UNIT 3 INTELLIGENCE INFORMATION SYSTEMS

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3.0 INTRODUCTION

In today's fast-changing global markets, success is no longer tied to the traditional inputs of labour, capital or land. The new critical resource is inside the heads of employees: knowledge. What a company knows? and how it leverages that knowledge into knowledge management for its use in the organisation. The individual technologies are not in themselves knowledge management solutions. Instead, when brought to market they are typically embedded in a smaller number of solutions packages, each of which is designed to be adaptable to solve a range of business problems. Examples are portals, collaboration software, and distance learning software. In this unit we are aiming at imparting knowledge about this knowledge management and how to use different tools and technologies to achieve the objectives of an organisation.

Business Analytics and Business Intelligence are concerned with the process of collecting and analysing domain-specific data stored in data warehouses to derive valuable insights about customers and emerging markets, and to identify opportunities as well as key drivers to business growth. It is increasingly being seen as the key differentiator that provides a competitive edge to companies across industries. The tools used in Business Analytics are varied. They range from simple slice-and-dice tools to statistical methods such as log it regression, discriminant analysis and multivariate analysis, to more sophisticated tools such as neural networks and optimisation. The application domains are equally varied. How companies, banks,

insurance companies and airlines have all been beneficiaries of Business Intelligence is what we are also going to discuss in this unit.

3.1 OBJECTIVES

After going through this unit, you will be able to:

- understand the knowledge management system;
- understand the Artificial Intelligence and its use for business;
- understand the use of business intelligence system for Marketing, Human Resource, and Finance etc;
- design business intellgence system for your organisation;
- understand the use of businesses intelligence tools, and
- understand the use business intelligence reports.

3.2 KNOWLEDGE MANAGEMENT IN ORGANISATION

Knowledge management (KM) is the management of knowledge within organisations. A widely accepted 'working definition' of knowledge management applied in worldwide organisations is "Knowledge Management caters to the critical issues of organisational adaptation, survival, and competence in the face of increasingly discontinuous environmental change.... Essentially, it embodies organisational processes that seek synergistic combination of data and information processing capacity of information technologies, and the creative and innovative capacity of human beings."

This definition not only gives an indication of what Knowledge Management is, but of how its advocates often treat the English language. In simpler terms, Knowledge Management seeks to make the best use of the knowledge that is available to an organisation, creating new knowledge in the process.

It is helpful to make a clear distinction between knowledge on the one hand, and information and data on the other.

Information can be considered as a message. It typically has a sender and a receiver. Information is the sort of stuff that can, at least potentially, be saved onto a computer. Data is a type of information that is structured, but has not been interpreted.

Knowledge might be described as information that has a use or purpose. Whereas information can be placed onto a computer, knowledge exists in the heads of people. Knowledge is information to which intent has been attached.

3.2.1 First and Second Generation Knowledge Management

By the early nineties, it was clear that there were two distinct branches of Knowledge Management.

First Generation Knowledge Management involves the capture of information and experience so that it is easily accessible in a corporate environment. An alternate term is "knowledge capture". Managing this capture allows the system to grow into a powerful information asset.

This first branch had its roots firmly in the use of technology. In this view Knowledge Management is an issue of information storage and retrieval. It uses ideas derived

from systems analysis and management theory. This approach led to a boom in consultancies and in the development of so-called knowledge technologies. Typically first-generation Knowledge Management involved developing sophisticated data analysis and retrieval systems with little thought as to how the information they contained would be developed or used. This led to organisations investing heavily in technological fixes that had either little impact or a negative impact on the way in which knowledge was used.

A typical scenario might have seen an organisation install a sophisticated intranet in order to categorise and disseminate information, only to find that the extra work involved in setting up the metadata meant that few within the organisation actually used the intranet. This occasionally led to management mandating the use of the intranet, resulting in resentment amongst staff, and undermining their trust in the organisation. Thus first generation solutions are often counterproductive.

Management theory functions as a branch of Economics, and to a large extent it adopts econometric standards. When it became apparent that it would be useful to be able to manage knowledge, it was natural for managers to attempt to apply their preferred econometric methods to the cause. But econometrics is about commodities and cash flow. It found it therefore necessary to treat knowledge as if it were a commodity.

This, of course, was a surprisingly difficult thing to do, essentially because knowledge is not a commodity but a process. But a suitable epistemology was found, in the form of that developed by Michael Polanyi. Polanyi's epistemology objectified the cognitive component of knowledge – learning and doing – by labelling it *tacit knowledge* and for the most part removing it from the public view. Learning and doing became a 'black box' that was not really subject to management; the best that could be done was to make tacit knowledge explicit.

Its failure to provide any theoretical understanding of how organisations learn new things and how they act on this information meant that first generation Knowledge Management was incapable of managing knowledge creation.

Second Generation Knowledge Management: Faced with the theoretical and practical failure of first generation techniques to live up to its promise, theorists began to look more closely at the ways in which knowledge is created and shared.

Along with this realisation came a change in metaphor. Organisations came to be seen as capable of learning, and so a link grew between learning theory and management.

At the same time hierarchical models of organisational structure were replaced by more organic models, which see effective organisations as capable of structural change in response to their environment.

The advent of *complexity theory* and *chaos theory* provided more metaphors that enable managers to replace models of organisations as integrated systems with models of organisations as complex interdependent entities that are capable of responding to their environment.

Second generation Knowledge Management gives priority to the way in which people construct and use knowledge. It derives its ideas from complex systems, often making use of organic metaphors to describe knowledge growth. It is closely related to organisational learning. It recognises that learning and doing are more important to organisational success than dissemination and imitation.

3.2.2 Knowledge

Knowledge is the awareness and understanding of facts, truths or information gained in the form of experience or learning. Knowledge is an appreciation of the possession of interconnected details which, in isolation, are of lesser value.

Knowledge is a term with many meanings depending on context, but is (as a rule) closely related to such concepts as meaning, information, instruction, communication, representation, learning and mental stimulus.

Knowledge is distinct from simple information. Both knowledge and information consist of true statements, but knowledge is information that has a purpose or use. Philosophers would describe this as information associated with intentionality. The study of knowledge is called epistemology.

A common definition of knowledge is that it consists of justified true belief. This definition derives from Plato's Theaetetus. It is considered as necessary, but not sufficient, conditions for some statement to count as knowledge.

What constitutes knowledge certainty and truth are controversial issues. These issues are debated by philosophers, social scientists, and historians. Ludwig Wittgenstein wrote "On Certainty" — aphorisms on these concepts — exploring relationships between knowledge and certainty. A thread of his concern has become an entire field, the philosophy of action.

Distinguishing *knowing that* from *knowing how*

Suppose that Fred says to you: "The fastest swimming stroke is the front crawl. One performs the front crawl by oscillating the legs at the hip, and moving the arms in an approximately circular motion". Here, Fred has propositional knowledge of swimming and how to perform the front crawl.

However, if Fred acquired this propositional knowledge from an encyclopedia, he will not have acquired the skill of swimming: he has some propositional knowledge, but does not have any procedural knowledge or "know-how". In general, one can demonstrate know-how by performing the task in question, but it is harder to demonstrate propositional knowledge.

Inferential vs. Factual Knowledge

Knowledge may be factual or inferential. Factual knowledge is based on direct observation. It is still not free of uncertainty, as errors of observation or interpretation may occur, and any sense can be deceived by illusions.

Inferential knowledge is based on reasoning from facts or from other inferential knowledge such as a theory. Such knowledge may or may not be verifiable by observation or testing. For example, all knowledge of the atom is inferential knowledge. The distinction between factual knowledge and inferential knowledge has been explored by the discipline of general semantics.

3.2.3 Approach for Successful Implementation of Knowledge Management

Although KM is as an enterprise-wide goal, many companies find success if they kickoff an initiative in one department and then extend the practices throughout other parts of the organisation. Here, we will outline those practices that help ensure a successful KM initiative within the IT help desk or customer contact center. Often KM practices relating to service and support can be defined as knowledge-powered problem resolution — using a knowledge base, knowledge sharing, collaboration and knowledge reuse to efficiently solve customer questions.

A successful knowledge management initiative within a help desk or call center can reduce agent training time and speed new employee ramp up. Knowledge-powered problem resolution enables agents to become more confident and competent sooner than they otherwise would without a KM practice. By having access to a knowledge base, new help desk and customer service agents can get answers to common questions without having to constantly ask other more experienced agents. Customers and end-users benefit from faster problem resolution, and experienced agents can focus on solving more challenging problems.

Customers and end-users also benefit when they have direct access to a knowledge base to solve their own issues without ever contacting an agent. A growing number of people now prefer self-service to live interaction, at least for certain problem types. For some people, self-service fits perfectly into their lifestyle. They are in a hurry and they need a specific piece of information and that's all they want. Say, for example, in a corporate environment, an employee needs to know if there is a Windows 2000 driver for a USB Zip drive. She doesn't want to wait in a queue. She doesn't want to talk to an agent. She just wants to know if there is a driver available and where to find it. In this case, self-service can be superior to agent-assisted service.

Knowledge Management is an evolving discipline that can be affected by new technologies and best practices, but there are some things that we do know for sure. There is a systematic approach to successfully implementing knowledge management and if you analyse what you are trying to accomplish, map out a strategy, garner support from the organisation and have a way to measure it, then you are much more likely to be successful., The outlined 11 points that will serve as a primer to help understand what it takes to have a successful Knowledge Management initiative.

Point 1: Knowledge Management is a discipline

A lot of people think knowledge management is a technology or software solution but it is much more than that; knowledge management is a discipline. Obviously, you have to have a good piece of software or a good system to capture knowledge – but that's not the whole equation. Underestimating what it takes just to capture the knowledge correctly is a big risk, as is underestimating the integration task into your already complex environment.

There are some providers of pre-packaged knowledge out there, but our experience is that while they can be useful to the help desk they are not relevant to customer service centers which have business-specific content needs. In either case, you must ensure you have the adequate resources to create and maintain the content you promise. Creating content is not a one-time project. Also, over time the content must be updated and supplemented as new products or services are supported as shown in *Figure 1*. Empowering agents to add new content as resolutions are discovered is the key to maintaining a robust system.

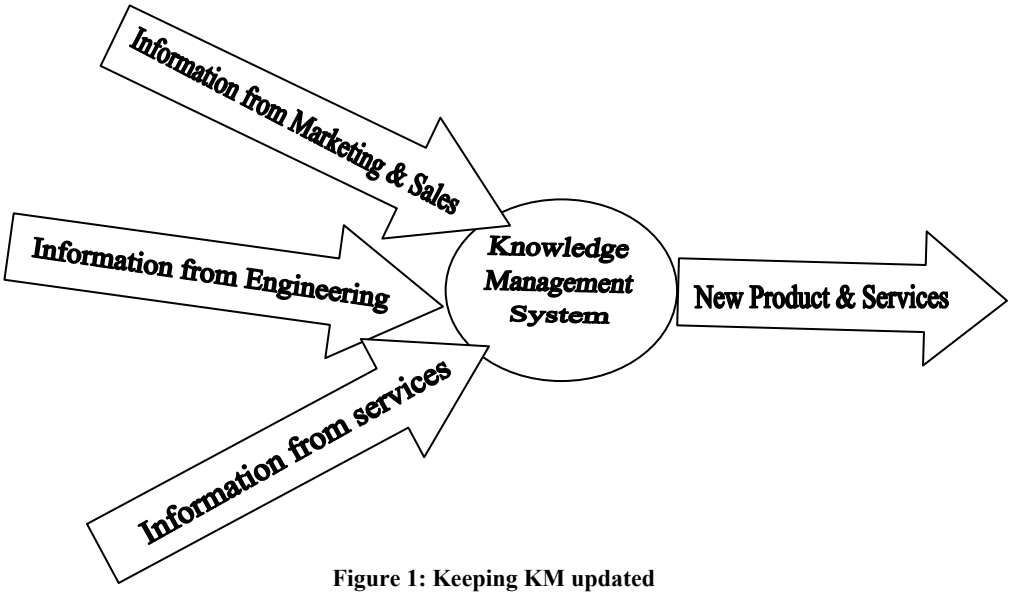


Figure 1: Keeping KM updated

Point 2: One champion is not enough

To be successful, your project must have several champions within the organisation. These are individuals that believe in the project, enthusiastically advocate it and have the clout to "make things happen." Projects that lack a champion generally don't get off the ground. Those with only one champion are also at serious risk.

Losing your champion can spell disaster for your project. This is a real problem for knowledge management projects, due to their continuous duration. If the project champion transfers, retires or leaves the company, the project often loses its momentum and the project may falter as someone else takes it over.

What we like to see when we work with clients is a dual-sponsorship: one at the operational level and one at the executive level. So if an operations manager decides the company really needs knowledge management, that manager should find somebody on the executive staff who will agree to support the vision. By having that dual track of vision the project is more likely to succeed.

Point 3: Cultural change isn't automatic

Buy-in is needed at all levels, and this may require cultural change. The people that are going to use the tools have to be part of the design unless you plan on strong-arming them (and that doesn't work very well). Don't make this management decision in a vacuum. Include some people from the various groups that would directly or indirectly use the system.

Sometimes there is a fear that knowledge management will be used to replace people. If your staff thinks that is what you are trying to do, then you really need to address that head-on. If that is not your intention, you should convince your team that current head count reduction is not the goal. Therefore, you need to look for and plan the motivation for each party. After all, you are asking people to shift from a system where being a tower of knowledge is rewarded, to a system where they share their expertise with everybody on the team.

Each party will have a unique motivation to embrace knowledge management. For example, in a technical support environment, a frontline tech will have a different motivational schema than a 3rd level technician. The frontline tech is not going to have to ask the 2nd line tech as many questions, and can resolve more problems faster. The 2nd level tech is not going to get as many of the common questions. Level 3 researchers won't have to start at ground zero when handed a problem by level 2, because they know that all the intermediate steps have been covered. So as you look

across the organisation everybody has a different interest and you have to protect all of them.

