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Business Process Automation through Application Software

Learning Objectives

- ◆ To understand business applications and the basis for their classification;
- ◆ To understand how to go about automation of critical business processes;
- ◆ To identify the need for automation of information processing cycles;
- ◆ To understand the need for adopting effective delivery channels based on user needs;
- ◆ To understand functioning of Application Controls; and
- ◆ To have an overview of the key Emerging Technologies and their usage.

Task Statements

- ◆ To identify various types of business applications according to their usage;
- ◆ To identify critical business processes, which can be automated and assess the impact of business process automation;
- ◆ To distinguish between computerized information processing and manual information processing;
- ◆ To assess the impact of the choice of delivery channels on business decision making;
- ◆ To assess the risk of having poor controls and areas where they are needed to be deployed; and
- ◆ To identify opportunities for resource optimization using new technologies like Virtualization, Grid Computing and Cloud Computing.

Knowledge Statements

- ◆ Knowledge of various types of business applications that have been developed to automate business processes across varied industries;
- ◆ Knowledge of the steps involved in business process automation, the applications that enable automation and the relevant controls;

- ◆ Knowledge of different types of information processing cycles and the current trends;
- ◆ Knowledge of various types of delivery channels and how they impact business decision making;
- ◆ Knowledge of various types of application controls, the functions they perform and the way they are deployed; and
- ◆ Knowledge of the working of new technologies like Virtualization, Grid Computing and Cloud Computing.

5.1 Introduction

Information Technology (IT) is an exciting avenue where massive investments are being made and the impact on its deployment will not only affect the way enterprises operate and provide their services but it will also influence the way business will be done in the near future. IT will open out new vistas of commerce breaking all barriers and boundaries. This has made the concept of “Geography is History” as true. The rapid growth in communication technology making it faster and reliable coupled with its integration with IT has truly made the world today a global village making true the concept, “The Network is the Computer”. With network availability, there are really no barriers or boundaries. Any enterprise located in any remote corner can make their products or services available to anyone, anywhere at any time.

The speed of automation of all activities, whether they be connected to business or not directly connected to business, has surprised the stakeholders of enterprises, who are affected by such computerization. The changing dynamics of business due to this automation has forced management to re-think their strategy to stay in business. Today the speed with which automation has occurred, the extent of automation and the dependency on automation for ensuring enterprise success is one of the key challenges for enterprises to survive and thrive in the global digital age.

We find pervasiveness of automation in every aspect of our daily life whether it is personal or professional. The day starts with delivery of newspaper; the delivery boy has used Google maps to chart his/her path to our house. The milkman: AMUL, uses high degree of technology to ensure that we get the freshest milk. Next on the list is the vegetable vendor, which is now the nearby departmental stores selling vegetables using technology for all their key operations right from procurement to stock replenishment. The kids going to school find that their test scores are being emailed or sent by SMS to their parents. In higher educational institutions, if a student is absent, the system directly sends an automated SMS to parents of the child.

In our professional work, we realize that our daily job has changed, due to use of technology. Now, few routine jobs are expected to be done by an employee but are taken care by automated systems. For example: attendance marking and tracking. Many office automation systems have reduced the manual jobs, as they can be easily done by computer systems. Indian citizens need not go to government offices to deposit taxes, or pay utility bills; everything has been made available online. Commercial establishments have all automated

their processes, like banks, share markets, insurance companies, etc. The level of automation has helped our country to progress faster and helped businesses to save costs.

Governments at both Central and State level have embarked upon large IT enabled service programs to using e-governance model. Now, virtually every tax department in country is computerized. The level of computerization has now started trickling down to municipal corporations with many municipalities in India enabling citizens to pay municipal taxes online.

The level of computerization and the acceptance of the same in the country has not only changed the way enterprise provide products and services but also it has changed the way people are performing regular tasks. For example, people are not reading books but reading e-books. People do not go to nearby mall to buy a product but buy the same online at the convenience of home/office and at any time during the day/night. The delivery channels have changed from physical to e-mode, by delivery of information or goods.

However, the level of automation needs to be controlled considering the inherent risks of technology. This makes it imperative to implement the adequate level of appropriate controls during all stages of computer processing right from the data capture to the data storage phase. It is important to process the information effectively and efficiently and at the heart of this information processing is IT. Business value is derived by making information available to all stakeholders but also ensuring security of this information.

New technologies are getting developed due to large scale computerization, decreasing costs of storing data and increasing speed of internet. Emerging technologies such as virtualization, grid computing and cloud delivery model are enabling technology revolution version 2. It is basically application of technology revolution version 1, where large scale networking created a huge network of computers called as Internet.

5.2 Business Applications

The meaning of Business Application can be best understood by dividing the set of words into their constituents. Business is defined as a person's regular occupation or commercial activity, a person's concern. Application, in terms of computers, is defined as a computer program to fulfill a particular purpose. Bringing together these definitions shall define the word Business Application as a computer program used to fulfill a person's need for regular occupation or commercial activity.

This means that business applications are software or set of software used by business people. The next step is to understand the business needs, which can be fulfilled through the software. These can be all activities to run business, like keeping track of inventory levels, checking for bank account balances, checking status of delivery of goods dispatched, and all other business activities.

5.2.1 Types of Business Applications

Business applications can be classified based on various usages they are put to as well as user's understanding of the application. A typical classification is shown in Table 5.2.1.

Table 5.2.1: Classification of Business Applications

Types	Nature of processing	Source of application	Nature of business	Functions covered
Type I	Batch Processing	In-house developed	Small business	Accounting application
Type II	Online Processing	Purchased application	Medium business	Cash Management
Type III	Real-time Processing	Leased	Large business	Manufacturing Applications
More types	No	Yes	No	Yes
Students need to understand that business applications by their nature can be varied may be numerous numbers. Above categorization is a just a sample way of classifying them. Above list is only illustrative; students are expected to use their intelligence to add further items to above list.				

Classification is an effort to categorize numerous types of business applications on a logical basis. Let us understand the basis of the above classification.

- ◆ **Nature of processing:** This is the way an application updates data, say in batch processing, there is a time delay in occurrence and recording of transaction. On the other hand in online processing, the transactions are recorded at the moment they occur. An application that allows query handling/ responses to updates in system is classified as real time processing system.
- ◆ **Source of application:** The name of category is self-explanatory, as it tells the source from where application has been bought. TALLY, is a purchased application. An entity may get an application developed for itself, this is in-house developed application. A new method for getting applications is being used today, i.e. leased applications, where user pays fixed rent for using the application for agreed terms. Many specialized vendors provide users with option to get their job done by paying monthly rent, this is referred to as outsourcing.
- ◆ **Nature of business:** This classification is based on the users for whom the application has been developed. Here, the emphasis is on size and complexity of business process. Say, for example, a business application being used by a large number of small business establishment in India may not be effective for a large business organizations. This categorization is again important, as it denotes the basic purpose of any business application.

- ◆ **Functions covered:** A business application may be classified based on business function it covers. For example, accounting applications, Office Management software, Compliance application, Customer relationship management, Decision making software, ERP software, Product lifecycle management, etc.

5.2.2 Business applications based on nature of application

It is clear from the above discussion that the categorization can be extended based on an individual's understanding and perception of application under review. As business applications get their name from word applications, so the discussion here is being restricted to one category, which is based on nature of application.

- ◆ **Accounting Applications:** Accounting applications range from application software such as TALLY and wings to high-and applications such as SAP and Oracle Financials. These are used by business entities for the purpose of day-to-day transactions of accounting and generating financial information such as balance sheet, profit and loss account and cash flow statements. These are classified as accounting applications.
- ◆ **Office Management Software:** These applications help entities to manage their office requirements like word processors (MS Word), electronic spreadsheets (MS Excel), presentation software (PowerPoint), file sharing systems, etc. The purpose is to automate the day-to-day office work and administration.
- ◆ **Compliance Applications:** Enterprises need to comply with applicable laws and regulations. India has taken a long stride in adopting e-compliance for its citizens with government promoting e-filing of documents, e-payments taxes, e-storage of data, etc. This has raised the requirements for software which can help any entity achieve compliances. A separate class of business application are available that facilitate meeting the compliance requirements.
- ◆ **Customer Relationship Management Software:** These are specialized applications catering to the need of organizations largely in FMCG (Fast-Moving Consumer Goods) categories. These entities need to interact with their customers and respond to them. The response may be in the form of service support or may lead to product innovation. These are sought by entities, which deal directly with consumers.
- ◆ **Management Support Software:** These are applications catering to decision-making needs of the management. They may be further classified based on the level of management using them. For example, Management Information System are generally used by middle level manager's for their decision making needs, on the other hand Decision Support Systems are used by top management for their information requirements.
- ◆ **ERP Software:** These applications called as Enterprise Resource Planning software, which are used by entities to manage resources optimally and to maximize the three Es i.e. Economy, Efficiency and Effectiveness of business operations.

