **stock database** for the delivered goods

Internet Shopping (e-Commerce)
In the last few years, Internet shopping has become very popular. Stores like Amazon and the iTunes Store are some of the largest retail businesses in the world. Online you can buy anything from air flights to fresh eggs.
Customers like Internet shopping because...

- The **convenience** of being able to browse goods from your home
- Stores are open **24 hours** a day, every day of the year
- The wider **range of choice** - can access stores all over the world
- Easy if you have **limited mobility** (due to a disability, or old age)
- Goods are often **cheaper** than in stores
- **Payment is simple** using credit cards or services such as PayPal

Businesses like Internet shopping because...

- **Lower costs** since no expensive retail stores and less staff
- Lower costs = lower selling prices = **higher sales** = **bigger profits**
- Many **more potential customers**

However there are some **problems** too...

- You **cannot try** items before purchasing (e.g. clothes)
- You may have to **wait several days** before receiving your goods
- **Returning** goods or getting help can be difficult
- There is a **security risk** using credit cards online. The card details may be stolen and used to commit fraud.

MEDICAL & HOSPITAL SYSTEMS

Computer system are used in several quite different ways within doctor's surgeries and hospitals...

Monitoring of Patients

When a patient is in hospital, they often require close monitoring. It is not possible for a doctor or nurse to monitor patients continuously, 24 hours a day, so computerised monitors are used instead.

Sensors are attached to the patient. Senors are used to monitor:

- **Pulse rate** (heart beats per minute)
- **Temperature**
- **Breathing rate** (breathes per minute)
- **Blood oxygen** levels
- **Blood pressure**

The sensors feed information back to a computer which **processes** the data:

- Data is checked for any **problems** (e.g. pulse rate too low/high)
- Data is **logged** so that it can be checked later

Several **outputs** from the computer system let hospital staff the patient's condition:

- A large **display** / **monitor** shows graphs of pulse, breathing, etc.
- A loud **buzzer** / **alarm** can be sounded if there is a problem to attract the attention of a nurse/doctor
- A small **printer** can produce a hard-copy of the data

The data from several patients can be fed back to a central nursing station so that the nursing staff can see exactly what is happening in the ward.

Diagnosis of Illness
Body Scanners

CT scanners and **MRI scanners** allow doctors to investigate what is happening inside a patient's body without intrusive surgery.

The complex signals that come back from these huge machines are picked up by **sensors** and fed into a computer. The computer **processes**the data, then outputs **full-colour images**, sometimes in **3D**, for the doctor, giving views of the patient's body.

Expert Systems

Expert systems allow medical staff with limited medical knowledge (e.g. nurses) to get advice from a computer 'expert'

Expert systems are described **here**. But they essentially work by:

1. Medical staff **inputs** patient's **symptoms** (or answers questions about them)
2. The expert system's search engine **searches** the **knowledge base**(a collection of medical knowledge) to find possible diagnoses
3. The system **outputs** a list of **possible diagnoses**, and treatments

USES OF ICT IN WORKPLACE

Managing Patient Records

Doctors and hospitals have to deal with thousands of patients every week. It is essential that the **medical details** of every patient is recorded**accurately** so that the correct diagnosis can be made, and the correct treatment can be given.

For this reason, hospitals make use of **computerised databases** to store patient records. Computerised databases mean that:

- Patient data can be easily **shared** between **doctors**, **pharmacies**and other **hospitals**
- It is easy to **search** for and retrieve patient records
- Doctors can instruct a **pharmacy** to issue **medication** for a patient (no paper note needs to be written)

Databases are described fully **here**. In the case of hospitals, the patient data that would be typically stored would be:

- Patient **ID** (number or text) - this would be the key field
- **Name** (text)
- **Date-of-birth** (date)
- **Gender** (boolean)
- **Blood group** (text)
- **Allergies** (text)
- **Medical history** (text)
- **Doctor** currently treating (text)
- Current **symptoms** (text)
- Current **diagnosis** (text)
- Current **treatment** (text)
- Current **medication** (text)
- **X-rays** or body **scans** (links to image/video files)

It used to be the case that patient records were all written on paper, and stored in huge, manual databases.