Failing to see how knowledge management is going to fit into the rest of the organisation is a mistake. You must invest the time and energy to understand the culture, identify motivations and ensure change happens where needed.

Point 4: Create a change management plan

If your employees are not already sharing information, you will need a change management plan because you are asking people to do their jobs differently. The change management plan specifies how you will gain acceptance of knowledge management within the organisation. Let's say you are a call center manager and you measure your employees' performance by call handle time and number of cases closed. Now you are going to be asking them to use a knowledge base on every call or email interaction – thus asking them to change the way they perform their job on a daily basis. Also, if you don't make changes to their performance reviews and compensation, there may be friction because you're asking them to do one thing but you are judging them by another set of rules. As part of the overall change management plan you need to update job descriptions, feedback sessions and performance reviews to reflect the new workflow. Neglecting to make these changes may foster acceptance issues with your team members.

Point 5: Stay strategic

Knowledge management is a strategic endeavour, not just a project. I prefer to call it a strategic initiative as opposed to a project because a project implies a finite timeline. With KM you are never really done; you initiate it and you build it and then it is online and you maintain it.

In our practice we look for our clients to have a strategic goal for the project rather than a tactical goal. If you are looking to shorten handle time that's a tactical motivation and you're not as likely to be willing to go through the steps that a successful enterprise rollout would take. But if it is a strategic initiative, especially something that is top-down motivated (for instance improving customer service or improving employee satisfaction) then there is a better value statement involved and you are not relying on changing one metric. So you might see improvement in individual metrics like handle time and resolution rates but their value is limited compared to the return from becoming a collaborative knowledge sharing organisation.

To get going, decide what goals you are trying to accomplish and why. Then try to identify a solution and methodology that will help you attain those goals in your environment. Sometimes people within an organisation may say that a KM initiative is nice-to-have, but an economic downturn might slow the process down or defer it — thus, being counterproductive when resources are scarce. But I think it's counterproductive to consider KM a nice-to-have because the rewards are equally beneficial during both a downturn and the inevitable upturn. If you wait until the upturn then you will be forced to play catch up as your call volumes increase and your email volume doubles; that's not the time to introduce a knowledge-powered system or build a knowledge base. It's not necessary to hire more employees if you have resources that are not 100% utilized or if you encourage your agents to contribute knowledge during their daily workflow.

Point 6: Pick a topic, go in-depth, and keep it current

We advise that you pick one area that needs improvement or has limited resources, and then build a robust knowledge base for that subject matter. Use that experience to learn about implementing knowledge in your organisation; do one call center or one

product group and learn from there. It is much better to be comprehensive for a narrow topic than fail to get enough depth. Sometimes an enterprise initiative is needed right away, and it can be done successfully, but it can involve a larger resource commitment to do a full-scale project all at once. Remember, the depth of your knowledge base truly depends upon your customers' needs.

Today's systems should enable agents to contribute new knowledge during their natural workflow. This is critical to ensure that solutions that are not currently in the system can be quickly added once the resolution has been determined. It's also important to remember that regular and timely maintenance of the knowledge base is the key to success. You should also consider appointing resources to maintain the knowledge. Be sure to build in a mechanism that identifies gaps in content (information sought but not found), and a process for filling those gaps. If people repeatedly fail to find what they are looking for they will stop using the system.

Point 7: Don't get hung up on the limitations

Certain types of knowledge are very well suited to quickly harvesting into a knowledge base. Company processes or technical procedures are well suited for knowledge management. By populating a knowledge base with this type of information and making it available to employees and customers, an organisation can shorten or even avoid many calls. Organisations can also use a KM system to access existing unstructured sources of information that may already exist on a corporate network, intranet or within an existing call center or help desk system. It's important to note that experienced agents can certainly benefit from access to both structured knowledge and unstructured information because they're more likely to be able to pinpoint a solution within an unstructured document. However, level 1 agents or end-users accessing the knowledge base through self-service, may not find these sources of unstructured information helpful because they don't have the expertise to decipher the information quickly.

In addition to sources of knowledge, the specific type of information is also important to consider. The craftsmanship or expertise that a true expert has is much more difficult to capture. A master craftsman has a huge body of knowledge. S/he tends to "chunk" their knowledge and can't tell you the steps they use when they make a decision in their field; they just do it. Much like tying your shoe, you do it everyday but when you have to explain it its tough because you have internalized the process. I think that is where the breakdown is for harvesting expertise. We think a KM initiative could be somewhat limited because of the nature of complex knowledge, and thankfully we will always need human expertise. However, when it comes to a successful initiative, it's important to first determine what knowledge can be easily added to the system and then provide agents or a knowledge manager with the tools to add this step-by-step complex information to the system, ensuring that even difficult questions can be answered accurately.

Point 8: Set expectations or risk extinction

A big pitfall is the failure of knowledge management proponents in helping executive management set appropriate expectations. Customers, employees and management alike must know what they are going to get out of knowledge management, what it will take to get those results and how success will be measured. Measurement is where most organisations fail because they are doing things that were not measured before. So a year from now, you've built this thing, it's up and running and everyone loves it and your boss says "where's my return?" If you don't have a measurement system in place then you will have a hard time answering his or her question – especially for the new metrics that didn't exist before. You probably measured handle time, abandon rates, and similar operational metrics. But you may not be measuring call avoidance or knowledge usage, which affects ultimately the ability to measure resolution rates.

In addition to setting management expectations you have to set customer and end-user expectations. For example, if you are going to provide customers with Web self-service for one specific product then you must include the known problems that they are going to encounter in the knowledge base. In that situation you are better off to set their expectations that the knowledge base covers only that product and no other. Customers pose the same extinction risk that your employees do. If they visit the site a few times and they can't find an accurate or appropriate answer they will probably not return again.

Point 9: Integrate KM into existing systems

Typically, organisations that are implementing knowledge management already have an established data center, so they are not only building a knowledge base – they must also integrate it into their existing environment – their call tracking system, IVR system, email, remote diagnostics and other support systems.
When selecting a KM system, consider systems that have open architectures and proven integrations into existing call center and help desk tools to ensure a successful implementation. Also, processes will be affected, requiring change to reporting and measurement systems as well. Integrate reporting capabilities where possible to best understand how the combined systems are affecting the effectiveness of your support operations.

Point 10: Educate your self-service users

You've created your KM plan, determined the critical knowledge to include, initiated a plan to garner cultural acceptance, trained your agents and pinpointed key sources of knowledge – finally you need to educate your self-service users on how to find and access support information online to ensure a satisfying experience.

There are many ways to "push" your self-service capabilities out to your end-user audience. Traditional marketing techniques should be employed to promote this valuable service, such as email, online newsletters or direct mail. Encourage users to visit your online support site by making it easy to find and access the knowledge base. Be sure to include the site URL and directions for obtaining a login, if needed, in your marketing communications.

Another method is to encourage your agents to end support calls by informing the user of the support site. "Thanks for calling today, I'm glad that I could help you solve your problem. By the way, we now have a Web self-service site if you'd like to search the knowledge base. You can find it at www.ABC-Support.com and you can obtain a login by clicking the request login button on that page."

Finally, make sure your Internet or intranet site includes an easy-to-find link to your Web self-service site. A twist on the old saying, "If they can't find it, they won't come." So make it easy to find, easy to access and easy to use.

Point 11: Become a knowledge-enabled organisation

We think it is inevitable that knowledge management will have a high adoption rate in the next few years. Over time to remain competitive it will be essential to be "knowledge-enabled." Just a few years ago email was not a common method for seeking customer service; now customers demand the ability to contact you through channels other than the phone. Going forward, as customers deal with companies that are knowledge-enabled and can quickly and efficiently answer their questions, they are going to expect a greater level of service in all of their support interactions.

The bottom line can be summarized with a quote from Gartner, Inc. – "Those enterprises that include KM processes as part of their customer relationship management initiatives have a higher probability of success than those that don't".

3.3 CREATING, DEVELOPING AND SHARING KNOWLEDGE

Knowledge flows comprise the set of processes, events and activities through which data, information, knowledge and meta-knowledge are transformed from one state to another. To simplify the analysis of knowledge flows, the framework described here is based primarily on the Knowledge Model. The model organizes knowledge flows into four primary activity areas: knowledge creation, retention, transfer and utilisation (*Figure 2*).

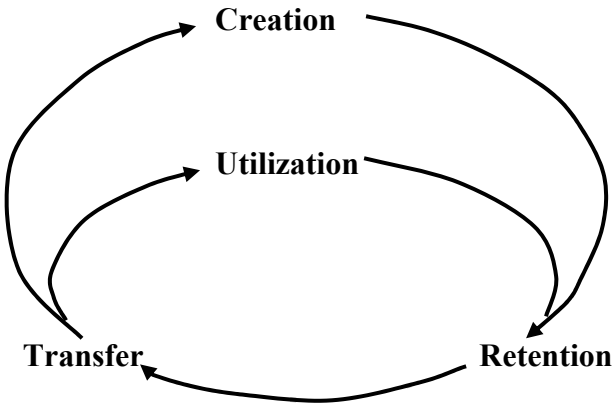


Figure 2: Knowledge model

Knowledge Creation: This comprises activities associated with the entry of new knowledge into the system, and includes knowledge development, discovery and capture.

Knowledge Retention: This includes all activities that preserve knowledge and allow it to remain in the system once introduced. It also includes those activities that maintain the viability of knowledge within the system.

Knowledge Transfer: This refers to activities associated with the flow of knowledge from one party to another. This includes communication, translation, conversion, filtering and rendering.

Knowledge Utilisation: This includes the activities and events connected with the application of knowledge to business processes.

Let us, look at the basic processes of **knowledge creation and sharing** within organisations and what type of technologies can be applied to knowledge management and to assess their actual or potential contribution.

3.3.1 Knowledge Creation and Sharing

A set of systematic and disciplined actions that an organisation can take to obtain the greatest value from the knowledge available is given the name Knowledge management. “Knowledge” in this context includes both the experience and understanding of the people in the organisation and the information artifacts, such as documents and reports, available within the organisation and in the world outside. Effective knowledge management typically requires an appropriate combination of organisational, social, and managerial initiatives along with, in many cases, deployment of appropriate technology.

To structure the discussion of processes involved in knowledge creation and sharing and technologies involved, it is helpful to classify the technologies by reference to the notions of **tacit** and **explicit knowledge**.

- **Tacit knowledge** is what the knower knows, which is derived from experience and embodies beliefs and values. Tacit knowledge is actionable knowledge, and therefore the most valuable. Furthermore, tacit knowledge is the most important basis for the generation of new knowledge; however, the key to knowledge creation is the mobilisation and conversion of tacit knowledge.

- **Explicit knowledge** is represented by some artifact, such as a document or a video, which has typically been created with the goal of communicating with another person.

  Both forms of knowledge are important for organisational effectiveness.

  Now, let us look at processes by which knowledge is transformed between its tacit and explicit forms, as shown in *Figure 3*. Organisational learning takes place as individuals participate in these processes, since by doing so their knowledge is shared, articulated, and made available to others. **Creation of new knowledge** takes place through the processes of combination and internalisation. As shown in *Figure 3*, the processes by which knowledge is transformed within and between forms usable by people are:

  - **Socialisation (tacit to tacit):** Socialisation includes the shared formation and communication of tacit knowledge between people, e.g., in meetings. Knowledge sharing is often done without ever producing explicit knowledge and, to be most effective, should take place between people who have a common culture and can work together effectively. Thus, tacit knowledge sharing is connected to ideas of communities and collaboration. A typical activity in which tacit knowledge sharing can take place is a team meeting during which experiences are described and discussed, often informal, in which information technology (IT) plays a minimal role. However, an increasing proportion of meetings and other interpersonal interactions use on-line tools known as groupware. These tools are used either to supplement conventional meetings, or in some cases to replace them. To what extent can these tools facilitate formulation and transfer of tacit knowledge?

TACIT-TO-TACIT Socialisation Team meeting & discussion	**TACTI-TO-EXPLICIT** Externalisation Team meeting & Answer Questions
EXPLICIT-TO-TACIT Internalisation Learning-from-Reports	**EXPLICIT-TO-EXPLICIT** Combination E-mail/Reports

Figure 3: Conversion of Knowledge from Tacit-to-Explicit form and *vice-versa*, Processes & Techniques

Groupware: Groupware is a fairly broad category of application software that helps individuals to work together in groups or teams. Groupware can to some extent support all four of the facets of knowledge transformation. To examine the role of groupware in socialization we focus on two important aspects: shared experiences and trust.

Shared experiences are an important basis for the formation and sharing of tacit knowledge. Groupware provides a synthetic environment, often called a virtual space, within which participants can share certain kinds of experience; for example, they can conduct meetings, listen to presentations, have discussions, and share documents relevant to some task. Indeed, if a geographically dispersed team never meets face to face, the importance of shared experiences in virtual spaces is proportionally enhanced. An example of current groupware is Lotus Notes, which facilitates the sharing of documents and discussions and allows various applications for sharing information and conducting asynchronous discussions to be built. Groupware might be thought to mainly facilitate the combination process, i.e., sharing of explicit knowledge. However, the selection and discussion of explicit knowledge to some degree constitutes a shared experience.

A richer kind of shared experience can be provided by applications that support **real-time on-line meetings,** a more recent category of groupware. On-line meetings can include video and text-based conferencing, as well as synchronous communication and chat. Text-based chat is believed to be capable of supporting a group of people in knowledge sharing in a conversational mode. Commercial products of this type include Lotus Sametime and Microsoft NetMeeting. These products integrate both instant messaging and on-line meeting capabilities. Instant messaging is found to have properties between those of the personal meeting and the telephone: it is less intrusive than interrupting a person with a question but more effective than the telephone in broadcasting a query to a group and leaving it to be answered later.