- ◆ **Product Lifecycle Management Software:** These business applications are used by enterprises that launch new products and are involved in development of new products. The recent trend in auto-sector in India reflects the growing importance and need of this type of software. Each month a new product is launched by auto companies in India, may it be two-wheeler or four-wheeler segment. The top management of all these companies often say that “the life cycle of auto products have significantly reduced”.
- ◆ **Logistics Management Software:** For large logistics managing companies, these are key business applications. These companies need to keep track of products and people across the globe to check whether there are any discrepancies that need action.
- ◆ **Legal Management Software:** In India, a lot of effort is being put to digitize the legal system. Government of India, is keen to reduce the pendency in courts. As this process goes on legal profession in India shall need such systems. There are big legal firms in India, which are already using such business applications.
- ◆ **Industry Specific Applications:** These are industry specific applications focused on a specific industry sector. For example, software designed especially for Banking applications, Insurance applications, Automobile dealer system, billing systems for malls, Cinema ticketing software, Travel industry related software, etc.

5.3 Business Process Automation

A business process is a set of activities that are designed to accomplish specific organizational goals. To better understand a business process, the activities may be arranged in the form of a flowchart or process matrix. Business Process Automation (BPA) is a strategy to automate business processes so as to bring benefit to enterprise in terms of cost, time and effort. The core objective of BPA is achieved through integrating various business processes.

5.3.1 Why BPA?

What are the primary reasons to automate the business process foreign enterprise and ‘what are the key benefits?’ These are basic questions, which need to be answered before pursuing automation. Generally, the primary reasons for automation by enterprises are:

- ◆ **Cost Saving:** Automation leads to saving in time and labour costs.
- ◆ **To remain competitive:** To provide the level of products and services as offered by competition.
- ◆ **Fast service to customers:** This was not the initial reason for adaption of BPA but gradually business managers realized that automation could help them to serve their customers faster and better.

Objectives of BPA

The success of any business process automation shall only be achieved when BPA ensures:

- ◆ **Confidentiality:** To ensure that data is only available to persons who have right to see the same;
- ◆ **Integrity:** To ensure that no un-authorized amendments can be made in the data;
- ◆ **Availability:** To ensure that data is available when asked for; and
- ◆ **Timeliness:** To ensure that data is made available in at the right time.

To ensure that all the above parameters are met, BPA needs to have appropriate internal controls put in place. A more detailed discussion follows in later sections of the chapter.

Case Study

The following case study offers interesting insights on the benefit of BPA:

Amazon Inc., the largest book shop on internet has achieved a quarterly turnover of over USD 21 Billion for Q4 of year 2012. Compare the same to Barnes and Noble, one of the oldest book shops in US having a Q4 2012, turnover of around USD 2 Billion. The difference is of 10 times and is a reflection that automation is the key. Amazon allowed users to access books at a click of button, and with ease. The success of Amazon, was not only the availability of books on internet but also, its ability to streamline the delivery mechanism. There are lot of Indian companies which have used the same model and are achieving success, namely Flipkart and Snapdeal. In fact, these online retailers are now a serious threat to the business of shopping malls.

5.3.2 How to go about BPA?

The steps to go about implementing business process automation are depicted here in Fig. 5.3.1. One important point to remember is that not all processes can be automated at a time. The best way to go about automation is to first understand the criticality of the business process to the enterprise.

Let us discuss the key steps in detail.

(i) Step 1: Define why we plan to implement a BPA?

The primary purpose for which an enterprise implements automation may vary from enterprise to enterprise. A list of generic reasons for going for BPA may include any or combination of the following:

- ◆ Errors in manual processes leading to higher costs.
- ◆ Payment processes not streamlined, due to duplicate or late payments, missing early pay discounts, and losing revenue.
- ◆ Paying for goods and services not received.
- ◆ Poor debtor management leading to high invoice aging and poor cash flow.

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- ◆ Not being able to find documents quickly during an audit or lawsuit or not being able to find all documents.
- ◆ Lengthy or incomplete new employee or new account on-boarding.
- ◆ Unable to recruit and train new employees, but where employees are urgently required.
- ◆ Lack of management understanding of business processes.
- ◆ Poor customer service.

Step 1: Define why we plan to implement BPA?	• The answer to this question will provide justification for implementing BPA.
Step 2: Understand the rules/ regulation under which it needs to comply with?	• The underlying issue is that any BPA created needs to comply with applicable laws and regulations.
Step 3: Document the process, we wish to automate.	• The current process which are planned to be automated need to be correctly and completely documented at this step.
Step 4: Define the objectives/goals to be achieved by implementing BPA.	• This enables the developer and user to understand the reasons for going for BPA. The goals need to be precise and clear.
Step 5: Engage the business process consultant.	• Once the entity has been able to define the above, the entity needs to appoint an expert, who can implement it for the entity.
Step 6: Calculate the RoI for project.	• The answer to this question can be used for convincing top management to say 'yes' to the BPA exercise.
Step 7: Development of BPA.	• Once the top management grant their approval, the right business solution has to be procured and implemented or developed and implemented covering the necessary BPA.
Step 8: Testing the BPA.	• Before making the process live, the BPA solutions should be fully tested.

Fig. 5.3.1: Steps involved in Implementing Business Process Automation

- (ii) Step 2: Understand the rules / regulation under which enterprise needs to comply with?

One of the most important steps in automating any business process is to understand the rules of engagement, which include following the rules, adhering to regulations and following document retention requirements. This governance is established by a combination of internal corporate policies, external industry regulations and local, state, and central laws. Regardless of the source, it is important to be aware of their existence and how they affect the documents that drive the processes. It is important to understand that laws may require documents to be

retained for specified number of years and in a specified format. Entity needs to ensure that any BPA adheres to the requirements of law.

(iii) Step 3: Document the process, we wish to automate

At this step, all the documents that are currently being used need to be documented. The following aspects need to be kept in mind while documenting the present process:

- ◆ What documents need to be captured?
- ◆ Where do they come from?
- ◆ What format are they in: Paper, FAX, email, PDF etc.?
- ◆ Who is involved in processing of the documents?
- ◆ What is the impact of regulations on processing of these documents?
- ◆ Can there be a better way to do the same job?
- ◆ How are exceptions in the process handled?

The benefit of the above process for user and entity being:

- ◆ It provides clarity on the process.
- ◆ It helps to determine the sources of inefficiency, bottlenecks, and problems.
- ◆ It allows to re-design the process to focus on the desired result with workflow automation.

An easy way to do this is to sketch the processes on a piece of paper, possibly in a flowchart format. Visio or even Word can be used to create flowcharts easily.

It is important to understand that no automation shall benefit the entity, if the process being automated is error-prone. Investment in hardware, workflow software and professional services, would get wasted if the processes being automated are not made error-free. Use of technology needs to be made to realize the goal of accurate, complete and timely processing of data so as to provide right information to the right people safely and securely at optimum cost.

(iv) Step 4: Define the objectives/goals to be achieved by implementing BPA

Once the above steps have been completed, entity needs to determine the key objectives of the process improvement activities. When determining goals, remember that goals need to be SMART:

- ◆ Specific: Clearly defined,
- ◆ Measurable: Easily quantifiable in monetary terms,
- ◆ Attainable: Achievable through best efforts,
- ◆ Relevant: Entity must be in need of these, and
- ◆ Timely: Achieved within a given time frame.

For example,

Case 1: For vendor's offering early payment discounts, entity needs to consider:

- ◆ How much could be saved if they were taken advantage of, and if the entity has got the cash flow to do so?
- ◆ Vendor priority can be created based on above calculations, for who gets paid sooner rather than later.