This made accessing the records slow. Sometimes records could get lost, and there was no easy way to make a back-up copy.

*Doctors can access a patients record whilst they are visiting patients, by using a computer connected **wirelessly** to the hospital network.*

*Doctors often use **tablet computers**(which are portable like laptops, but have a **touch screen**, and no keyboard) as they can be held in one hand, and operated with the other.*

*Notes can be written on the screen using a stylus, and **handwriting-recognition** software converts it into computer text data.*

SCHOOL MANAGEMENT SYSTEMS

Schools have to manage many different sets of data:

- **Pupil information** (name, contact details, etc.)
- **Staff information** (name, bank details for pay, etc.)
- **Timetable** (rooms, times, subject, staff, classes, etc.)
- **Pupil attainment** (marks, grades, comments, etc.)
- **Pupil behaviour** (dates, incidents, notes, etc.)
- **Administration** data (letters, forms, etc.)
- **Financial** records (wages, fees, etc.)
- **Exam** entries (times, dates, pupils, results, etc.)

Rather than use lots of different systems to manage this information, many schools use a **School Management System** (sometimes called a **School Information System**, or SIS). This is a system that manages all of a school's data in a single, integrated application.

Having all of the information in a single system allows schools to more easily **connect** data together.

For example, when viewing a pupil's record, the user could follow a link to the pupil's class, and from there a link to the pupil's teacher, and from there a link to the teacher's other classes, and so on.

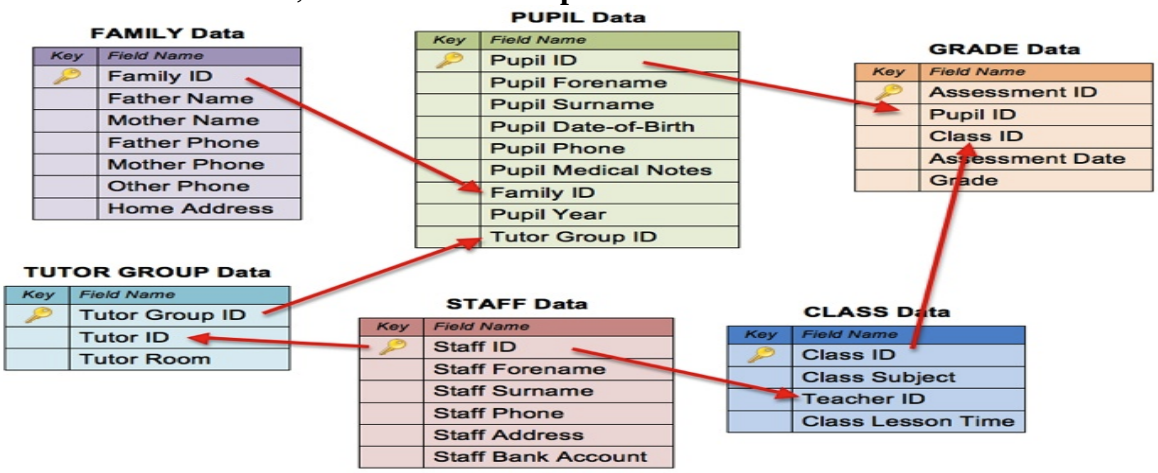
These connections between sets of data allow complex tasks to easily be performed such as:

- Sending letters to all parents of pupils who scored below 50% in their last English test
- Printing personalised timetables for IGCSE pupils (even though they have all chosen different options)
- Monitoring the progress of pupils in multiple subjects, over a number of years

As you can imagine, School Management Systems are pretty **complex**. Most systems are based on a complex **relational database**. The database contains **many tables** of data, each table having **many records**and **many fields**.

An Example...