Some of the limitations of groupware for tacit knowledge formation and sharing have been highlighted by recent work on the closely related issue of the degree of trust established among the participants. It was found that videoconferencing (at high resolution—not Internet video) was almost as good as face-to-face meetings, whereas audio conferencing was less effective and text chat least so. These results suggest that a new generation of videoconferencing might be helpful in the socialization process, at least in so far as it facilitates the building of trust. But even current groupware products have features that are found to be helpful in this regard. In particular, access control, which is a feature of most commercial products, enables access to the discussions to be restricted to the team members if appropriate, which has been shown to encourage frankness and build trust.

- **Externalisation (tacit to explicit):** By its nature, tacit knowledge is difficult to convert into explicit knowledge. Through conceptualization, elicitation, and ultimately articulation, typically in collaboration with others, some proportion of a person's tacit knowledge may be captured in explicit form. Typical activities in which the conversion takes place are in dialog among team members, in responding to questions, or through the elicitation of stories.

  The conversion of tacit to explicit knowledge (externalization) involves forming a shared mental model, then articulating through dialog. Collaboration systems and other groupware (for example, specialized brainstorming applications) can support this kind of interaction to some extent.

On-line discussion databases are another potential tool to capture tacit knowledge and to apply it to immediate problems. It needs to be noted that team members may share knowledge in groupware applications. To be most effective for externalization, the discussion should be such as to allow the formulation and sharing of metaphors and analogies, which probably requires a fairly informal and even freewheeling style. This style is more likely to be found in chat and other real-time interactions within teams.

Newsgroups and similar forums are open to all, unlike typical team discussions, and share some of the same characteristics in that questions can be posed and answered, but differ in that the participants are typically strangers. Nevertheless, it is found that many people who participate in newsgroups are willing to offer advice and assistance, presumably driven by a mixture of motivations including altruism, a wish to be seen as an expert, and the gratitude and positive feedback contributed by the people they have helped.

3.3.2 Capturing Knowledge

Once tacit knowledge has been conceptualized and articulated, thus converting it to explicit knowledge, capturing it in a persistent form as a report, an e-mail, a presentation, or a Web page makes it available to the rest of the organisation. Technology already contributes to knowledge capture through the ubiquitous use of word processing, which generates electronic documents that are easy to share via the Web, e-mail, or a document management system. Capturing explicit knowledge in this way makes it available to a wider audience, and "improving knowledge capture" is a goal of many knowledge management projects.

- ***Combination: (explicit to explicit):*** Explicit knowledge can be shared in meetings, via documents, e-mails, etc., or through education and training. The use of technology to manage and search collections of explicit knowledge is well established. However, there is a further opportunity to foster knowledge creation, namely to enrich the collected information in some way, such as by reconfiguring it, so that it is more usable. An example is to use text classification to assign documents automatically to a subject schema. A typical activity here might be to put a document into a shared database.There can be little doubt that the phase of knowledge transformation best supported by IT is combination, because it deals with explicit knowledge. We can distinguish the challenges of knowledge management from those of information management by bearing in mind that in knowledge management the conversion of explicit knowledge from and to tacit knowledge is always involved.

- ***Internalisation (explicit to tacit):*** In order to act on information, individuals have to understand and internalize it, which involves creating their own tacit knowledge. By reading documents, they can to some extent re-experience what others previously learned. By reading documents from many sources, they have the opportunity to create new knowledge by combining their existing tacit knowledge with the knowledge of others. However, this process is becoming more challenging because individuals have to deal with ever-larger amounts of information. A typical activity would be to read and study documents from a number of different databases.

These processes do not occur in isolation, but work together in different combinations in typical business situations. For example, knowledge creation results from interaction of persons and tacit and explicit knowledge. Through interaction with others, tacit knowledge is externalized and shared. Although individuals, such as employees, for example, experience each of these processes from a knowledge management and therefore an organisational perspective, the greatest value occurs from their combination since, as already noted, new knowledge is thereby created, disseminated, and internalized by other employees who can therefore act on it and thus

form new experiences and tacit knowledge that can in turn be shared with others and so on. Since all the processes of *Figure 3* are important, it seems likely that knowledge management solutions should support all of them, although we must recognise that the balance between them in a particular organisation will depend on the knowledge management strategy used.

Table 1 shows some examples of technologies that may be applied to facilitate the knowledge conversion processes of *Figure 3*. The individual technologies are not in themselves knowledge management solutions. Instead, when brought to market they are typically embedded in a smaller number of solutions packages, each of which is designed to be adaptable to solve a range of business problems. Examples are portals, collaboration software, and distance learning software. Each of these can and does include several different technologies.

Table 1: Examples of technologies that can support or enhance the transformation of knowledge

Tacit to Tacit	**Tacit to Explicit**
E-meetings	Answering questions
Synchronous collaboration (chat)	Annotation
Explicit to Tacit	**Explicit to Explicit**
Visualization	Text search
Browsable video/audio of presentations	Document categorization

It is found that the strongest contribution to current solutions is made by technologies that deal largely with explicit knowledge, such as search and classification.

Contributions to the formation and communication of tacit knowledge, and support for making it explicit, are currently weaker, although some encouraging developments are highlighted, such as the use of text-based chat, expertise location, and unrestricted bulletin boards.

Knowledge capture stages

Knowledge may be accessed, or captured, at three stages: before, during, or after knowledge-related activities. For example, individuals undertaking a new project for an organisation might access KM resources to learn best practices and lessons learnt for similar projects undertaken previously, access the KM network again during the project implementation to seek advice on issues encountered, and access the system afterwards for advice on after-project actions and review activities. Similarly, knowledge may be captured and recorded into the system before the project implementation, for example, as the project team learns information and lessons during the initial project analysis. Similarly, lessons learnt during the project operation may be entered into the KM system, and after-action reviews may lead to further insights and lessons being recorded in the KM system for future access.

3.3.3 Knowledge Transfer and Organisation

In the Organisational development area of organisational learning, a practical problem is that of **knowledge transfer**, how to get some packet of knowledge, that exists in one part of the organisation, into another (or all other) parts of the organisation. It's more than just a communications problem. If it were merely that, then a memo, an e-mail or a meeting would accomplish the knowledge transfer.

Challenges

What complicates knowledge transfer? There are many factors, including:

- geography
- language

- areas of expertise
- internal conflicts (e.g., professional territoriality)
- generational differences
- union-management relations
- incentives
- the use of visual representations to transfer knowledge (Knowledge visualization)

Process

- identifying the key knowledge holders within the organisation
- motivating them to share
- designing a sharing mechanism to facilitate the transfer
- executing the transfer plan
- measuring to ensure the transfer
- applying the knowledge transferred

3.3.4 Drivers of Knowledge Management

There are a number of 'drivers', or motivations, leading to organisations undertaking a Knowledge Management program. Perhaps first among these are to gain the competitive advantage that comes with improved or faster learning and new knowledge creation. KM programs may lead to greater innovation, better customer experiences, consistency in best practices and knowledge access across a global organisation, as well as many other benefits, and KM programs may be driven with these goals in mind.

Considerations driving a knowledge management program might include:

- making available increased knowledge content in the development and provision of products and services.
- achieving shorter new product development cycles.
- facilitating and managing organisational innovation.
- leverage the expertise of people across the organization.
- Benefiting from 'network effects' as the number of productive connections between employees in the organisation increases and the quality of information shared increases.
- managing the proliferation of data and information in complex business environments and allowing employees to rapidly access useful and relevant knowledge resources and best practice guidelines.
- facilitate organisational learning.
- managing intellectual capital and intellectual assets in the workforce (such as the expertise and know-how possessed by key individuals) as individuals retire – in larger numbers than they have in a long time - and new workers are hired.

Knowledge Management enablers

Historically, there have been a number of *technologies* 'enabling, or facilitating KM practices in the organisation, including expert systems, knowledge bases, software help desk tools, document management systems and other IT systems supporting organisational knowledge flows.

The advent of the internet brought with it further enabling technologies, including E-learning, web conferencing, collaborative software, Content management systems, corporate 'Yellow pages' directories, email lists, Wikis, Blogs, and other technologies. Each enabling technology can expand the level of inquiry available to an employee, while providing a platform to achieve specific goals or actions. The practice of KM will continue to evolve with the growth of collaboration applications available by IT and through the Internet. Since its adoption by the mainstream population and business

community, the Internet has led to an increase in creative collaboration, learning and research, e-commerce, and instant information.

There are also a variety of *organisational* enablers for KM programs, including Communities of Practice, before-, after- and during- action reviews, peer assists, information taxonomies, coaching and mentoring, and so on.

3.3.5 Knowledge Representation

Knowledge representation is a central problem in arranging knowledge. It is needed for library classification and processing concepts in an information system.

There are difficulties in the field of artificial intelligence. The problem consists of how to store and manipulate knowledge in an information system in a formal way so that it may be used by mechanisms to accomplish a given task. Examples of applications are expert systems, machine translation systems, computer-aided maintenance systems and information retrieval systems (including database front-ends).

Some people think it would be best to represent knowledge in the same way that it is represented in the human mind, which is the only known working intelligence so far, or to represent knowledge in the form of human language. Unfortunately, we don't know how knowledge is represented in the human mind, or how to manipulate human languages in the same way as the human mind.

For this reason, various artificial languages and notations have been proposed for representing knowledge. They are typically based on logic and mathematics, and have easily parsed grammars to ease machine processing.

The recent fashion in knowledge representation languages is to use XML as the low-level syntax. This tends to make the output of these KR languages easy for machines to parse, at the expense of human readability.

First-order predicate calculus is commonly used as a mathematical basis for these systems, to avoid excessive complexity. However, even simple systems based on this simple logic can be used to represent data which is well beyond the processing capability of current computer systems:

Examples of notations:

- DATR is an example for representing lexical knowledge
- RDF is a simple notation for representing relationships between objects

Examples of artificial languages intended for knowledge representation include:

- CycL
- Loom
- OWL
- KM

Techniques of knowledge representation

Semantic networks may be used to represent knowledge. Each node represents a concept and the arcs are used to define relations between the concepts.

From the earliest times, the knowledge frame or just *frame* has been used. A frame consists of *slots* which contain values; for instance, the frame for *house* might contain a *color* slot, *number of floors* slot, etc.

Frames can behave something like object-oriented programming languages, with inheritance of features described by the "is-a" link. However, there has been no small amount of inconsistency in the usage of the "is-a" link: Ronald J. Brachman wrote a paper titled "What IS-A is and isn't", wherein 29 different semantics were found in projects whose knowledge representation schemes involved an "is-a" link. Other links include the "has-part" link.

Frame structures are well-suited for the representation of schematic knowledge and stereotypical cognitive patterns. The elements of such schematic patterns are weighted unequally, attributing higher weights to the more typical elements of a schema. A pattern is activated by certain expectations: If a person sees a big bird, he or she will classify it rather as a sea eagle than a golden eagle, given his or her "sea-scheme" is currently activated.

Frames representations are more object-centers than semantic networks: all the facts and properties of a concept are located in one place - there is no need for costly search processes in the database.

Frames suffer from the frame problem of knowledge linking.

A *script* is a type of frame that describes what happens temporally; the usual example given is that of describing going to a restaurant. The steps include waiting to be seated, receiving a menu, ordering, etc.

Check Your Progress 1

1) State whether True or False:

   a) Knowledge Management seeks to make the best use of the knowledge that is available to an organisation, creating new knowledge in the process. True ☐ False ☐
   b) Explicit knowledge is represented by some artifact, such as a document or a video, which has typically been created with the goal of communicating with another person. True ☐ False ☐
   c) Explicit knowledge is the most important basis for the generation of new knowledge. True ☐ False ☐
   d) Socialization Process is involved for transfer of Tacit to Tacit information. True ☐ False ☐
   e) Internalization Process is involved for conversion/ transfer of Tacit to Explicit information. True ☐ False ☐
   f) Externalization Process is involved for conversion/ transfer of Explicit to Tacit information. True ☐ False ☐
   g) Combination Process is involved for conversion/ transfer of Explicit to Explicit information. True ☐ False ☐

2) Answer the Following Question:

   a) What are the factors which make knowledge management implementation difficult in an organisation?

      ……
      ……
      ……

3.4 ARTIFICIAL INTELLIGENCE IN BUSINESS

Intelligence is the capability to solve perceptual problems. By the term "perceptual", we mean individual, special, random, fuzzy, sensory, and/or emotional. Solving such

problems requires accumulation, induction and inference of experiences to form new knowledge.

Artificial intelligence (abbreviated **AI**) is defined as intelligence exhibited by an artificial entity. Such an entity is generally computer-controlled; therefore artificial intelligence in this context is pre-programmed. Humans use intuition and viewpoints to make judgments and choices instead of using precise rules or procedures. However, almost none of those used by human beings can be done programmatically. In conclusion, we can say that no matter how powerful a computer might be, if it works only upon a given set of rules/programs, it is not regarded as having real intelligence.

Research in AI is concerned with producing machines to automate tasks requiring intelligent behavior. Examples include control, planning and scheduling, the ability to answer diagnostic and consumer questions, handwriting, speech, and facial recognition. As such, it has become a scientific discipline, focused on providing solutions to real life problems. AI systems are now in routine use in economics, medicine, engineering and the military, as well as being built into many common home computer software applications, traditional strategy games like computer chess and other video games.

Schools of thought

AI is divided roughly into two schools of thought: Conventional AI and Computational Intelligence (CI).

Conventional AI mostly involves methods now classified as machine learning, characterized by formalism and statistical analysis. This is also known as symbolic AI, logical AI, neat AI and Good Old Fashioned Artificial Intelligence (GOFAI). AI Methods include

- *Expert systems*: apply reasoning capabilities to reach a conclusion. An expert system can process large amounts of known information and provide conclusions based on them.
- Case based reasoning.
- Bayesian networks.
- Behaviour based AI: a modular method of building AI systems by hand.