Case 2: To determine the average invoice aging per customer. Entity can decide to reduce the average from 75 days to 60 days. This alone can dramatically improve cash flow.

(v) Step 5: Engage the business process consultant

This is again a critical step to achieve BPA. To decide as to which company/ consultant to partner with, depends upon the following:

- ◆ Objectivity of consultant in understanding/evaluating entity situation.
- ◆ Does the consultant have experience with entity business process?
- ◆ Is the consultant experienced in resolving critical business issues?
- ◆ Whether the consultant is capable of recommending and implementing a combination of hardware, software and services as appropriate to meeting enterprise BPA requirements?
- ◆ Does the consultant have the required expertise to clearly articulate the business value of every aspect of the proposed solution?

(vi) Step 6: Calculate the RoI for project

The right stakeholders need to be engaged and involved to ensure that the benefits of BPA are clearly communicated and implementation becomes successful. Hence, the required business process owners have to be convinced so as to justify the benefits of BPA and get approval from senior management. A lot of meticulous effort would be required to convince the senior management about need to implement the right solution for BPA. The right business case has to be made covering technical and financial feasibility so as to justify and get approval for implementing the BPA. The best way to convince would be to generate a proposition that communicates to the stakeholders that BPA shall lead to not only cost savings for the enterprise but also improves efficiency and effectiveness of service offerings.

Some of the methods for justification of a BPA proposal may include:

- ◆ Cost Savings, being clearly computed and demonstrated.
- ◆ How BPA could lead to reduction in required manpower leading to no new recruits need to be hired and how existing employees can be re-deployed or used for further expansion.
- ◆ Savings in employee salary by not having to replace those due to attrition.

- ◆ The cost of space regained from paper, file cabinets, reduced.
- ◆ Eliminating fines to be paid by entity due to delays being avoided.
- ◆ Reducing the cost of audits and lawsuits.
- ◆ Taking advantage of early payment discounts and eliminating duplicate payments.
- ◆ Ensuring complete documentation for all new accounts.
- ◆ New revenue generation opportunities.
- ◆ Collecting accounts receivable faster and improving cash flow.
- ◆ Building business by providing superior levels of customer service.
- ◆ Charging for instant access to records (e.g. public information, student transcripts, medical records)

The above can be very well presented to justify the proposal and convince management to go ahead with the project of BPA implementation as required for the enterprise.

(vii) Step 7: Developing the BPA

Once the requirements have been document, ROI has been computed and top management approval to go ahead has been received, the consultant develops the requisite BPA. The developed BPA needs to meet the objectives for which the same is being developed.

(viii) Step 8: Testing the BPA

Once developed, it is important to test the new process to determine how well it works and identify where additional “exception processing” steps need to be included. The process of testing is an iterative process, the objective being to remove all problems during this phase.

Testing allows room for improvements prior to the official launch of the new process, increases user adoption and decreases resistance to change. Documenting the final version of the process will help to capture all of this hard work, thinking and experience which can be used to train new people.

5.3.3 Case studies on automation of business processes

(i) Case 1: Automation of purchase order generation process, in a manufacturing entity

Various steps of automation are given as follows:

Step 1: Define why we plan to go for a BPA?

The entity has been facing the problem of non-availability of critical raw material items which is leading to production stoppages and delay in delivery. Delay in delivery has already cost company in terms of losing customer and sales.

Step 2: Understand the rules / regulation under which needs to be complied with?

The item is not covered by regulation, regarding quantity to be ordered or stored. To keep cost at minimum entity has calculated economic order quantity for which orders are placed.

Step 3: Document the process, we wish to automate.

The present process is manual where the orders are received by purchase department from stores department. Stores department generates the order based on manual stock register, based on item's re-order levels. The levels were decided five years back and stores records are not updated timely.

Step 4: Define the objectives/goals to be achieved by implementing BPA

The objective behind the present exercise is to ensure that there are no production losses due to non-availability of critical items of inventory. This shall automatically ensure timely delivery of goods to customer.

Step 5: Engage the business process consultant

ABC Limited, a consultant of repute, has been engaged for the same. The consultant has prior experience and knowledge about entity's business.

Step 6: Calculate the ROI for project

The opportunity loss for the project comes to around ₹ 100/- lakhs per year. The cost of implementing the whole BPA shall be around ₹ 50/- lakhs. It is expected that the opportunity loss after BPA shall reduce to ₹ 50 lakhs in year one, ₹ 25/- lakhs in later years for the next five years.

For students:

- ◆ Is the project worth going ahead?
- ◆ What is the ROI, based on three years data?
- ◆ What is the payback period?

Step 7: Developing the BPA

Once the top management says yes, the consultant develops the necessary BPA. The BPA is to generate purchase orders as soon as an item of inventory reaches its re-order level. To ensure accuracy, all data in the new system need to be checked and validated before being put the same into system:

- ◆ Item's inventory was physically counted before uploading to new system.
- ◆ Item's re-order levels were recalculated.
- ◆ All items issued for consumption were timely updated in system.
- ◆ All Purchase orders automatically generated are made available to Purchase manager at end of day for authorizations.

Step 8: Testing the BPA

Before making the process live, it should be thoroughly tested.

(ii) Case 2: Automation of employee attendance

Various steps of automation are given as follows:

Step 1: Define why we plan to go for a BPA?

The system of recording of attendance being followed is not generating confidence in employees about the accuracy. There have been complaints that salary payouts are not as per actual attendance. It has also created friction and differences between employees, as some feels that other employees have been paid more or their salary has not been deducted for being absent.

Step 2: Understand the rules/regulation under which needs to comply with?

A number of regulations are applicable to employee attendance including Factories Act 1948, Payment of Wages Act 1936, State laws, etc. This is a compliance requirement and hence, any BPA needs to cater to these requirements.

Step 3: Document the process, we wish to automate.

The present system includes an attendance register and a register at the security gate. Employees are expected to put their signatures in attendance registers. The register at the gate is maintained by security staff, to mark when an employee has entered. There is always a dispute regarding the time when an employee has entered and what has been marked in the security register. The company policy specifies that an employee coming late by 30 minutes for two days in a month shall have a $\frac{1}{2}$ day salary deduction. There are over-writing in attendance register, leading to heated arguments between human resource department staff and employees. As the time taken to arrive at the correct attendance is large, there is a delay in preparation of salary. The same has already lead to penal action against company by labour department of the state.

Step 4: Define the objectives/goals to be achieved implementing BPA

The objective for implementing BPA, being:

- ◆ Correct recording of attendance.
- ◆ Timely compilation of monthly attendance so that salary can be calculated and distributed on a timely basis.
- ◆ To ensure compliance with statutes.

Step 5: Engage the business process consultant

XYZ Limited a consultant of repute has been engaged for the same. The consultant has prior experience and also knowledge about entity's business.

Step 6: Calculate the RoI for project

The BPA may provide Tangible benefits in the form of reduced penalties and intangible benefits which may include:

- ◆ Better employee motivation and morale,
- ◆ Reduced difference between employees,
- ◆ More focus on work rather than salary, and
- ◆ Improved productivity.

Step 7: Developing the BPA

Implementing BPA includes would result in the following:

- ◆ All employees would be given electronic identity cards.
- ◆ The cards would contain details about employees.
- ◆ The attendance system would work in the following manner:
 - Software with card reading machine would be installed at the entry gate.
 - Whenever an employee enters or leaves the company, he/she needs to put the card in front of machine.
 - The card reading machine would be linked to the software which would record the attendance of the employee.
 - At the end of month the software would print attendance reports employee-wise. These reports would also point out how many days an employee has reported late in the month.
 - Based on this report monthly attendance is put in the system to generate the monthly salary.

Step 8: Testing the BPA

Before making the process live, it should be thoroughly tested.

The above illustrations are of entities, which have gone for business process automation. There are thousands of processes across the world for which entity have gone for BPA and reaped numerous benefits. These include:

- ◆ Tracking movement of goods,
- ◆ Sales order processing,
- ◆ Customer services departments,
- ◆ Inventory management,
- ◆ Employee Management System, and
- ◆ Asset tracking systems.