An example of a part of a typical school database showing the different data **tables**, the **fields** within each table, and the **relationships** between the tables:



LIBRARY SYSTEMS

Libraries often contain many thousands of books, magazines, CD-ROMs, etc. In fact, some of the largest libraries (e.g. The British Library in the UK) contain well over 100 million items - that's a lot of things to keep track of!

For this reason, libraries use computer-based systems to keep a record of their books, and of the people who borrow the books.

A computerised library database allows for:

- Quick and easy searching for books
- Easy printing out of book lists / labels
- Easy tracking of book loans (who has it, when it was borrowed, etc.)
- Automatic printing of warning letters for borrowers who have not returned books

International Standard Book Number (ISBN)

Every published book has an International Standard Book Number (**ISBN**).

The ISBN is typically printed on the back of the book in **numeric** form, and as a **barcode** (to allow for quick data entry)

*It's important to note that a book's**ISBN** cannot be used as the **primary key** field in a library's book database.*

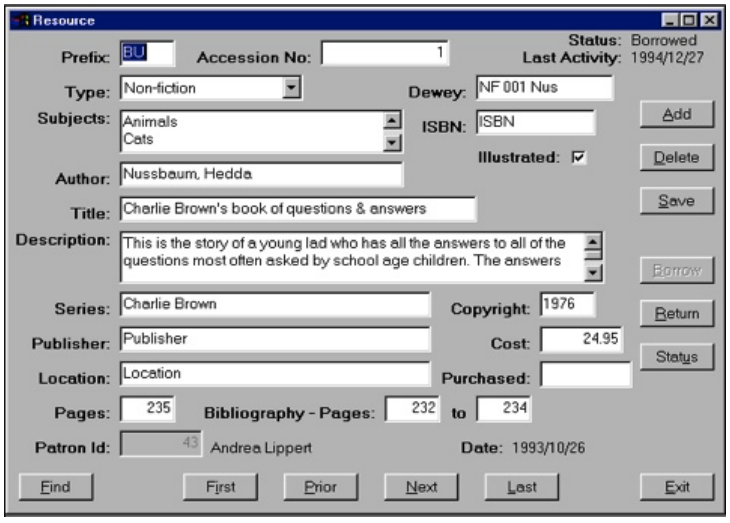
*Why? Because if you have **several copies** of the same book, they will all have the **same ISBN**. And the primary key must be unique.*

*For this reason, library books are given a **unique ID** number / code.*

The Book Database

A typical library book database might contain:

- **Book ID** (number / text)
- **Title** (text)
- **Author** (text)
- **Publisher** (text)
- **ISBN** (number)
- **Fiction** / **non-fiction** (boolean)
- **Genre** / **category** (text)
- **Cost** (number)
- **Date of purchase** (date)



USES OF ICT IN WORKPLACE

Before computers, libraries had to use manual paper-based systems.

Details of books were recorded on small cards which were then kept in small drawers (in order of author's name, for fiction books, or in order of subject, for non-fiction books)

You can probably imagine that keeping these cards up-to-date, and making sure non got lost, or put back in the wrong place, was a huge job!

The Borrower Database

A typical library borowwer database might contain:

- **Borrower ID** (number / text)
- **Name** (text)
- **Phone number** (text)
- **Address** (text)
- **E-mail** address (text)
- **Date of birth** (date)

Borrowers are commonly given**library cards** that have their details printed on, so that they don't have to remember their ID.

Most cards also have the borrower's ID in the form of a **barcode** for quick and easy data input when borrowing books

The Loans Database

The loans database has records added to it when someone borrows a book. The loans database **links** together records from the books database and the borrower database.

A typical loans database would contain:

- **Book ID** (number / text)
- **Borrower ID** (number / text)
- **Date of loan** (date)
- **Due date** (date)

The loans database can be regularly checked for loans that are late back. The computer simply has to search the database for records where:

Due date is before Today

When a late record is found, the borrower ID can be used to link to the borrower's record. The borrower's address / e-mail can then be used to send out an automatic reminder letter.

As with the manual book catalogue mentioned above, before computers all loans were recorded using a paper-based, manual system

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