Computational Intelligence involves iterative development or learning (e.g. parameter tuning e.g., in connectionist systems). Learning is based on empirical data and is associated with non-symbolic AI, scruffy AI and soft computing. Methods mainly include: Neural networks: systems with very strong pattern recognition capabilities.

- **Fuzzy systems:** techniques for reasoning under uncertainty, has been widely used in modern industrial and consumer product control systems.

- **Evolutionary computation:** applies biologically inspired concepts such as populations, mutation and survival of the fittest to generate increasingly better solutions to the problem. These methods most notably divide into evolutionary algorithms (e.g., genetic algorithms) and swarm intelligence (e.g., ant algorithms).

With hybrid intelligent systems attempts are made to combine these two groups. Expert inference rules can be generated through neural network or production rules from statistical learning such as in ACT-R.

A promising new approach called intelligence amplification tries to achieve artificial intelligence in an evolutionary development process as a side-effect of amplifying human intelligence through technology.

History of commercial AI applications

It was not until the late 1970s that the first commercial AI based System, XCON (Expert System), was developed. At that time, practical, commercial applications of AI were still rare. In the early 1980s, Fuzzy Logic techniques were implemented on Japanese subway trains and in a production application by a Danish cement manufacturer. Commercial AI products were only returning a few million dollars in revenue at this time.

The Expert Systems that companies are starting to use, and the AI groups in many large companies, were formed in the mid-1980s. Expert Systems started to show limits on the amount of rules they can work with, and 1986 sales of AI-based hardware and software were $425 million (WFMO, 2001). Likewise, interest in using Neural Nets in business applications developed. By the end of the 1980s, Expert Systems were increasingly used in industry, and other AI techniques were being implemented, often unnoticed but with beneficial effect (WFMO, 2001). AI revenues reach $1 billion (MIT, Timeline of AI, 2001).

In the early 1990s, AI applications such as automatic scheduling software, software to manage information for individuals, automatic mortgage underwriting systems, and automatic investment decision makers were used. In the mid-1990s, AI software to improve the prediction of daily revenues and staffing requirements for a business, credit fraud detection systems, and support systems were developed and used. It was not until the late-1990s that the applications such as data mining tools, e-mail filters, and web crawlers were developed and generally accepted.

Artificial intelligence methods for business use

We will discuss AI methods used in business namely Expert System, Artificial Neural Network (ANN), and Evolutionary Algorithm (EA) and move on to Hybrid Systems, (the AI methods that are used to complement, or in combination with these); Fuzzy Logic and Data Mining.

Expert System: *One of the accepted definition of Expert System is "A computer program with the expertise embodied in it, based on interview by a knowledge worker of the expert in that domain".* During the "knowledge acquisition" it will not only be the "knowledge" of experts that will be cloned and built into these systems, but also their intuition and the way that they reason, so that the best options can be selected under any given set of circumstances.

An Expert System can be developed by: Expert System Shell software that has been specifically designed to enable quick development, AI languages, such as LISP and Prolog or through the conventional languages, such as Fortran, C++, Java, etc.

While the Expert System concept may sound futuristic, one of the **first commercial Expert Systems**, called Mycin, was already in business use in 1974. Mycin, which was created by Edward H. Shortliffe at Stanford University, is one of the most famous Expert Systems. Mycin was designed as a medical diagnosis tool giving information concerning a patient's symptoms and test results; Mycin attempted to identify the cause of the patient's infection and suggested treatments. It was observed by some users that Mycin produced better analysis than medical students or practising doctors, provided its limitations were observed. Another example of an Expert System is Dendral, a computerized chemist. According to the Massachusetts Institute of Technology, the success of Dendral helped to convince computer science researchers

that systems using heuristics were capable of mimicking the way human experts solve problems.

As regards to **Potential Applications for an Expert System**, these have been developed for a variety of reasons, including: the archiving of rare skills, preserving the knowledge of retiring personnel, and to aggregate all of the available knowledge in a specific domain from several experts, (when no single expert has complete knowledge of that domain). Perhaps an expert's knowledge is needed more frequently than the expert can handle, or in places that the expert cannot travel to. The Expert System can train new employees or eliminate large amounts of the monotonous work humans do, thereby saving the expert 'time for situations requiring his or her expertise. In our opinion the only limit on the possible applications of stored knowledge in an Expert System is what the mind can imagine.

We may Conclude that the Expert System is an AI application that takes decisions based on knowledge and inference (the ability to react on the knowledge), as defined by experts in a certain domain and to solve problems in that domain. The Expert System normally falls under the definition of Weak AI, and is one of the AI techniques that has been easiest for companies to embrace. Commercial Expert Systems were developed during the 1970s, and continue to be used by companies. One advantage of an Expert System is that it can explain the logic behind a particular decision, why particular questions were asked, and/or why an alternative was eliminated. That is not the case with other AI methods.

Artificial Neural Network: Sometimes the following distinction is made between the terms "Neural Network" and "Artificial Neural Network". "Neural network" indicates networks that are hardware based and "Artificial Neural Network" normally refers to those which are software-based. In the following paragraphs, "Artificial Neural Network" is sometimes referred to as "Neural Network" or "Neural Computing". Neural Networks are an approach, which is inspired by the architecture of the human brain. In the human brain a neural network exists, which is comprised of over 10 billion neurons; each neuron then builds hundreds and even thousands of connections with other neurons.

*"**Neural computing** is defined as the study of networks of adaptable nodes which, through a process of learning from task examples, store experimental knowledge and make it available for use.".* As a Neural Network (NN) is designed, rather than being programmed, the systems learn to recognize patterns. Learning is achieved through repeated minor modifications to selected neuron weights (The weight is equal to the importance of the neuron). NN typically starts out with randomized weights for all their neurons. This means that they do not "know" anything, and must be trained. Once a NN has been trained correctly, it should be able to find the desired output to a given input; however, it cannot be guaranteed that a NN will produce the correct output pattern. NN learns by either a supervised or an unsupervised learning process.

i) **The Supervised Learning Process:** A supervised learning process has a target pattern (desired output). While learning different input patterns, the weight values are changed dynamically until their values are balanced, so that each input will lead to the desired output. There are two supervised learning algorithms: Forward, and Back-propagation, Learning Algorithms.

ii) An **unsupervised Neural Network** has no target outputs. During the learning process, the neural cells organise themselves in groups, according to input pattern. The incoming data is not only received by a single neural cell, but also influences other cells in its neighbourhood. The goal is to group neural cells with similar functions close together. Self-organisation Learning Algorithms tend to discover patterns and relationships in that data.

Artificial Neural Network Techniques: There are many kinds of Artificial Neural Networks. No one knows exactly how many. This dissertation only examines the most common ones. (i) Perceptron, (ii) Multi-Layer-Perceptron, (iii) Backpropagation Net, (iv) Hopfield Net Physicist, and (v) Kohonen Feature Map.

ANN as a method of Forecasting: "Forecasting is essential to business. NN does this job better than traditional forecasting methods. The advantages of ANN over traditional statistical forecasting methods are that ANN do not have to fulfill any statistical assumptions and the ability to handle non-linearity, which are common in business. Further advantages are that ANN is easy to learn and use, and normally requires less data preparation.

We can conclude that ANN is inspired by the architecture of the human brain, and learns to recognise patterns through repeated minor modifications to selected neuron weights. There are many kinds of ANN techniques that are good at solving problems involving patterns, pattern mapping, pattern completion, and pattern classification.

ANN pattern recognition capability makes it useful to forecast time series in business. A Neural Network can easily recognise patterns that have too many variables for humans to see. They have several advantages over conventional statistical models: they handle noisy data better, do not have to fulfil any statistical assumptions, and are generally better at handling large amounts of data with many variables.

A problem with Neural Networks is that it is very difficult to understand their internal reasoning process, however, this is not entirely accurate. It is possible to get an idea about the learned ANN variables' elasticity. By changing one variable at a time, looking at the changes in the output pattern during that time, at least some information regarding the importance of the different variables will be visible. Neural Networks can be very flexible systems for problem solving.

Evolutionary Algorithm is "an algorithm that maintains a population of structures (usually randomly generated initially) that evolves according to rules of selection, recombination, mutation and survival referred to as genetic operators. A shared "environment" determines the fitness or performance of each individual in the population. It also tells us that the fittest individuals are more likely to be selected for reproduction (retention or duplication), while recombination and mutation modifies those individuals, yielding potentially superior ones.

Branches of Evolutionary Algorithms: There are currently four main paradigms in (EA) research: Genetic Algorithm (GA), with two sub-classes and Genetic Programming (GP), Evolutionary Programming, and Evolution Strategy.

- **Genetic Algorithm** (GA), is inspired by Darwin's theory about evolution. Solution to a problem solved by genetic algorithms is evolved. Algorithm is started with a set of solutions (represented by chromosomes) called population. Solutions from one population are taken and used to form a new population. This is motivated by a hope, that the new population will be better than the old one. Solutions are selected to form new solutions (offspring) according to their fitness — the more suitable they are the more chances they have to reproduce. This is repeated until some condition (for example, "number of populations or improvement of the best solution) is satisfied."
- **Genetic programming** (GP) is a programming technique that extends the Genetic Algorithm to the domain of whole computer programs. In GP, populations of programs are genetically bred to solve problems.

- **Evolutionary Programming and Evolution Strategy:** Evolution programming uses mutations to evolve populations. Is a stochastic optimisation strategy similar to Genetic Algorithm, but instead places emphasis on the behavioural linkage between parents and their offspring, rather than seeking to emulate specific Genetic Operators as observed in nature. Evolutionary Programming is very similar to Evolution Strategies, although the two approaches developed independently.

Advantage and Disadvantages: Examples of problems where EA have been quite successful are: Timetabling and Job-Shop Scheduling Problem (JSSP), finding the most beneficial locations for offices, etc., and typical Operational Research (OR) problems with many constraints.

GA has proven to be well suited to optimisation of specific non-linear multivariable systems. GA is used in a variety of applications including scheduling, resource allocation, training ANNs, and selecting rules for fuzzy systems. *"GAs should be used when there is no other known problem solving strategy, and the problem domain is NP-complete. That is where GAs comes into play, heuristically finding solutions where all else fails." It is generally agreed that* EAs are especially ill suited for problems where efficient ways of solving them are already known.

We may conclude that the EA tries to mimic the process of biological evolution, complete with natural selection and survival of the fittest. The four main paradigms are Genetic Algorithm (GA), Genetic Programming (GP), Evolutionary Programming, and Evolution Strategy. EA is a useful method of optimisation when other techniques are not possible. EAs seem to offer an economic combination of simplicity and flexibility, and may be the better method for finding quick solutions than the more expensive and time consuming (but higher quality) OR methods. However, hybrid system between OR and EA should be able to perform quite well.

It is expected that if a backward Evolutionary Algorithm is used on an accepted OR solution, maybe then the human eye could easily rearrange the first string in a more effective way. If EA then were to run the string through the normal forward process, the end result could be better than using EA on an unperfected start string.

Hybrid System: More people have recently begun to consider combining the approaches into hybrid ones. Hybrid System is the system *that uses more than one problem-solving technique in order to solve a problem".* There is a huge amount of interest in Hybrid Systems, for example: neural-fuzzy, neural-genetic, and fuzzy-genetic hybrid systems. Researchers believe they can capture the best of the methods involved, and outperform the solitary methods.

"Fuzzy Logic and Fuzzy Expert System" and "Data Mining" are deliberately placed under the heading of Hybrid System. Fuzzy Logic is a method that is combined with other AI techniques (Hybrid System) to represent knowledge and reality in a better way. Data Mining does not have to be a Hybrid System, but usually is, for example, IBM's DB2 (Data Mining tool), which contains techniques (IBM, 2001) such as Statistics, ANN, GA, and Model quality graphics, etc. Let us now take a closer look at the methods.

Fuzzy Logic and Fuzzy Expert Systems Fuzzy Logic resembles human reasoning, but uses estimated information and vagueness in a better way. The answers to real-world problems are rarely black or white, true or false, or start or stop. By using Fuzzy Logic, knowledge can be expressed in a more natural way (fuzzy logic instead of Boolean "Crisp" logic).

i) Fuzzy Logic is *a departure from classical two-valued sets and logic, that uses "soft" linguistic (e.g,. large, hot, tall) system variables and a continuous range of truth values in the interval [0,1], rather than strict binary (True or False) decisions and assignments."*

Fuzzy Logic is ideal for controlling non-linear systems and for modeling complex systems where an inexact model exists, or in systems where ambiguity or vagueness is common. There are many commercial products are available today which uses Fuzzy logic like washing machines, high speed train etc.

ii) Fuzzy Expert Systems: Often Fuzzy Logic is combined with Expert Systems, such as the so-called Fuzzy Expert Systems which are the most common use of Fuzzy logic. These systems are also called "Fuzzy Systems" and use Fuzzy Logic instead of Boolean (crisp) logic. Fuzzy Expert Systems are used in several wide-ranging fields, including: Linear and Nonlinear Control Pattern Recognition, Financial Systems, Operation Research, Data Analysis, Pattern recognition etc.