5.3.4 Applications that help entity to achieve BPA

Many applications are available today that help enterprise to achieve business process automation. Few applications may be simpler, others may be more complex based on nature of process being considered. Some of them are mentioned below:

- ◆ **TALLY:** It is an accounting application that helps entity to automate processes relating to accounting of transactions. It also helps to achieve automation of few processes in inventory management. The latest version has been upgraded to help user achieve TAX compliances also. It has features such as Remote Access Capabilities, Tax Audit and Statutory Compliance, Payroll, Excise for Manufacturers, Multilingual Support, VAT Composition Returns, TDS, VAT (Value Added Tax), Rapid Implementation, Real Time Processing, Dynamic Interactive Reports and Unique Drill-Down Facility, Unlimited Companies and Periods of Accounting.
- ◆ **SAP R/3:** It is ERP software, which allows an entity to integrate its business processes. ERP stands for Enterprise Resource Planning, which aims at better utilization of the resources and helps entity achieve better business performance. It has the features such as time management, reporting and analytics, budget monitoring, workflow approval, sales management, team management, leave management, travel management, recruitment management and demand planning. This is used by most of the large enterprises across the world and covers enterprise automation end-to-end.
- ◆ **MS Office Applications:** These are various office automation systems made available by Microsoft Corporation which include MS Word, MS Excel, MS PowerPoint, MS Access, etc. Each of these software help to achieve automation of various tasks in the office. It has features such as customized ribbon, backstage view, built-in graphics toolset, enhanced security, excel spark lines, pivot for Excel, PowerPoint broadcast, Power Point compression, paste, preview and outlook conversation view.
- ◆ **Attendance Systems:** Many attendance automation systems are available in the market. The application helps entity to automate the process of attendance tracking and report generation. It has features such as supervisor login access, holiday pay settings, labour distribution, employee scheduling and rounding, employee view time card, overtime settings, battery-backed employee database and optional door/gate access control.
- ◆ **Vehicle Tracking System:** A lot of applications have been developed that allow entity to track their goods while in transit. Few applications are high end, allowing owner of goods to check the temperature of cold stored goods while in transit. It has features such as GPS based location, GPRS connection based real-time online data-logging and reporting, route accuracy on the fly while device is moving, real-time vehicle tracking, geo-fencing, SMS & e-mail notifications, over-the-air location query support, on-board memory to store location inputs during times when GPRS is not available or cellular coverage is absent.

- ◆ **Automated Toll Collection Systems:** As India progresses through creation of the golden quadrilateral project, many toll booths have been built to collect tolls. Many toll booths allow users to buy pre-paid cards, where user need not stop in lane to pay toll charges, but just swipe / wave the card in front of a scanner. The system keeps the track of card and the number of time same has been swiped / waved. It has features such as real-time toll plaza surveillance system, automatic vehicle identification system (based on in-road sensors), license plate recognition, zoom capability on captured images, laser based toll audit systems, automated vehicle classification, transaction processing and violation enforcement.
- ◆ **Department Stores Systems:** There has been huge development in the retail sector in India. The same has created a need to have systems to cater to the ever increasing need of Indian consumers. Two critical elements for managing departmental stores have been automated in India; they include the billing processes and inventory management. It has features such as point of sale, multi-channel operation, supplier database, products database, purchase ordering, management reporting, multiple promotions, loyalty schemes, stock control and inventory management.
- ◆ **Travel Management Systems:** Many business processes specific to this industry have been automated, including ticket booking for air, bus, train, hotel, etc. It has features such as streamlined foreign travel approval process, configurable to match enterprise's foreign travel program, build-in and manage travel policy compliance, 'safe return' process for people tracking, traveler portal for up to date information, secure traveler profile information, online retrieval of e-tickets, reservations, visas & inoculation records, management of entry visas & medical requirements, front, mid and back office tools on a single, and web based platform.
- ◆ **Educational Institute Management Systems:** India probably produces maximum number of engineers, doctors, MBAs and CAs across the world. A lot of automation has been achieved, including student tracking and record keeping. ICAI, itself is a good example of this automation. A student based on his/her registration number can file many documents online including exam forms. It has features such as student's registration, student's admission, fee collection, student's attendance, result management, result analysis, library management, HR management, staff attendance, payroll system, time-table management, financial accounting, assets management and MIS.
- ◆ **File Management System:** With increasing inventory of office files and records, many office automation systems have been developed. These allow office records to be kept in soft copy and easy tracking of the same. It has features such as web access, search, Microsoft office integration, records management software, electronic forms (e-forms), calendar, document version control, document scanning and imaging, check documents out/ check documents in, document "tagging" or metadata capture, virtual folders and document linking.
- ◆ **Other Systems:** The banking systems, the railway reservations systems and stock exchange systems are good examples of business process automations achieved.

5.4 Information Processing

Data when processed to meet the needs of the users is called information. Computer can be used as an aid to process this data so as to provide information, which has meaning to the users. *Information* may be defined as processed data, which is of value to the user. Information is necessary for decision making and survival of an entity as success of business depends upon making right decisions at the right time on the basis of the right information available. The effort to create information from raw data is known as Information Processing.

Classification of information is based on level of human/computer intervention, which is given as follows:

(i) Manual Information Processing Cycle

These are the systems where the level of manual intervention is very high. Say for example, valuation of exam papers, teaching, operations in operation theatres, ticket checking by railway staff in trains, buying of grocery, billing done by small medical shops, people maintaining books manually, etc.

Components of manual information processing cycle include:

- ◆ **Input:** Put details in register.
- ◆ **Process:** Summarize the information.
- ◆ **Output:** Present information to management in the form of reports.

A pictorial representation of the same is given in Fig. 5.4.1. As the level of human intervention is very high the quality of information generated from these systems is prone to flaws such as delayed information, inaccurate information, incomplete information and low levels of detail.



Fig. 5.4.1: Manual Processing Cycle

(ii) Computerized Information Processing Cycle

These are systems where computers are used at every stage of transaction processing. The components of a computerized information processing cycle include:

- ◆ **Input:** Entering data into the computer;
- ◆ **Processing:** Performing operations on the data;
- ◆ **Storage:** Saving data, programs, or output for future use; and
- ◆ **Output:** Presenting the results.

A pictorial representation of the same is given in Fig. 5.4.2. As the processing is computerized the quality of information generated from these systems is timely, accurate, fast and reliable.

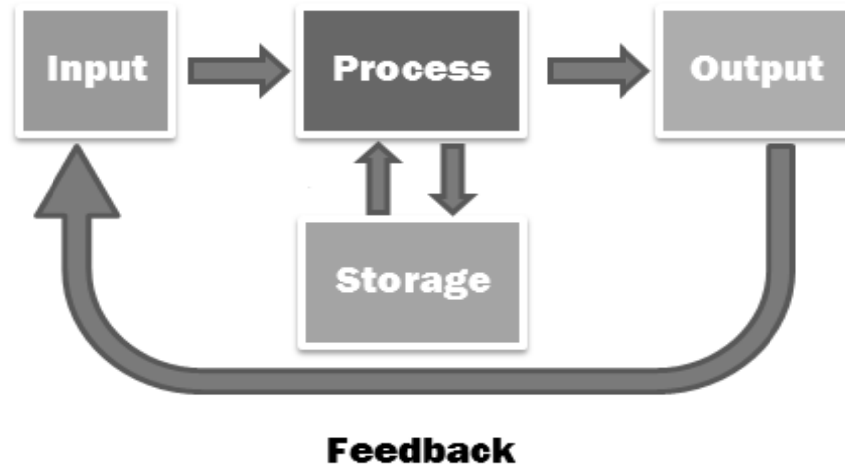


Fig. 5.4.2: Computerized Processing Cycle

The world has been rapidly moving towards more and more automation. Traditional manual systems are being replaced by computerised systems. This change has impacted businesses majorly. Consumer attitude towards business is directed by the level of computerisation businesses have adopted. There is preference to reach to those people who are fast, accurate and timely. The consumer behavior has impacted the way businesses operate. The same is explained in the next section, which deals with delivery channels.

5.5 Delivery Channels

Delivery channels refer to the mode through which information or products are delivered to users. For example,

- ◆ Delivery channels for information include:
 - ◆ Intranet: Network within the company/enterprise;
 - ◆ E-mail: The most widely used delivery channel for information today;
 - ◆ Internal newsletters and magazines;
 - ◆ Staff briefings, meetings and other face-to-face communications methods;
 - ◆ Notice boards in communal areas;
 - ◆ Manuals, guides and other printed resources;
 - ◆ Hand-held devices (PDAs, etc.); and
 - ◆ Social networking sites, like Facebook, whatsapp, etc.
- ◆ Delivery channels for products include:
 - ◆ Traditional models, brick and mortar type;

- ◆ Buying from a shop;
- ◆ Home delivery of products;
- ◆ Buying from a departmental store; and
- ◆ Buying online, getting home delivery and making cash payment on delivery.

5.5.1 Importance

Enterprises need to be aware of 'what information is required for effective delivery of products or services'. It is important to have proper and accurate delivery channels for information or product distribution and to consider each of these channels while planning an overall information management and communications strategy. In practice, more than one of these delivery channels will be needed, with different channels used to reach specific user groups.

5.5.2 Information Delivery Channel: How to choose one?

When choosing appropriate delivery channels, consider the following suggestions:

- ◆ **More than just the intranet:** It is rarely sensible to have a goal of "increasing intranet usage". Fundamentally, staff will (and should) use whichever methods are easiest and most efficient to obtain information. Any attempt to move staff usage to the intranet away from existing information sources will almost certainly fail, unless the intranet is easier than the current methods.

For example, it may be effective to put a notice on the notice board in a canteen (such as for field staff), rather than putting the same on intranet.

- ◆ **Understand staff needs & environment:** Job roles and work environments will have a major impact upon the suitability of delivery channels. This includes which systems do staff use, their level of PC access, their amount of computer knowledge, and their geographic location.

For example, there may only be a single PC in an enterprise and people working may have no time available in the day to access the intranet anyway. In this situation, the intranet would not be an effective delivery channel and face-to-face communication may be better.

- ◆ **Traditional Channel need to be formalized:** Instead of attempting to eliminate existing information sources in favour of the intranet, it may be more beneficial to formalize the current practices.

For example, staff may have key details pinned to the walls of their cubicles or work locations. The best outcome in this situation could be to organize monthly reprinting of these notes to ensure they are up-to-date.

5.5.3 Product Delivery Channels: How to choose one?

The way customer response is changing the way business operates. Online retailers are giving a run for money to physical mall owners. Customers while going for online shopping find

wide range of products. The best part is that, a customer in a small town/village can have a shopping experience of a large store.

The change is so drastic that physical brick and mortar sellers have to bring themselves on internet. The change is other way round also. Many online travel sites have opened brick and mortar office in cities and towns, to meet their customers. The key words are "convincing" and "capturing" the customer. So, any delivery channel shall work till it convinces customer.

The customers have moved from purchase of physical books to e-books. This shift has forced business to strategize their delivery channels.

5.6 Controls in BPA

In today's computerized information systems, most of the business processes are being automated. Enterprises are increasingly relying on IT for business information and transaction processing. The growth of e-commerce has been supported by the growth of the Internet. The same has completely changed the business processes. The innovations in IT components such as hardware, software, networking technology, communication technology and ever-increasing bandwidth are leading to evolution completely new business models.

All these new business models and new methods presume that the information required by business managers is available all the time and is accurate. However, there is a need to ensure that all information that is generated from system is accurate, complete and reliable for decision making, hence the requirement for proper controls.

Control is defined as policies, procedures, practices and organization structure that are designed to provide reasonable assurance that business objectives are achieved and undesired events are prevented or detected and corrected.

Control Objectives

Major control objectives are given as follows:

- ◆ **Authorization** - ensures that all transactions are approved by responsible personnel in accordance with their specific or general authority before the transaction is recorded.
- ◆ **Completeness** - ensures that no valid transactions have been omitted from the accounting records.
- ◆ **Accuracy** - ensures that all valid transactions are accurate, consistent with the originating transaction data, and information is recorded in a timely manner.
- ◆ **Validity** - ensures that all recorded transactions fairly represent the economic events that actually occurred, are lawful in nature, and have been executed in accordance with management's general authorization.
- ◆ **Physical Safeguards and Security** - ensures that access to physical assets and information systems are controlled and properly restricted to authorized personnel.

- ◆ **Error Handling** - ensures that errors detected at any stage of processing receive prompts corrective action and are reported to the appropriate level of management.
- ◆ **Segregation of Duties** - ensures that duties are assigned to individuals in a manner that ensures that no one individual can control both the recording function and the procedures relative to processing a transaction.

Controls may either be **Application Controls** or **Internal Controls**.

- (I) **Application controls:** Application controls are the controls on the sequence of processing events. These controls cover all phases of data right from data origination to its final disposal. Application controls cover transactions as they recorded in each stage of processing into master, parameter and transaction files and include controls relating to transmission and distribution of output through display, electronic media or printed reports.

In other words, Application controls are those controls, which are implemented in an application to prevent or detect and correct errors. Controls in-built in the application software ensure accurate and reliable processing. Application controls ensure that all transactions are authorized, complete and accurate.

- (II) **Internal controls:** SA-315 defines the *system of internal control* as the plan of enterprise and all the methods and procedures adopted by the management of an entity to assist in achieving management's objective of ensuring, as far as practicable, the orderly and efficient conduct of its business, including adherence to management policies, the safeguarding of assets, prevention and detection of fraud and error, the accuracy and completeness of the accounting records, and the timely preparation of reliable financial information. The system of internal control extends beyond those matters which relate directly to the functions of the accounting system. The internal audit function constitutes a separate component of internal control with the objective of determining whether other internal controls are well designed and properly operated.

The system of internal control is said to be well designed and properly operated when:

- All transactions are executed in accordance with management's general or specific authorization;
- All transactions are promptly recorded in the correct amount, in the appropriate accounts and in the accounting period during which it is executed so as to permit preparation of financial information within a framework of recognized accounting policies and practices and relevant statutory requirements, if any, and to maintain accountability for assets;
- Assets are safeguarded from unauthorized access, use or disposition; and
- The recorded assets are compared with the existing assets at reasonable intervals and appropriate action is taken with regard to any differences.

Based on the time at which controls are applied, they may be categorized as follows:

- ◆ **Preventive:** Those, which prevent occurrence of an error/fraud, say security guards.
- ◆ **Detective:** Those, which capture an error, say audit trail.
- ◆ **Corrective:** Those, which correct an error or reduce the loss due to error/risk, say insurance policy.

All these aforementioned controls may be implemented on any of the control techniques.

5.6.1 Application Controls and their Types

Application Controls can be classified into the following types as depicted in the Fig. 5.6.1:

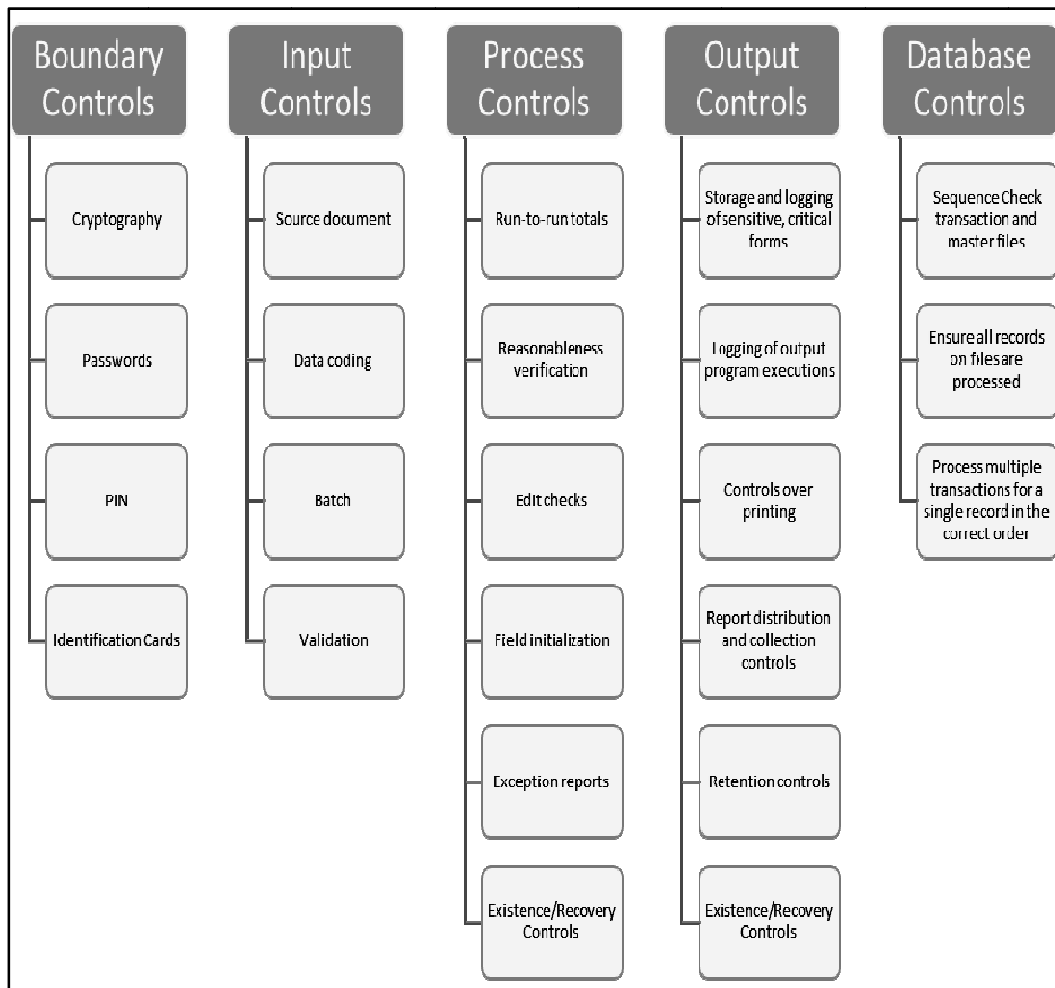


Fig. 5.6.1: Types of Application Controls

- (i) **Boundary Controls:** The major controls of the boundary system are the access control mechanisms. Access controls are implemented with an access control mechanism and links the authentic users to the authorized resources they are permitted to access. The access control mechanism has three steps: Identification, Authentication and Authorization with respect to the access control policy implemented.

Boundary control techniques include:

- **Cryptography:** There are programs that transform data into codes that appear meaningless to anyone who does not possess the authentication to access the respective system resource or file.
- **Passwords:** User identification by an authentication mechanism with personal characteristics like name, birth date, employee code, function, designation or a combination of two or more of these can be used as a password boundary access control.
- **Personal Identification Numbers (PIN):** The personal identification number is similar to a password assigned to a user by an institution based on the user characteristics and encrypted using a cryptographic algorithm. The application generates a random number stored in its database independent of user identification details or a customer selected number.
- **Identification Cards:** Identification cards are used to store information required in an authentication process. These cards that are used to identify a user need to go through procedural controls like application for a card, preparation of the card, issue of the card, use of the card and return of the card or card termination phases.

- (ii) **Input Controls:** These are responsible for ensuring the accuracy and completeness of data that are input into an application system. Input controls are important since substantial time is spent on inputting data which involves human intervention and are therefore prone to errors and fraud. Input control techniques are:

- **Source Document Control:** In systems that use physical source documents to initiate transactions, careful control must be exercised over these instruments. Source document fraud can be used to remove assets from the enterprise.
- **Data Coding Controls:** These controls are put in place to reduce user error during data feeding.

Few types of error may include:

- **Addition:** Addition of an extra character in a code. e.g. 12345 coded as 712345;
- **Truncation:** Omission of characters in the code. e.g. 12345 coded as 2345;
- **Transcription:** Recording wrong characters. 12345 coded as 82345;
- **Transposition:** Reversing adjacent characters. 12345 coded as 21345; and

- **Double transposition:** Reversing characters separated by one or more characters i.e., 12345 is entered as 23145.

Errors made in transcribing and keying data can have serious consequences on the enterprise. Control used to guard against these types of errors is a check digit. A check digit is a digit added to a string of numbers for error detection purposes. A check digit helps digital systems detect changes when data is transferred from transmitter to receiver.

- ◆ **Batch Controls:** These controls are put in place at locations where batch processing is being used. Batch processing is where there is a time gap between occurrence and recording of transactions, that is, transactions are not recorded at the time of occurrence but are accumulated and a set (based on number/ time) is processed. The objective is to ensure accuracy and completeness of the content and that they are not lost during transportation.

To implement batch control on each batch a batch control sheet is prepared and on that sheet following details are mentioned:

- Batch number, type, date, voucher type;
 - Total Monetary Amount: for example, for a cash payment batch, the total payout of cash payment vouchers;
 - Total Items: for example, the supporting with batch;
 - Total Documents: for example, total number of voucher with the batch; and
 - Hash Totals: for example, total of voucher number or account code (if numeric).
- ◆ **Validation Controls:** These controls validate the accuracy/correctness of input data. Input Validation Controls are intended to detect errors in transaction data before the data are processed. Validation procedures are most effective when they are performed as close to the source of the transactions as possible.

There are following levels of input validation controls, which are given as under:

Level 1: Field Interrogation

- **Limit Check:** It may be applied to both the input data and the output data. The field is checked by the program to ensure that its value lies within certain predefined limits. For example, no pay where there is sick leave, physical balance can never go below zero, etc.
- **Picture Checks:** These check against incorrect input format. For example, all rooms are numbered by numeric. An incorrect room number 4D3 would be filtered.
- **Valid Code Checks:** These checks are made against predetermined transactions codes, tables or order data to ensure that input data are valid. The predetermined

codes or tables may either be embedded in the programs or stored in direct access files.

- **Check Digits:** A customers' account number or any other numeric digits are checked for transcription and transposition errors.
- **Arithmetic Check:** Arithmetic check is performed in different ways to validate the results of other computations of the values of selected data fields.
- **Cross Checks:** These may be employed to verify fields appearing in different files to see that the results tally. For example, the quantity received, quantity invoiced by the supplier and quantity ordered may be compared. It may also be necessary to put check on the units of quantity.

Level 2: Record Interrogation

- **Sequence Checks:** These are exercised to detect any missing transactions, off serially numbered vouchers or erroneous sorting.
- **Format Completeness Checks:** These are used to check the presence and position of all the fields in a transaction. This check is particularly useful for variable data field records.
- **Redundant Data Checks:** these are used to check for fields that are repeated in two or more records.
- **Password:** These are used to authorize users to access, read and write information.

(iii) **Process Controls:** Data processing controls perform validation checks to identify errors during processing of data. They are required to ensure both the completeness and accuracy of the data being processed. Normally the processing controls are enforced through the database management system that stores the data. However, adequate controls should be enforced through the front end application system also, to have consistency in the control process.

- **Run-to-run Totals:** These help in verifying data that is subject to process through different stages. If the current balance of an invoice ledger is ₹ 250,000 and the additional invoices for the period is of total ₹ 30,000 then the total sales value should be ₹ 280,000. A specific record (probably the last record) can be used to maintain the control total.
- **Reasonableness Verification:** Two or more fields can be compared and cross verified to ensure their correctness. For example, the statutory percentage of provident fund can be calculated on the gross pay amount to verify if the provident fund contribution deducted is accurate.
- **Edit Checks:** Edit checks similar to the data validation controls can also be used at the processing stage to verify accuracy and completeness of data.