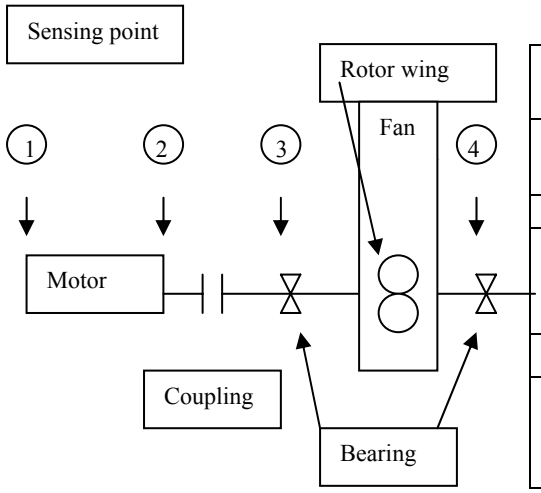
We may conclude that a Hybrid system uses more than one technique, such as neural-fuzzy, neural-genetic, Fuzzy Expert System, Data Mining (most often), etc., to solve a problem. Fuzzy logic is incorporated into computer systems so that they represent reality better by using "non-crisp" knowledge. Often Fuzzy Logic is combined with Expert Systems, the so-called Fuzzy Expert System or more simply, "Fuzzy System."

Data Mining software most often uses various techniques, including Neural Networks, statistical and visualization techniques, etc. to turn what are often mountains of data into useful information. Data Mining does not always contain AI techniques. It is expected that it is quite possible that Data Mining will become a very useful tool for companies in the competition for market shares.

More examples of commercial use of Artificial Intelligence:

Expert Systems For Equipment Failure Diagnosis:

Many expert systems for diagnosis have been developed in maintenance management. An example of expert system for diagnosing ventilators is described below. *Figure 4* shows the object (air fan) to be diagnosed and its possible areas and causes of failure.



Portion		Failure
Fan	Rotor wing	Unbalance looseness of bolt, etc.
	Rotor axis	Bending, resonance, etc.
Transmission	Coupling	Misalignment, looseness of bolt, etc.
Motor	Rotor	Unbalance bending of axis, etc.
	Stator	Unbalance of winding, etc.
	Cooling fan	Unbalance, etc.
Bearing		Bad lubrication, crack, wear, etc.
Base	Frame	Resonance, lack of silliness, etc.
	Bolt	Looseness, breaking, etc.
	Base	Lack of silliness, etc.

Figure 4: Failure analysis of an air fan

Rule 2 : If the velocities at measuring points 2 and 3 are abnormal, then the transmission failure is expected.

Figure 5: Production rules based on Experts' experience

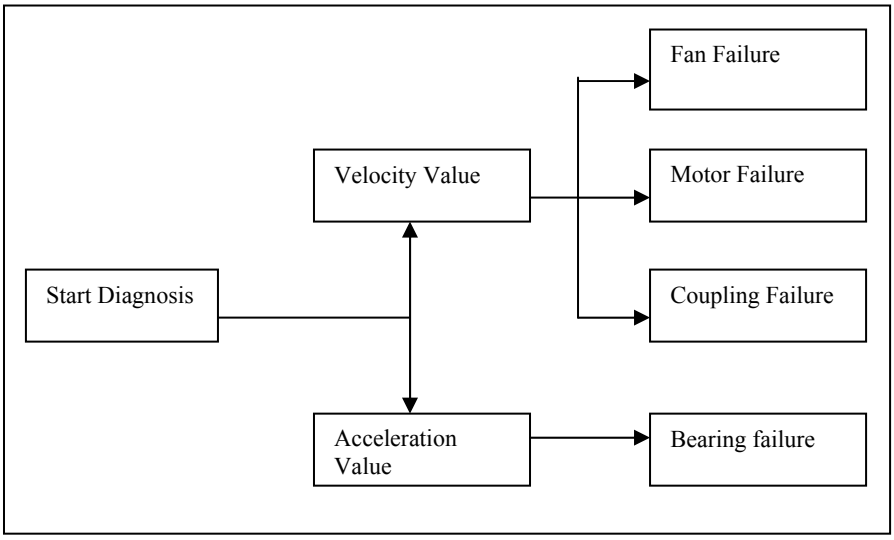


Figure 6: Inference process

The acceleration and velocity of vibration at the sensing points 1, 2, 3, and 4 are measured. The causalities between these measured values and failures are obtained by using expert knowledge. This knowledge is expressed in a matrix and is transformed into production rules are in *Figure 5*. The precise diagnosis is carried out based on the spectral analysis of the vibration data. The levels of the fundamental and higher components of the data are calculated. The relationship between the level values and failures is obtained by using expert knowledge. This knowledge is represented by frames. By using this knowledge source, the process of inference process as shown in *Figure 6*.

Predictive Maintenance in Place of Preventive Maintenance

With the help of AI the importance of predictive maintenance has increased although time based preventive maintenance has been used as a basic method. Predictive maintenance based on condition of the equipment that is for example, if we replace a bearing when the vibration exceeds a certain limit rather than being guided by replacing the bearing at a fixed interval. With use of predictive maintenance the extra time spent in breakdown maintenance can be avoided. Lastly, when the deterioration is slow, the predictive maintenance provides substantive time and cost advantages over the preventive maintenance performed at a set time interval. Thus, as demonstrated, the advantages of predictive maintenance include:

- replacement period prolongation
- safety improvement
- accident prevention
- reliability improvement

Diagnostic techniques based on machine condition are used to detect degradation of any equipment. In Japan, these techniques have been known since the 1960s, particularly in the steel manufacturing industry. Here are some examples.

Machinery and equipment

- Fluid machines
- Electric rotation machines
- Mills
- Stationary electric machines
- Motors

- Blowers
- Pumps
- Towers
- Drums

Sensing place

- Bearing portions
- Tanks
- Shafts
- Pipes

Condition-based diagnosis techniques have also been used to identify the mode of failure in abnormal vibration, crack by nondestructive examination (ultrasonic or X-ray), corrosion, or degradation of insulation. A very popular technique is to detect the abnormal vibration in the bearing portions and the shaft of rotating machinery. The level of vibration in the machine axis is measured by using the acceleration pick-up at regular intervals, thus obtaining the tendency of increasing vibration. Many rotating machines are maintained by using this method. The precondition for a condition-based strategy is to make the deteriorating conditions more transparent and predictable. This is where Artificial Intelligence can be used to bring competitive advantages.

Customer Relationship Management "Behaviour Analysis"

Behaviour Analysis and prediction of possible behaviour by the customer and then accordingly planning the business activity can definitely boost the business and profitability for business activities like retail business at a departmental store, credit card issuance and collections of dues, insurance policies coverage and mortgage etc. Such analysis is successfully being carried out by using AI techniques. The benefit of these new systems is that they reduce the amount of time necessary to approve a loan by using the computer to take decisions based on the variables values. Without human influence in the decision-making process, it becomes a very clean decision without emotion or preconceived ideas. Whether to apply for or extend a loan is often a critical decision for a company or an individual. With this new fast approval are companies not making it too easy to make loans? Perhaps the time needed before AI came on the scene gave the borrower time to think it though carefully. However, the methods exist and are in use at this moment to make decisions. Evidently AI has penetrated the business of Credit Card Issuers, Collectors, Insurance and Mortgage.

Customer Relationship Management "Support & Marketing"

The Office Assistant in Microsoft's Office packages uses AI and has a broad installed base today, with more than 90 percent of the Windows and Macintosh market, at the very least, this proves that support software containing AI has already penetrated the market. Advisory Expert Systems have been on the market for a long time.
At HP the interactive advice system CAST/BW, provides quick, accurate hardware sizing, network configuration, and usage recommendations. The system turns expert knowledge from SAP, HP internal competency centres, the HP Enterprise Server Group, and existing SAP. The Expert System functions in the same way as working directly with HP. Business Warehouse implementations into an easy-to-use advisory tool, use of robots, and marketing agents, support the assumption that support system based on AI have already entered the business market and are frequently used.

Company Control

There are several AI-based programs that control what employees do on the Internet, and what they send and receive in their e-mail at work. It is also believed that while preventing access to inappropriate web sites could be acceptable, checking employees' e-mail is going one step too far. Unless a reasonable limit is set, we will have a "Big

Brother" society. Furthermore, with all of the electronic information that companies receive today, it is expected that intelligent agents will be used more and more often to process information in automated and customized ways to ease information overload.

Production Management

AI software that learned to 'breed' factory schedules generates far better schedules than those that humans can produce with the help of Genetic Algorithms. With the case studies it has been proved that Data Mining with ANN, help solve some of the processing and interpretation problems for companies and have even played a key role in discovering oil fields.

Finance Management

Some believe that computers with Neural Networks are better at selecting stocks than people are. However, finding information regarding Neural Networks' success in the field of finance is difficult, most likely because successful systems are being treated as company secrets. The discussion of AI in the financial context has generally indicated that AI techniques are somewhat useful to most financial applications. AI techniques should catch on in coming years given the growing complexity of the markets, which will require more computing power and analysis to deal with information overload. It seems that many systems are best used as assistants to an existing team of experts rather than on their own.

We may conclude that AI has gained a foothold in the world of business. That foothold, moreover, is getting larger and larger as time goes by. One question which comes to mind is then why has it taken so long before these methods are visible in business applications. There appear to be four possible answers to that question. First, it seems that the development of processing power has been a catalyst that made it possible for AI-based system to gain a foothold in the business world. Furthermore, it is just lately that affordable computers with sufficient processing power have become available to companies. Second, AI often competes with business methods that have been quite successful and in use for very long periods of time. So, why risk changing a working concept, companies may think. There are also some interpretation difficulties in some AI systems for instance, old tried and true statistical methods win over ANN simply because people are unwilling to use a system where they do not see the effect of each variable (i.e., the Black Box). This can be a high threshold to overcome. Third, many AI applications involve large investments of money and failure can also be very costly; this makes the companies circumspect regarding investment decisions. Finally the fourth reason is simply that new technologies seems always to have a threshold for acceptance. Furthermore, many critics believe that AI has not fulfilled its promise. Yet they do not discard it as a method. It is a fact that companies are using AI and earning money as a result.

3.5 BUSINESS ANALYTICS

Business analytics is a term used for sophisticated forms of business data analysis. Analytics closely resembles statistical analysis and data mining, but tends to be based on physics modeling involving extensive computation.

Example: A common application of business analytics is portfolio analysis. Let us take a case of a bank or lending agency which has a collection of accounts, some from wealthy people, some from middle class people, and some from poor people. The question is how to evaluate the whole portfolio.

The bank can make money by lending to wealthy people, but there are only few wealthy people. The bank can make more money by also lending to middle class people. The bank can make even more money by lending to poor people.

Note that poorer people are usually at greater risk of default. Note too, that some poor people are excellent borrowers. Note too, that a few poor people may eventually become rich, and will reward the bank for loyalty.

The bank wants to maximize its income, while minimizing its risk, which makes the portfolio hard to understand.

The analytics solution may combine time series analysis, with many other issues in order to make decisions on when to lend money to these different borrower segments, or decisions on the interest rate charged to members of a portfolio segment to cover any losses among members in that segment.

Business analytics as Change Manager: The best hedge against an uncertain future is figuring out how to avoid being surprised when the unexpected happens. Better yet, business executives need to be able to quickly take advantage of changing conditions with new products and services. To accomplish these somewhat elusive goals, companies must constantly improve their ability to identify, classify, and intelligently analyse all available information.

A company's enterprise-information assets — particularly customer data — can be vast, but all too often they're squirreled away in application silos. The marketing department has customer demographics; the accounting department oversees purchase histories, payment frequency, and contract terms; and the customer-service department maintains problem reports.

Web sites are adding to the mounds of customer data that companies have to deal with. Web managers can monitor click stream log files to identify how customers navigate a site, where they came from, how long they were there, what they purchased, and where they headed afterward.

The goal of high-end business analytics is to turn these individually useful but often marginalized data resources into something that lets business managers immediately grasp the dynamic state of their business. This includes the current and projected status of their customers by group and individual needs. Ideally, analytics lets companies combine demographic and behavioural data with sales information to determine how best to leverage the customer relationship.

A company's ultimate goal is to precisely target new and existing goods to those individuals and groups based on the profiles gleaned from the analytic process. Corporate decision makers need to be increasingly attuned to business opportunities that arise whenever a customer, business, or industry factor changes. Exploiting change is the role of business analytics.

Most companies have Web-log data that's sparse and discrete and a wealth of transaction data, in some cases going back 20 years or more, that's rich and continuous. The nirvana here, is to integrate these data sources in a meaningful way so a company can tell what its customers are doing now and have done in the past. Business analysts can take that data, do a little trend analysis, and decide how best to pitch new products to customers.

There are costs associated with integrating all this data. The investment in gathering the data and aggregating it in meaningful ways must yield a quantifiable business benefit. You can gather all kinds of information, but if you don't have context, if you don't advance a business hypothesis and generate a good strategy, it's pretty much worthless information.

Reviewing historical and current data over time can optimally yield enough trend information to feed statistical models that let trained users predict events and trends. However, there's a reticence on the part of decision makers to trust "black box" business models used by consultants and in some software tools without understanding the parameters being measured.

Most of the data is extremely diverse and often in a constant state of flux, so there's usually no single, specific analytic technique appropriate to your data at a particular stage of its evolution. The upshot is that predictive models must be appropriate to the task, highly customized to specific business conditions, and targeted to address specific areas of interest or answer particular questions.

Rather than just having high-end modeling at one end of the spectrum and static reports at the other, what's needed is analytics and analytic applications that watch for change and initiate actions at both an individual and a group level. Analytics are most useful when the application proactively lets the right people know when relevant business factors change.

One way of spotting trends is to be able to measure just the part of the business that's changing. The future level of a lake can be predicted based on how much water is going in and how much is going out. The same analogy applies to business customers.

It has been observed that half of companies perform daily data warehouse updates, 40% have weekly or monthly updates, and 10% have real-time or near-real-time updates. It has also been observed that many of the companies performing weekly or monthly updates are apt to shift *en masse* to performing daily or continuous updates as a result of evolving market and competitive conditions.

The need to act upon information is a key driver of high-end analytic applications. Folding business intelligence back into the business decision-making process, operational systems, or human interaction is the primary way to make sure that a company can respond appropriately to changes in customer and market conditions. To bring about this organisational dynamic, the analytic results must be available to all of the people within a company. Traditionally, a lot of information gleaned from a company's business-intelligence tools went to upper management, but it didn't percolate quickly down into the trenches where it could be acted upon by the rank and file. However, the percolated information needs to be based on customization for the company, as company may not like to send all information to every employee.