- **Field Initialization:** Data overflow can occur, if records are constantly added to a table or if fields are added to a record without initializing it, i.e., setting all values to zero before inserting the field or record.
 - **Exception Reports:** Exception reports are generated to identify errors in data processed. Such exception reports give the transaction code and why the particular transaction was not processed or what is the error in processing the transaction.
 - **Existence/Recovery Controls:** The check-point/restart logs, facility is a short-term backup and recovery control that enables a system to be recovered if failure is temporary and localized.
- (iv) **Output Controls:** Output controls ensure that the data delivered to users will be presented, formatted and delivered in a consistent and secured manner. Output can be in any form, it can either be a printed data report or a database file in a removable media such as a flash drive or CD-ROM or it can be a Word document on the computer's hard disk. Whatever the type of output, it should be ensured that the confidentiality and integrity of the output is maintained and that the output is consistent. Output controls have to be enforced both in a batch-processing environment as well as in an online environment.
- **Storage and Logging of Sensitive and Critical Forms:** Pre-printed stationery should be stored securely to prevent unauthorized destruction or removal and usage. Only authorized persons should be allowed access to stationery supplies such as security forms, negotiable instruments etc.
 - **Logging of Output Program Executions:** When programs, used for output of data, are executed, they should be logged and monitored. In the absence of control over such output program executions, confidentiality of data could be compromised.
 - **Controls Over Printing:** It should be ensured that unauthorized disclosure of information printed is prevented. Users must be trained to select the correct printer and access restrictions may be placed on the workstations that can be used for printing.
 - **Report Distribution and Collection Controls:** Distribution of reports should be made in a secure way to avoid unauthorized disclosure of data. It should be done immediately after printing to ensure that the time gap between generation and distribution is reduced. A log should be maintained as to what reports were generated and to whom it was distributed. Where users have to collect reports, the user should be responsible for timely collection of the report especially if it is printed in a public area. A log should be maintained as to what reports were printed and which of them were collected. Uncollected reports should be stored securely.
 - **Retention Controls:** Retention controls consider the duration for which outputs should be retained before being destroyed. Consideration should be given to the type of medium on which the output is stored. Retention control requires that a date

should be determined for each output item produced. Various factors ranging from the need of the output, use of the output, to legislative requirements would affect the retention period.

- **Existence/Recovery Controls:** These controls are needed to recover output in the event that it is lost or destroyed. If the output is written to a spool of files or report files and has been kept, then recovery is easy and straight-forward. The system maintains the state of a transaction at a point of time with before and after images. In case of errors or disruption, the check/restart helps in recovery of data. For example when a hardware problem causes a program that prints customer invoices to abort in midstream, the restart features re-builds the correct and complete set of data by using the check-points and the before and after images of each transaction and re-computing/re-processing the data as required.
- (v) **Database Controls:** Protecting the integrity of a database when application software acts as an interface to interact between the user and the database are called the update controls.
- **Sequence Check Transaction and Master Files:** Synchronization and the correct sequence of processing between the master file and transaction file is critical to maintain the integrity of updation, insertion or deletion of records in the master file with respect to the transaction records. If errors in this stage are overlooked, it leads to corruption of the critical data.
 - **Ensure all records on files are processed:** While processing the transaction file records mapped to the respective master file the end-of-file of the transaction file with respect to the end-of-file of the master file is to be ensured.
 - **Process multiple transactions for a single record in the correct order:** Multiple transactions can occur based on a single master record. For example, dispatch of a product to different distribution centers. The order in which transactions are processed against the product master record must be done based on a sorted transaction codes.

5.7 Emerging Technologies

Various emerging technologies/concepts are given in the following sections:

5.7.1 Network Virtualization

In IT, **Virtualization** is the process of creating logical computing resources from available physical resources. This is accomplished using virtualization software to create a layer of abstraction between workloads and the underlying physical hardware. Once installed, the virtualized computing resources such as memory, CPUs, network and disk I/O and storage can all be pooled and provisioned to workloads without regard for physical location within a data center.

Network Virtualization allows a large physical network to be provisioned into multiple smaller logical networks and conversely allows multiple physical LANs to be combined into a larger logical network. This behavior allows administrators to improve network traffic control, enterprise and security."

Major applications of the concepts of the virtualization are given as follows:

- ◆ **Server Consolidation:** Virtual machines are used to consolidate many physical servers into fewer servers, which in turn host virtual machines. Each physical server is reflected as a virtual machine "guest" residing on a virtual machine host system. This is also known as "Physical-to-Virtual" or 'P2V' transformation.
- ◆ **Disaster Recovery:** Virtual machines can be used as "hot standby" environments for physical production servers. This changes the classical "backup-and-restore" philosophy, by providing backup images that can "boot" into live virtual machines, capable of taking over workload for a production server experiencing an outage.
- ◆ **Testing and Training:** Hardware virtualization can give root access to a virtual machine. This can be very useful such as in kernel development and operating system courses.
- ◆ **Portable Applications:** Portable applications are needed when running an application from a removable drive, without installing it on the system's main disk drive. Virtualization can be used to encapsulate the application with a redirection layer that stores temporary files, windows registry entries and other state information in the application's installation directory and not within the system's permanent file system.
- ◆ **Portable Workspaces:** Recent technologies have used virtualization to create portable workspaces on devices like iPods and USB memory sticks.

5.7.2 Grid Computing

Grid Computing is a computer network in which each computer's resources are shared with every other computer in the system. Processing power, memory and data storage are all community resources that authorized users can tap into and leverage for specific tasks. A grid computing system can be as simple as a collection of similar computers running on the same operating system or as complex as inter-networked systems comprised of every computer platform we can think of. A typical Grid Model is shown in Fig. 5.7.1.

It is a special kind of distributed computing. In distributed computing, different computers within the same network share one or more resources. In the ideal grid computing system, every resource is shared, turning a computer network into a powerful supercomputer. With the right user interface, accessing a grid computing system would look no different than accessing a local machine's resources. Every authorized computer would have access to enormous processing power and storage capacity.

Why need Grid Computing?

- ◆ Civil engineers collaborate to design, execute, & analyze shake table experiments.

- ◆ An insurance company mines data from partner hospitals for fraud detection.
- ◆ An application service provider offloads excess load to a compute cycle provider.
- ◆ An enterprise configures internal & external resources to support e-Business workload.
- ◆ Large-scale science and engineering are done through the interaction of people, heterogeneous computing resources, information systems and instruments, all of which are geographically and organizationally dispersed.

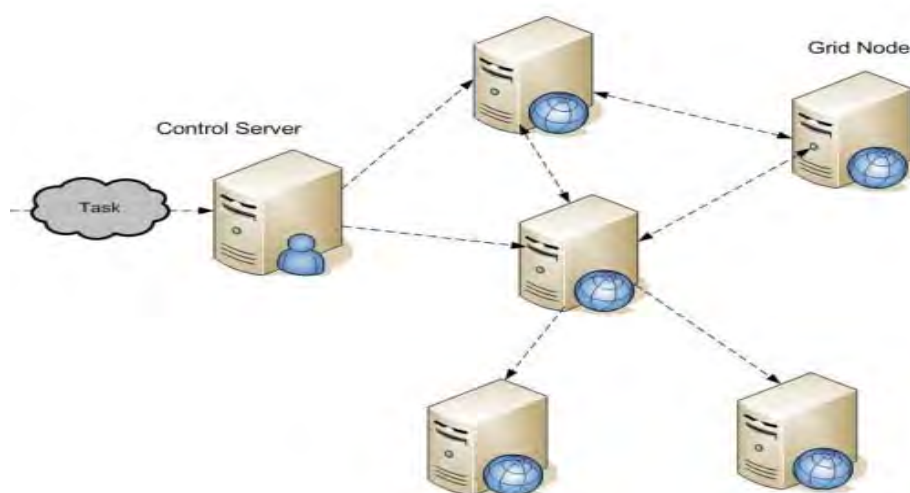


Fig. 5.7.1: A Grid Model

5.7.3 Cloud Computing

A detailed discussion on Cloud Computing, its architecture and Service Models has already been introduced in Chapter – 1 “Business Process Management & IT” & Chapter -2 “Information Systems and IT Fundamentals” of the Study Material of Intermediate (IPC) Course. However, an overview of Cloud Computing is again provided here.

As already explained, Cloud Computing is the use of various services, such as software development platforms, servers, storage, and software, over the Internet, often referred to as the “cloud.”

Many cloud computing advancements are closely related to virtualization. The ability to pay on-demand and scale quickly is largely a result of cloud computing vendors being able to pool resources that may be divided among multiple clients.

(i) Characteristics of Cloud Computing

The following is a list of characteristics of a cloud-computing environment. Not all characteristics may be present in a specific cloud solution. However, some of the key characteristics are given as follows:

- ◆ **Elasticity and Scalability:** Cloud computing gives us the ability to expand and reduce resources according to the specific service requirement. For example, we may need a large number of server resources for the duration of a specific task. We can then release these server resources after we complete our task.
- ◆ **Pay-per-Use:** We pay for cloud services only when we use them, either for the short term (for example, for CPU time) or for a longer duration (for example, for cloud-based storage or vault services).
- ◆ **On-demand:** Because we invoke cloud services only when we need them, they are not permanent parts of the IT infrastructure: this is a significant advantage for cloud use as opposed to internal IT services. With cloud services there is no need to have dedicated resources waiting to be used, as is the case with internal services.
- ◆ **Resiliency:** The resiliency of a cloud service offering can completely isolate the failure of server and storage resources from cloud users. Work is migrated to a different physical resource in the cloud with or without user awareness and intervention.
- ◆ **Multi Tenancy:** Public cloud service providers often can host the cloud services for multiple users within the same infrastructure. Server and storage isolation may be physical or virtual depending upon the specific user requirements.
- ◆ **Workload Movement:** This characteristic is related to resiliency and cost considerations. Here, cloud-computing providers can migrate workloads across servers both inside the data center and across data centers (even in a different geographic area). This migration might be necessitated by cost (less expensive to run a workload in a data center in another country based on time of day or power requirements) or efficiency considerations (for example, network bandwidth). A third reason could be regulatory considerations for certain types of workloads.

(ii) Cloud Service Models

Although Cloud Service Models (SaaS, PaaS, IaaS, CaaS and FaaS) have already been discussed in Chapter – 2 “Information Systems and IT Fundamentals” of the Study Material, we shall here again discuss the common Cloud Computing Service Models - Software as a Service (SaaS), Platform as a Service (PaaS) or Infrastructure as a Service (IaaS), shown in Fig. 5.7.2.

- ◆ **Software as a Service (SaaS):** SaaS features a complete application offered as a service on-demand. A service provider hosts the application at its data centre over the

Internet and customer accesses it via a standard Web browser. For example, Google Apps.

- ◆ **Platform as a Service (PaaS):** PaaS service delivery model allows a customer to rent virtualized servers and associated services used to run existing applications, or to design, develop, test, deploy and host applications. The consumer may create software using tools and/or libraries from the provider. The consumer may also control software deployment and configuration settings. The provider provides the networks, servers, storage, and other services. For example, AppScale allows a user to deploy some applications written for Google App Engine to their own servers.

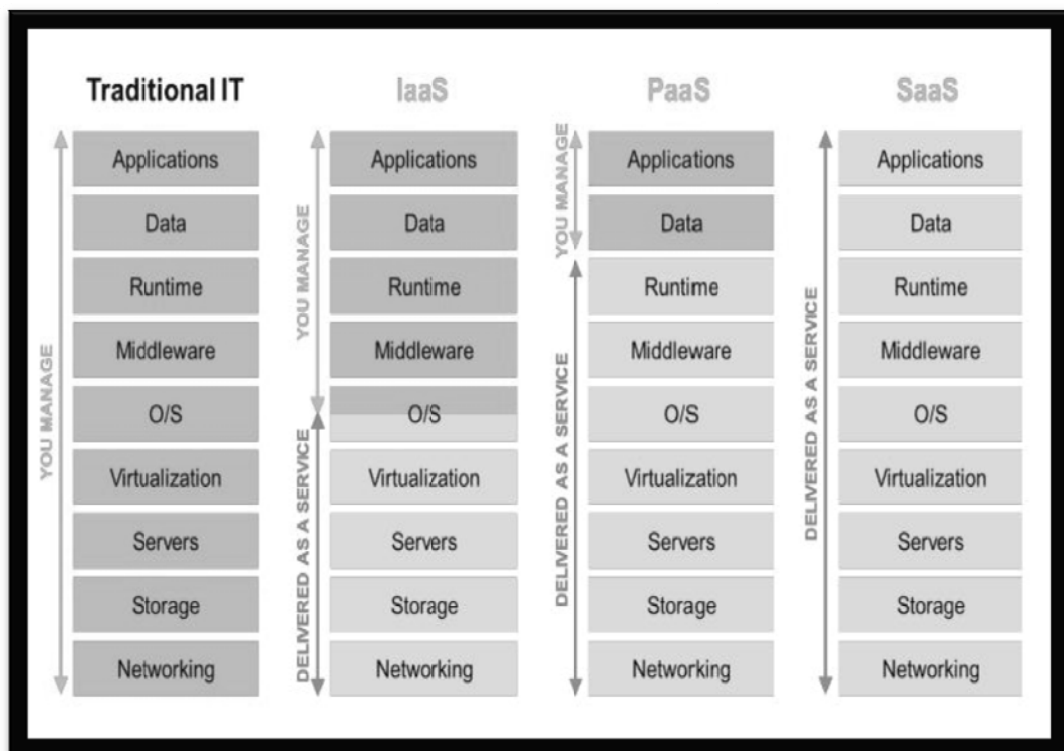


Fig. 5.7.2: Cloud Service Models

- ◆ **Infrastructure as a Service (IaaS):** IaaS delivers computer infrastructure on an outsourced basis to support enterprise operations. Typically, IaaS provides hardware, storage, servers and data centre space or network components; it may also include software.

(iii) Advantages of Cloud Computing

If used properly and to the extent necessary, working with data in the cloud can vastly benefit all types of businesses. Mentioned below are some of the advantages of this technology:

- **Cost Efficient:** Cloud computing is probably the most cost efficient method to use, maintain and upgrade.
- **Almost Unlimited Storage:** Storing information in the cloud gives us almost unlimited storage capacity.
- **Backup and Recovery:** Since all the data is stored in the cloud, backing it up and restoring the same is relatively much easier than storing the same on a physical device. Furthermore, most cloud service providers are usually competent enough to handle recovery of information.
- **Automatic Software Integration:** In the cloud, software integration is usually something that occurs automatically. Not only that, cloud computing allows us to customize the options with great ease. Hence, we can handpick just those services and software applications that we think will best suit the particular enterprise.
- **Easy Access to Information:** Once we register ourselves in the cloud, we can access the information from anywhere, where there is an Internet connection.
- **Quick Deployment:** Once we opt for this method of functioning, the entire system can be fully functional in a matter of a few minutes. Of course, the amount of time taken here will depend on the exact kind of technology that we need for our business.

(iv) Disadvantages of Cloud Computing

In spite of its many benefits, as mentioned above, cloud computing also has its disadvantages. Businesses, especially smaller ones, need to be aware of these cons before going in for this technology. Major disadvantages are given as follows:

- **Technical Issues:** This technology is always prone to outages and other technical issues. Even the best cloud service providers run into this kind of trouble, in spite of keeping up high standards of maintenance. We will invariably be stuck in case of network and connectivity problems.
- **Security in the Cloud:** Surrendering all the company's sensitive information to a third-party cloud service provider could potentially put the company to great risk.
- **Prone to Attack:** Storing information in the cloud could make the company vulnerable to external hack attacks and threats. Nothing on the Internet is completely secure and hence, there is always the lurking possibility of stealth of sensitive data.

5.8 Summary

Most of the enterprises processes are now automated whether they are in the private or public sector or government. Enterprises are increasingly relying on IT in all key areas. The profitability and the future viability of enterprises increasingly depend on the continued functioning of IT systems. Without them, there is often doubt if a company will survive. These IT systems also represent a considerable proportion of any company's capital budget. The emphasis of chapter has been to update students with the latest developments in technology. These developments have been happening through automations, delivery channels being changed with extensive use of emerging technologies such as cloud computing, mobile computing, BI, etc.

The first part of chapter discusses about business applications. The business applications can be used for varied business functions such as accounting, payroll, purchases, sales, etc. The chapter helps students to understand the importance of software applications to business. The second part is in continuation to the discussion of the part I. It deals with the Business Process Automation, which is a word used in businesses across the world. The chapter helps students to understand the nature and impact of business automation on businesses. It also gives thought to what-if, no automation is made.

The next part of the chapter deals with Information Processing and Delivery channels. The chapter highlights the way businesses have been modified due to change in delivery channels. An updated discussion on latest trend in consumer behavior vis-à-vis technology adoption is there in the chapter. The business impact due to change in delivery channel is also discussed in the chapter with live examples.

Application controls, discussed in the chapter shall help student to understand the nature of control and why they are needed in business. Controls are important for survival of any good business process. If an entity creates business process automation and does not properly control the same, it shall spell disaster for business. This section highlights this aspect of the business.

The last part of the chapter deals with emerging technologies namely virtualization, grid computing and cloud computing. The objective of this section is to give brief overview of the technology as it is used and the benefits the society is getting from it. The best word to define these technologies is “social technologies”.