Business analytics is moving beyond data warehousing, which a limited number of experts usually use, to include other components, such as publish-and-subscribe technology to distribute market intelligence to the various employees who need it. If certain events happen, the affected parties are notified in a timely fashion. This represents a kind of opting-in capability for specific kinds of information that helps mid-and low-level decision makers more quickly get the data they need to take action.

Improved search and text-mining techniques are aiding the quest for timely information. Predictive modeling applies in this scenario as well. This form of business modeling can help present information based on particular users' past interests and help predict what a manager might want or need to know in the future.

It's all well and good to have a group of statisticians sitting in their ivory cubicles, and it's quite true that companies still need those people to do the data mining today. But if business intelligence is to be more widely used across the enterprise, people must be able to act upon it in a timely fashion and fold the information back into the business process. Critical information about the state of the business must be distributed

quickly, efficiently, and appropriately to those people and departments that can affect the company's adaptability.

These are goals that IT departments have avidly pursued but have hitherto never been able to grasp fully. Fortunately, today's advanced analytics tools point to a time when compiling data, monitoring near-real-time business events, and synthesizing that data via data-mining and other advanced techniques will let companies respond almost immediately to perceived or predicted changes in market conditions. Early versions of these tools already let companies make business forecasts, optimize resources on the fly, and suggest appropriate actions with unprecedented speed, agility, and accuracy.

Companies should look twice at implementing traditional business-intelligence solutions and look more toward solutions that deliver analytics at the point of a business process.

A classic example of this is seen in inventory reordering systems based on supply-and-demand forecasts. Market data is fed back into the system to determine where, when, and how much inventory should be reordered. This type of analysis results directly in a modification of the business processes. The trick is to incorporate this intelligence into both tactical and strategic decision-making with managers making real-time decisions.

The latest challenge in business analytics is to capture external data from sources that companies haven't really considered before. If there's a cliché in the making here, it's that data abounds, but knowledge acquisition takes a lot more work. Many alternate sources of data are available via the Web. The number of customer-data sources continues to expand dramatically. The key will be to determine which of these data points are more relevant and to figure out organisational processes that will permit appropriate data to be fed to the analytics engine so a company or department can respond to it in real time and feed it into ongoing projects, sales efforts, and marketing campaigns.

Neural networks are flexible models that can be applied to predictive analysis and pattern-recognition problems. You want to control for different factors and see what's working for you and what's giving you the most bang for your buck. Well-targeted analytics will provide yield indicators and trends that the company can exploit to its advantage.

Another trend that we're seeing is a kind of cross-disciplinary awareness. Companies that have statisticians with different bases of experience or analysts who are able to make analogies more easily than most of us have recognised that there are large data issues in fields such as genomics. Both genetic researchers and companies with terabyte-level customer-relationship management systems share some common data management issues. Each group could learn from the other and share common analytical approaches.

Another way business-intelligence tools are evolving is in interactive analytics, in which users are able to slice and dice data and also carry out what-if scenarios. Instead of driving the enterprise by looking in the rearview mirror, you're looking forward to what might happen and can strategize on how to reach that outcome. Interactive analytics is an area where many conventional business-analytical tools fall short. Organisations want a single view of the customer, particularly given current economic trends. This requires a move away from point solutions to more integrated systems. It's a giant problem to access all of the disparate data sources scattered around the organisation. The reason it's a giant problem is that many companies wouldn't even know what to do with it once it's in one place.

This was characteristic of the naiveté of early data warehouse projects in the 1990s—many of which failed. "We're seeing much more sophistication around the way high-end business analytics are approached today, We don't really just want to bring a lot of data together; we actually want to work backward from the questions we're trying to answer."

There's also the issue of corporate management developing a level of trust in advanced analytical tools. Being comfortable with driving their business based on associations that aren't easily visible to the human eye doesn't come easily to many CEOs and business managers. As well, many VPs and marketing managers approach marketing as more of an art than a science and are somewhat resistant to analytic technologies.

The acceptance problem is twofold. The tools and techniques are still complex and difficult to use. Companies require the guys with the lab coats to make these tools hum. The analytic results that derive from them are often barely auditable, especially when employing things such as neural networks. The sheer sophistication of the tools makes it difficult for business managers to understand how the software came to a particular conclusion. As a result, decision makers often feel uncomfortable implementing results from analysis that they can't audit, figure out what the assumptions are, and how the results were derived.

Trust will emerge when people take a couple of these recommendations, implement them, and see a positive impact on the bottom line. The ultimate outcome of high-end analytics will be systems that can process diverse business data, draw conclusions, and alert managers to proposed actions and outcomes.

Hopefully, the impact on business will be companies that are more agile and better informed about all the conditions both within and outside their corporate boundaries.

Available Business Analytics: Such suits are being offered by several vendors. Vendors claim that these suits identify trends, perform comparisons and highlight opportunities in various business functions like supply chain management, even when large amounts of data are involved. These suits combine technology with human effort and help decision-makers in business areas such as sourcing, inventory management, manufacturing, quality, sales and logistics. Business Analytics solutions leverage investments made in enterprise applications, web technologies, data warehouses and information obtained from external sources to locate patterns among transactional, demographic and behavioural data.

Vendors claim that with wafer-thin margins, managing costs is an ongoing challenge. Business analytics solutions being offered can help managers in sales, marketing, customer support, supply chain planning and financials understand and respond to key issues, such as:

- Correctly analysing barriers to market-entry, this varies widely with each product,
- Responding to competition within a well defined supply tier structure,
- Dealing with the high threat of product substitutes,
- Continually driving product innovation,
- Managing product lifecycles to maximize returns.

Business analytics solutions available have capabilities for:

Executive Information Systems (EIS): Executive dashboards with drilldown analysis capabilities that support decision-making at an executive level.

Online Analytical Processing (OLAP): OLAP tools are mainly used by analysts. They apply relatively simple techniques such as deduction, induction, and pattern recognition to data in order to derive new information and insights.

Standard reports are designed and built centrally and then published for general use.

There are three types of standard reports:

- *Static reports or canned reports:* Fixed-format reports that can be generated on demand.
- *Parameterized reports:* Fixed layout reports that allow users to specify which data are to be included, such as date ranges and geographic regions.
- *Interactive reports:* These reports give users the flexibility to manipulate the structure, layout and content of a generic report via buttons, drop-down menus and other interactive devices.

Ad-hoc reports: generated by users as a "one-off" exercise. The only limitations are the capabilities of the reporting tool and the available data.

Advanced Analytics: Advanced statistical and analytical processing such as correlations, regressions, sensitivity analysis and hypothesis testing.

Empowers everyone: Provide each person with relevant, complete information tailored to their role.

- **Drive more effective actions:** Guide users toward more intelligent actions and customer interactions.
- **Do it in real time:** Use real-time intelligence to drive better business outcomes and operational results every second of every day.

Comprehensive Pre-built Analytic Applications

The Commercial Business Analytics available offer a comprehensive set of industry-specific analytic applications to optimize performance for sales, service, marketing, contact center, finance, supplier / supply chain, HR / workforce, and executive management. These pre-built analytic applications integrate and transform data from a range of enterprise sources-including Siebel, Oracle, PeopleSoft, SAP, and others-into actionable intelligence for each business function and user role. A few pre-built applications are described below:

- Sales Analytics
- Service and Contact Center Analytics
- Marketing Analytics
- Supply Chain Analytics
- Financial Analytics
- Workforce Analytics
- Real-Time Decisions Solutions

Stages of a Business Analytics

Figure 7 depicts the various stages in a data warehouse and business analytics initiative. While data analytics comprise the service layer for the applications, the other stages are equally important. Analytical services have varying applicability across the high tech value chain.

Examples of Pre-built Analytic Applications: As claimed by vendors, the Business Analytics platform provides the full range of enterprise business intelligence functionality-interactive dashboards; full ad hoc, proactive intelligence and alerts; advanced reporting; and predictive analytics all delivered on one common, modern Web architecture. Business intelligence (BI) tool enables the enterprise to get it SBI requirements such as common, shared metadata; heterogeneous data source access; and server-centric Web architectures, Business Analytics' make available robust BI platform which is mature and proven in these areas. Business Analytics platform provides the next level of enterprise BI functions.

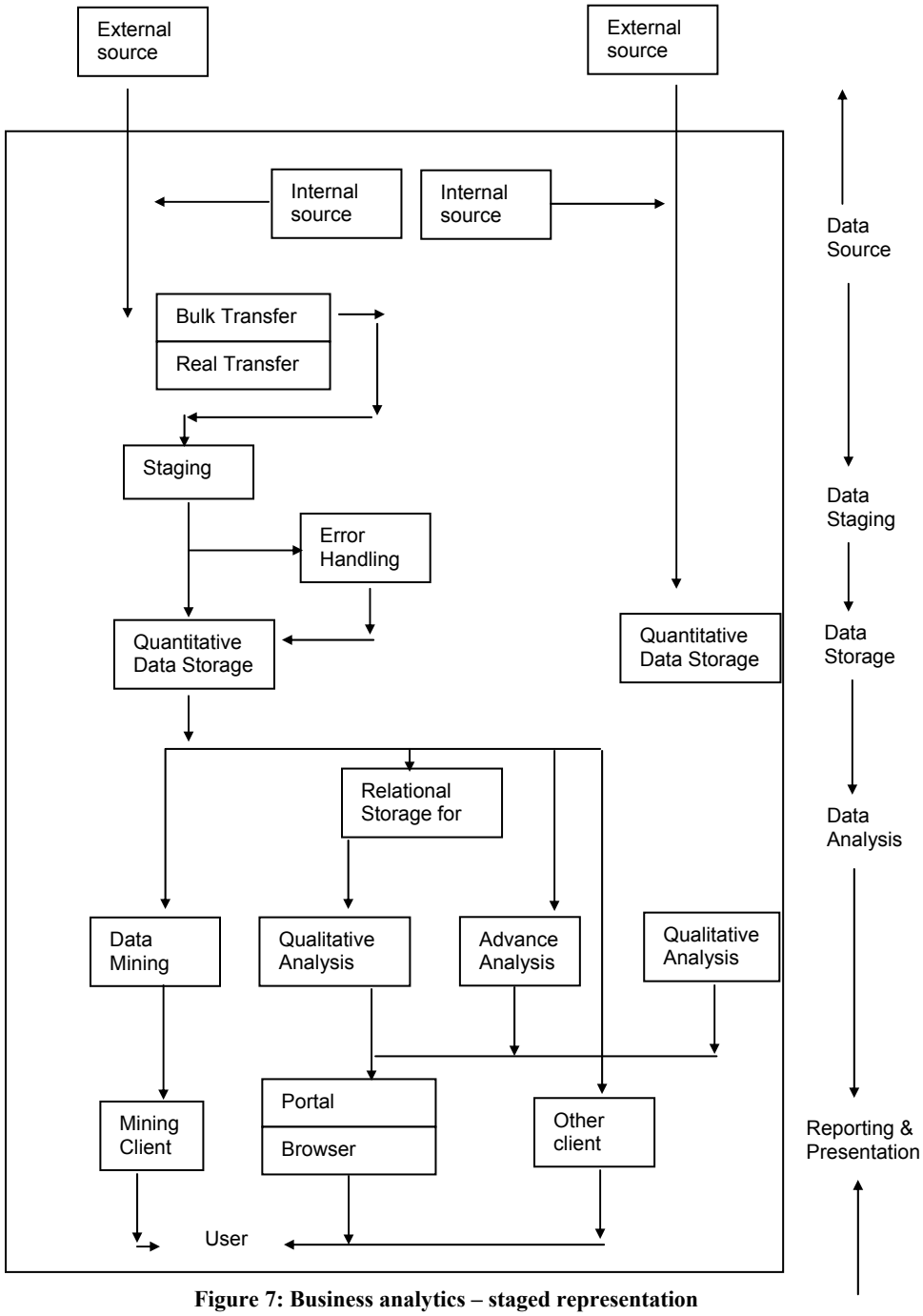


Figure 7: Business analytics – staged representation

Supply Chain Analytics

It enables more effective management of the complexities of the organisation's supply chain. A typical Supply Chain Analytics provides several dashboards, and several pre-built reports that deliver comprehensive insight across sales, logistics, procurement, manufacturing, and quality assurance departments. This helps to:

- Better manage customer commitments while optimising inventory and supplier spend,
- Gain up-to-the-minute insight to inventory, sourcing, and supplier performance.

The given examples of pre-built applications are from Sieable Business Analytics:

Supplier Sourcing Analytics

- Gain detailed visibility into direct and indirect spend,
- View product delivery schedules and payments,
- Identify opportunities to consolidate spend and reduce costs.

Supplier Performance Analytics

- Determine who are the best and worst performing suppliers,
- Monitor price, delivery, and product quality performance,
- Manage supply to minimize business disruption risks.

Inventory Analytics

- Gain visibility into inventory activities to minimize unnecessary expenditures,
- Optimize inventory levels to conserve working capital,
- Ensure customer satisfaction through better product availability.

Enterprise Sales Analytics

Enterprise Sales Analytics provides several key performance indicators and large number of reports delivered in several customizable dashboards. A typical Enterprise Sales Analytics enables sales managers and front-line representatives to dramatically improve sales effectiveness by:

- Providing real-time, actionable insight into every sales opportunity at the point of customer contact,
- Closing business faster and increasing overall sales revenue,
- Confidently providing more accurate and up-to-date sales forecasts,
- Quickly pinpointing problems and opportunities to close more business,
- Sales Analytics,
- Monitor status and take actions to ensure quota achievement,
- Maximize revenue through better cross-selling and up-selling,
- Shorten sales cycles and increase win rates.

Sales Revenue Analytics

Track sales orders, invoicing, and revenue. Increase customer value and follow-on sales potential. Proactively manage order pipeline and focus resources to maximize sales revenue.

Sales Revenue and Fulfilment Analytics

- Ensure faster customer order fulfilment and revenue recognition,
- Increase customer satisfaction and manage expectations,
- Improve product delivery cycle times,
- Achieve more effective backlog management and sales revenue attainment.

Sales Revenue and Pipeline Analytics

- Accelerate lead to cash cycle through visibility across entire sales process,
- Achieve comprehensive view of customer orders and invoices,
- Maximize sales throughput.

Financial Analytics

This enables understanding and managing the key drivers of shareholder value and profitability. A typical Financial Analytics helps front-line managers improve financial performance through complete, up-to-the-minute information on their department's expenses and revenue contribution. Users will benefit from:

- Up-to-the-minute information enabling financial managers to take actions that improve cash flow,
- Lower costs and increased profitability,
- More accurate, timely, and transparent financial reporting,
- Financial Analytics features large nuber of best practice-based key performance indicators and several reports.

Payables Analysis

- Assess cash management effectiveness,
- Ensure that strategic suppliers receive timely payments,
- Monitor operational effectiveness of the payables department in ensuring lowest transaction costs.

Receivables Analysis

- Effective working capital management by monitoring DSOs and cash cycles,
- Identify past due accounts and manage collections,
- Manage and control receivables risk.

General Ledger Analysis

- Perform faster end-of-period closing,
- Manage financial performance across locations, customers, products, and territories,
- Receive real-time alerts on material events that may impact financial condition.

Profitability Analysis

- Identify your most profitable customers, products, and channels,
- Understand profitability drivers across regions, divisions, and profit centres,
- Gain visibility into cost drivers and take actions to improve profitability.

Marketing Analytics

This enables maximum results from marketing investments. A typical analytic provides the entire marketing organisation with a complete, up-to-the-minute picture of customer preferences, buying behavior, and profitability. Marketing Analytics helps to:

- Develop closer, more valuable customer and prospect relationships,
- Improve marketing effectiveness,
- Maximize the return on marketing investment.

Marketing Planning Analytics

- Achieve better campaign response rates,
- Profile customers for more effective event-based promotions,
- Allocate resources more effectively by identifying what drives campaign results.

Campaign Performance Analytics

- Track and measure campaign effectiveness in real time,
- Understand factors that drive campaign results and lead conversion rates,
- Compare individual campaign results to target metrics.

Customer Insight Analytics

- Understand product affinity for targeted promotions,
- Profile customers, buying behaviour for more effective promotions,
- Gain better insight into segmentation characteristics,
- Understand which offers have the greatest impact on customer behaviour.

3.6 BUSINESS INTELLIGENCE

The term **business intelligence** (**BI**) typically refers to a set of business processes for collecting and analyzing business information. This includes the technology used in these processes, and the information obtained from these processes.

BI business processes

Organisations typically gather information in order to assess the business environment, and cover fields such as marketing, research, industry or market research, and competitor analysis. Competitive organisations accumulate business intelligence in order to gain sustainable competitive advantage, and may regard such intelligence as a valuable core competence in some instances.

Generally, BI-collectors glean their primary information from internal business sources. Such sources help decision-makers understand how well they have performed. Secondary sources of information include customer needs, customer decision-making processes, the competition and competitive pressures, conditions in relevant industries, and general economic, technological, and cultural trends. Industrial espionage may also provide business intelligence by using covert techniques. A gray area exists between “normal” business intelligence and industrial espionage.

Each business intelligence system has a specific goal, which derives from an organisational goal or from a vision statement. Both short-term goals (such as quarterly numbers to share market) and long term goals (such as shareholder value, target industry share / size, etc.) exist.

BI technology

Some observers regard BI as the process of enhancing data into information and then into knowledge. Persons involved in business intelligence processes may use application software and other technologies to gather, store, analyze, and provide access to data, and present that data in a simple, useful manner. The software aids in Business performance management, and aims to help people make "better" business decisions by making accurate, current, and relevant information available to them when they need it.

Some people use the term “BI” interchangeably with “briefing books” or with “executive information systems”, and the information that they contain. In this sense, one can regard a business intelligence system as a decision-support system (DSS).

BI software types

People working in business intelligence have developed tools that ease the work, especially when the intelligence task involves gathering and analyzing large quantities of unstructured data. Each vendor typically defines Business Intelligence his/her own way, and markets tools to do BI the way that they see it.

Business intelligence includes tools in various categories, including the following:

- AQL - Associative Query Logic
- Scorecarding
- Business Performance Management and Performance Measurement
- Business Planning
- Business Process Re-engineering
- Competitive Analysis
- Customer Relationship Management (CRM) and Marketing
- Data mining (DM), Data Farming, and Data warehouses
- Decision Support Systems (DSS) and Forecasting
- Document warehouses and Document Management
- Enterprise Management systems
- Executive Information Systems (EIS)
- Finance and Budgeting
- Human Resources
- Knowledge Management
- Mapping, Information visualization, and Dashboarding
- Management Information Systems (MIS)
- Geographic Information Systems (GIS)
- Online Analytical Processing (OLAP) and multidimensional analysis; sometimes simply called Analytics (based on the so-called hypercube or cube)
- Statistics and Technical Data Analysis
- Supply Chain Management/Demand Chain Management
- Systems intelligence
- Trend Analysis
- User/End-user Query and Reporting
- Web Personalization and Web Mining
- Text mining.

History

Prior to the start of the Information Age in the late 20th century, businesses sometimes struggled to collect data from non-automated sources. Businesses then lacked the computing resources to properly analyze the data, and often made business decisions primarily on the basis of intuition.

As businesses started automating more and more systems, more and more data became available. However, collection remained a challenge due to a lack of infrastructure for

data exchange or to incompatibilities between systems. Analysis of the data that was gathered and reports on the data sometimes took months to generate. Such reports allowed informed long-term strategic decision-making. However, short-term tactical decision-making continued to rely on intuition.

In modern businesses, increasing standards, automation, and technologies have led to vast amounts of data becoming available. Data warehouse technologies have set up repositories to store this data. Improved Extract, transform, load (ETL) and even recently Enterprise Application Integration tools have increased the speedy collecting of data. OLAP reporting technologies have allowed faster generation of new reports which analyze the data. Business intelligence has now become the art of sieving through large amounts of data, extracting pertinent information, and turning that information into knowledge upon which actions can be taken.

Business intelligence software incorporates the ability to data mine, analyze, and report. Some modern BI software allow users to cross-analyze and perform deep data research rapidly for better analysis of sales or performance on an individual, department, or company level. In modern applications of business intelligence software, managers are able to quickly compile reports from data for forecasting, analysis, and business decision making.

Indicators

BI often uses *Key performance indicators* (KPIs) to assess the present state of business and to prescribe a course of action. More and more organisations have started to make more data available more promptly. In the past, data only became available after a month or two, which did not help managers to adjust activities in time to hit Share Market targets. Recently, banks have tried to make data available at shorter intervals and have reduced delays.

The KPI methodology was further expanded with the Chief Performance Officer methodology which incorporated KPIs and root cause analysis into a single methodology.

KPI example

For example, for businesses which have higher operational/credit risk loading (for example, credit cards and "wealth management"), a large multi-national bank makes KPI-related data available weekly, and sometimes offers a daily analysis of numbers. This means data usually becomes available within 24 hours, necessitating automation and the use of IT systems.

Designing and implementing a business intelligence programme

When implementing a BI programme one might like to pose a number of questions and take a number of resultant decisions, such as:

- **Goal Alignment queries:** The first step determines the short and medium-term purposes of the programme. What strategic goal(s) of the organisation will the programme address? What organisational mission/vision does it relate to? A crafted hypothesis needs to detail how this initiative will eventually improve results / performance (i.e., a strategy map).

- **Baseline queries:** Current information-gathering competency needs assessing. Does the organisation have the capability of monitoring important sources of information? What data does the organisation collect and how does it store that data? What are the statistical parameters of this data, e.g., how much random variation does it contain? Does the organisation measure this?

- **Cost and risk queries:** The financial consequences of a new BI initiative should be estimated. It is necessary to assess the cost of the present operations and the increase in costs associated with the BI initiative. What is the risk that the initiative will fail? This risk assessment should be converted into a financial metric and included in the planning?
- **Customer and Stakeholder queries:** Determine who will benefit from the initiative and who will pay. Who has a stake in the current procedure? What kinds of customers/stakeholders will benefit directly from this initiative? Who will benefit indirectly? What are the quantitative / qualitative benefits? Is the specified initiative the best way to increase satisfaction for all kinds of customers, or is there a better way? How will customers' benefits be monitored? What about employees? shareholders? and distribution channel members?

- **Metrics-related queries:** These information requirements must be operationaged zed into clearly defined metrics. One must decide what metrics to use for each piece of information being gathered. Are these the best metrics? How do we know that? How many metrics need to be tracked? If this is a large number (it usually is), what kind of system can be used to track them? Are the metrics standardized, so they can be benchmarked against performance in other organisations? What are the industry standard metrics available?

- **Measurement Methodology-related queries:** One should establish a methodology or a procedure to determine the best (or acceptable) way of measuring the required metrics. What methods will be used, and how frequently will the organisation collect data? Do industry standards exist for this? Is this the best way to do the measurements? How do we know that?

- **Results-related queries:** Someone should monitor the BI programme to ensure that objectives are being met. Adjustments in the programme may be necessary. The programme should be tested for accuracy, reliability, and validity. How can one demonstrate that the BI initiative (rather than other factors) contributed to a change in results? How much of the change was probably random?.

3.7 ROLE OF BUSINESS INTELLIGENCE

The information economy puts a premium on high quality actionable information — exactly what *Business Intelligence (BI)* tools like data warehousing, data mining, and OLAP can provide to the business. A close look at the different organisational functions suggests that BI can play a crucial role in almost every function. It can give new and often surprising insights about customer behavior; thereby helping the businesses meeting their ever-changing needs and desires. On the supply side, BI can help businesses to identify their best vendors and determine what separates them from not so good vendors. It can give businesses better understanding of inventory and its movement and also help improve production and storefront operations through better category management. Through a host of analyses and reports, BI can also improve internal organisational support functions like finance and human resource management of any business.

Business Intelligence is applicable to all types of businesses; however, the magnitude of gains may vary. Here we will discuss in detail how BI can improve the key functional areas and thereby the overall productivity of the business.

3.7.1 Marketing

Smart Businesses in their efforts to meet the competition have reoriented their *business around the customer* by improving *Customer Relationship Management.* In the mad rush to acquire new customers, they have realized it is equally important to

retain the existing ones. Increased interaction and sophisticated analysis techniques have given businesses unprecedented access to the mind of the customer; and they are using this to develop one-to-one relation with the customer, design marketing and promotion campaigns, optimize sale front layout, and manage e-commerce operations. For improving Customer Relationship Management (CRM), the CRM strategy needs to include:

- *Operational CRM:* Automating interaction with the customers and sales force,
- *Analytical CRM:* Sophisticated analysis of the customer data generated by operational CRM and other sources like Sales Orders transactions, web site transactions, and third-party data providers.

A typical business organisation has a huge customer base and often customer's needs are fairly varying. Without the means to analyze voluminous customer data, CRM strategy is bound to be a failure, therefore, the Analytical CRM forms the core of the customer relationship strategy of a business.

Marketing and sales functions are the primary beneficiaries of Analytical CRM and the main touch points from where the insights gained about the customer is absorbed in the organisation.

Analytical CRM uses key business intelligence tools like data warehousing, data mining, and OLAP to present a unified view of the customer. Following are some of the uses of Analytical CRM:

- *Customer Classification*: Customer classification is a vital ingredient in a business organisation's marketing strategy. It can offer insights into how different segments respond to shifts in demographics, fashions and trends. For example it can help classify customers in the following segments:

  a) Customers who respond to new promotions
  b) Customers who respond to new product launches
  c) Customers who respond to discounts
  d) Customers who show a tendency to purchase specific products.

- *Campaign / Marketing Promotion Effectiveness Analysis*: Once a campaign is launched, its effectiveness can be studied across different media and in terms of costs and benefits; this greatly helps in understanding what goes into a successful marketing campaign. Campaign/ promotion effectiveness analysis can answer questions such as:

  a) Which media channels have been most successful in the past for various campaigns?
  b) Which geographic locations responded well to a particular campaign?
  c) What were the relative costs and benefits of this campaign?
  d) Which customer segments responded to the campaign?

- *Customer Lifetime Value*: Not all customers are equally profitable. At the same time customers who are not very profitable today may have the potential of being profitable in future. Hence, it is absolutely essential to identify customers with high lifetime value; the idea is to establish long-term relations with these customers.
  The basic methodology used to calculate customer lifetime value is to deduct the cost of servicing a customer from the expected future revenue generated by the customer, add to this the net value of new customers referred by this customer, and discount the result for the duration of the relationship. Though this sounds easy, there are a number of subjective variables like overall duration of the

customer's relation with the business, gap between intermediate cash flows, and discount rate. It is suggested that data mining tools should be used to develop customized models for calculating customer lifetime value.

1) *Customer Loyalty Analysis*: It is more economical to retain an existing customer than to acquire a new one. To develop effective customer retention programs it is vital to analyze the reasons for customer attrition. Business Intelligence helps in understanding customer attrition with respect to various factors influencing a customer and at times one can drill down to individual transactions, which might have resulted in the change of loyalty.

2) *Cross Selling*: Businesses use the vast amount of customer information available with them to cross sell other products at the time of purchase. This effort is largely based on the tastes of a particular customer, which can be analyzed using BI tools based on previous purchases. Businesses can also 'up sell' - sell more profitable products - to the customer at the time of contact.

3) *Product Pricing*: Pricing is one of the most crucial marketing decisions taken by businesses. Often an increase in price of a product can result in lower sales and customer adoption of replacement products. Using data warehousing and data mining, businesses can develop sophisticated price models for different products, which can establish price - sales relationships for the product and how changes in prices affect the sales of other products.

4) *Target Marketing*: Businesses can optimize the overall marketing and promotion effort by targeting campaigns to specific customers or groups of customers. Target marketing can be based on a very simple analysis of the buying habits of the customer or the customer group; but increasingly data mining tools are being used to define specific customer segments that are likely to respond to particular types of campaigns.

3.7.2 Sales and Orders

The success of a business in the future would depend on how effectively it manages multiple delivery channels like the Internet, interactive TV, catalogs, etc. A single customer is likely to interact with the retailer along multiple channels over a period of time. This calls for an integrated strategy to serve the customer well, which requires smooth flow of information across channels. To ensure smooth flow of information customer data needs to be collected from different channels in one data warehouse. Customer relationship strategy can then be built around this customer-centric data warehouse. We have already discussed how Analytical CRM can provide analyses over the centralized data warehouse. In this section we will explore how data warehousing and data mining can improve the effectiveness of a channel.

- ***E-Business Analysis:*** The Internet has emerged as a powerful alternative channel for established sales methods. Increasing competition from businesses operating purely over the Internet has forced the businesses who had not adopted this route to quickly adopt this channel. Their success would largely depend on how they use the Net to complement their existing channels. Web logs and Information forms filled over the web are very rich sources of data that can provide insightful information about customer's browsing behavior, purchasing patterns, likes and dislikes, etc. Two main types of analysis done on the web site data are:

1) ***Web Log Analysis:*** This involves analyzing the basic traffic information over the e-commerce web site. This analysis is primarily required to optimize the operations over the Internet. It typically includes following analyses:

   - **Site Navigation:** An analysis of the typical route followed by the user while navigating the web site. It also includes an analysis of the most popular pages in the web site. This can significantly help in site optimization by making it more user- friendly.

   - **Referrer Analysis:** An analysis of the sites, which are very prolific in diverting traffic to the company's web site.

   - **Error Analysis:** An analysis of the errors encountered by the user while navigating the web site. This can help in solving the errors and making the browsing experience more pleasurable.

   - **Keyword Analysis:** An analysis of the most popular keywords used by various users in Internet search engines to reach the concerned business e-commerce web site.

2) ***Web Housing:*** This involves integration of web log data with data from other sources like the purchase order transactions, third party data vendors etc. Once the data is collected in a single customer centric data warehouse, often referred to as Web house, all the applications already described under CRM can be implemented. Often a business wants to design specific campaigns for users who purchase from the e-commerce web site. In this case, segmentation and profiling can be done specifically for the .e-customers to understand their needs and browsing behavior. It can also be used to personalize the content of the e-commerce web site for these users.

3) ***Channel Profitability:*** Data warehousing can help analyze channel profitability, and whether it makes sense for the business to continue building up expertise in the channel. The decision of continuing with a channel would also include a number of subjective factors like outlook of key enabling technologies for that channel.

4) ***Product Channel Affinity:*** Some product categories sell particularly well on certain channels. Data warehousing can help identify hidden product-channel affinities and help the business design better promotion and marketing campaigns.

3.7.3 Human Resource

Data warehousing can significantly help in aligning the HR strategy to the overall business strategy. It can present an integrated view of the workforce and help in designing retention schemes, improve productivity, and curtail costs. Some BI applications in HR are:

- **Human Resource Reports/ Analytics:** Reports and analysis can be generated to support an integrated view of the workforce. Various analyses include staff movement and performance, workforce attrition by business, workforce performance by business, compensation and attrition, and other customized analyses and reports. The HR data can be integrated with benchmark figures for the industry and various reports can be generated to measure performance vis-à-vis industry benchmarks.

- **Manpower Allocation:** This includes allocating manpower based on the demand projections. According to the seasonal variation in demand, temporary manpower can be hired to maintain service levels. The demand levels vary within one working day also, which can be used to allocate resources accordingly.

- **HR Portal:** Employers need to maintain accurate employee data, which can be viewed by the employees for information relating to compensation, benefits, retirement facilities, etc. Payroll data can be integrated with data from other human resource management applications in the HR data warehouse. This data can then be circulated within the organisation through the HR portal.

- **Training and Succession Planning:** Accurate data about the skill sets of the workforce can be maintained in the data warehouse. This can be used to design training programs and for effective succession planning.

3.7.4 Finance and Accounts

The role of financial reporting has undergone a paradigm shift during the last decade. It is no longer restricted to just financial statements required by the law; increasingly it is being used to help in strategic decision making. Also, many organisations have embraced a free information architecture, whereby financial information is openly available for internal use. Many analytics described till now use financial data. Many companies, across industries, have integrated financial data in their enterprise wide data warehouse or established separate Financial Data Warehouse (FDW). Following are some of the uses of BI in finance:

- **Budgetary Analysis:** Data warehousing facilitates analysis of budgeted versus actual expenditure for various cost heads like promotion campaigns, energy costs, salary, etc. OLAP tools can provide drill down facility whereby the reasons for cost overruns can be analyzed in more detail. It can also be used to allocate budgets for the coming financial period.

- **Fixed Asset Return Analysis:** This is used to analyse financial viability of the fixed assets owned or leased by the company. It would typically involve measures like profitability per sq. foot of the space, total lease cost vs. profitability, etc.

- **Financial Ratio Analysis:** Various financial ratios like debt-equity, liquidity ratios, etc. can be analyzed over a period of time. The ability to drill down and join inter-related reports and analyses provided by all major OLAP tool vendors can make ratio analysis much more perceptive.

- **Profitability Analysis:** This includes profitability of individual business, departments within the business, product categories, brands, and individual SKUs. A major component of profitability analysis is the costs incurred by departments and the cost of acquiring, storing and allocating shelf space to particular product categories, brands, or SKUs. It goes without saying that profitability analysis has an extremely universal appeal and would be required by other groups within the business organisation.

3.8 BUSINESS INTELLIGENCE TOOLS

Business intelligence tools are a type of Application software designed to help the business intelligence (BI) business processes. Specifically they are generally tools that aid in the analysis and presentation of data. While some business intelligence tools

include ETL functionality, ETL tools are generally not considered business intelligence tools.

Types of business intelligence tools

- OLAP (including HOLAP, ROLAP and MOLAP)
- Reporting software (also called Pixel perfect reporting software)
- Data mining
- Business performance management (BPM)

Open Source Business Intelligence Products

- **Pentaho:** enterprise-class reporting, analysis, dashboard, data mining and workflow capabilities.
- **OpenI:** simple web application that does out-of-box OLAP reporting.
- **Greenplum Inc.:** first open source powered database server that can scale to support multi-terabyte data warehousing demands.
- **YALE (Yet Another Learning Environment):** free open source software for Business Intelligence, Knowledge Discovery, Data Mining, Machine Learning, etc.
- **BEE Project:** BI Suite of tools ideal for mid size companies that has 50GB or less of data. It has ETL and uses ROLAP and is under the GPL license.
- **MarvelIT:** open source Business Intelligence solution based on the Apache Jetspeed Enterprise Portal and the popular OpenReports reporting application.
- **SpagoBI:** complete suite for the development of Business Intelligence that covers data and metadata organisation, static reporting and dimensional analysis, hidden information discovering by means of data mining techniques, the building of a structured and dynamic control suite with dashboard components.
- **DecisionStudio-Professional:** Comprehensive GPL desktop BI platform built on best-of-breed open source projects including MySQL, R Environment, DBDesigner, iReport, Python, etc. It is an advanced graphical desktop data mining, reporting, modeling, and analysis environment comprehensive capabilities to each role in the analytics value chain.

Commercial Products used as business intelligence tools:

- ACE*COMM
- Actuate
- Alphablox
- Analysis Center Library
- Applix
- Business Objects
- Cognos
- Cyberscience
- DataHabitat
- Decision Technology
- Information Builders
- Hyperion Solutions Corporation
- KCI Computing
- MaxQ Technologies
- Metrinomics - Metrivox
- Microsoft Analysis Services
- MicroStrategy
- MIS DecisionWare
- OutlookSoft
- Panorama
- Pentaho
- ProClarity

- Oracle Corporation
- QlikView
- Siebel Systems
- SAP Business Information Warehouse
- SAS Institute
- Saksoft
- Synola Ltd
- Stratws.

Same as these Business tool is being discussed in detail in the following unit:

On Line Analytical Processing (OLAP)

OLAP is an acronym for *On Line Analytical Processing*. It is an approach to quickly provide the answer to analytical queries that are multi-dimensional in nature. It is part of the broader category business intelligence, which also includes ETL (Extract, Transform, Load), relational reporting and data mining. The typical applications of OLAP are in business reporting for sales, marketing, management reporting, business performance management (BPM), budgeting and forecasting, financial reporting and similar areas. The term OLAP was created as a slight modification of the traditional database term OLTP (On Line Transaction Processing).

Databases configured for OLAP employ a multidimensional data model, allowing for complex analytical and ad-hoc queries with a rapid execution time. Nigel Pendse has suggested that an alternative and perhaps more descriptive term to describe the concept of OLAP is Fast Analysis of Shared Multidimensional Information (FASMI). They borrow aspects of navigational databases and hierarchical databases that are speedier than their relational kin.

OLAP Functionality

OLAP takes a snapshot of a set of source data and restructures it into an OLAP cube. The queries can then be run against this. It has been claimed that for complex queries OLAP can produce an answer in around 0.1% of the time for the same query on OLTP relational data.

The cube is created from a star schema or snowflake schema of tables. At the centre is the fact table which lists the core facts which make up the query. Numerous dimension tables are linked to the fact tables. These tables indicate how the aggregations of relational data can be analyzed. The number of possible aggregations is determined by every possible manner in which the original data can be hierarchically linked. For example a set of customers can be grouped by city, by district or by country; so with 50 cities, 8 districts and two countries there are three hierarchical levels with 60 members. These customers can be considered in relation to products; if there are 250 products with 20 categories, three families and three departments then there are 276 product members. With just these two dimensions there are 16,560 (276 * 60) possible aggregations. As the data considered increases the number of aggregations can quickly total tens of millions or more.

The calculation of the aggregations and the base data combined make up an OLAP cube, which can potentially contain all the answers to every query which can be answered from the data. Due to the potentially large number of aggregations to be calculated, often only a predetermined number are fully calculated while the remainder are solved on demand.

Types of OLAP

There are three types of OLAP.

Multidimensional OLAP

MOLAP is the 'classic' form of OLAP and is sometimes referred to as just OLAP. MOLAP uses database structures that are generally optimal attributes such as time period, location, product or account code. The way that each dimension will be aggregated is defined in advance by one or more hierarchies.

Relational OLAP

ROLAP works directly with relational databases.The base data and the dimension tables are stored as relational tables and new tables are created to hold the aggregated information.

Hybrid OLAP

There is no clear agreement across the industry as to what constitutes "Hybrid OLAP", except that a database will divide data between relational and specialized storage. For example, for some vendors, a HOLAP database will use relational tables to hold the larger quantities of detailed data, and use specialized storage for at least some aspects of the smaller quantities of more-aggregate or less-detailed data.

Comparison

Each type has certain benefits, although there is disagreement about the specifics of the benefits between providers. MOLAP is better on smaller sets of data, it is faster to calculate the aggregations and return answers and needs less storage space. ROLAP is considered more scalable. However, large volume pre-processing is difficult to implement efficiently so it is frequently skipped. ROLAP query performance can therefore suffer.

HOLAP is between the two in all areas, but it can pre-process quickly and scale well. All types though are prone to database explosion. Database explosion is a phenomenon causing vast amount of storage space being used by OLAP databases when certain but frequent conditions are met: high number of dimensions, pre-calculated results and sparse multidimensional data. The difficulty in implementing OLAP comes in forming the queries, choosing the base data and developing the schema, as a result of which most modern OLAP products come with huge libraries of pre-configured queries. Another problem is in the base data quality - it must be complete and consistent.

Other types

The following acronyms are also used sometimes, although they are not as widespread as the ones above

- WOLAP - Web-based OLAP
- DOLAP - Desktop OLAP
- RTOLAP - Real-Time OLAP.

APIs and query languages

Unlike relational databases - which had SQL as the standard query language and wide-spread APIs such as ODBC, JDBC and OLEDB - there was no such unification in the OLAP world. The first real standard API was OLEDB for OLAP specification from Microsoft which appeared in 1997 and introduced the MDX query language. Several OLAP vendors - both server and client - adopted it. In 2001 Microsoft and Hyperion announced the XML for Analysis specification, which was endorsed by most of the

OLAP vendors. Since this also used MDX as a query language, MDX became the de-facto standard in the OLAP world.

Commercial OLAP products

Open Source OLAP

Palo - An Open Source MOLAP Server

Mondrian - An Open Source ROLAP Server
JPalo - Open Source Development Tools for Palo.

Data mining

Data Mining, also known as **Knowledge-Discovery in Databases (KDD)**, is the process of automatically searching large volumes of data for patterns..
Data Mining can be defined as "The nontrivial extraction of implicit, previously unknown, and potentially useful information from data and The science of extracting useful information from large data sets or databases." Although it is usually used in relation to analysis of data, data mining, like artificial intelligence, is an umbrella term and is used with varied meaning in a wide range of contexts. It is usually associated with a business or other organisation's need to identify trends. Data mining involves the process of analyzing data to show patterns or relationships and sorting through large amounts of data and picking out pieces of relative information or patterns that occur e.g. picking out statistical information from some data.

A simple example of data mining is its use in a retail sales department. If a store tracks the purchases of a customer and notices that a customer buys a lot of silk shirts, the data mining system will make a correlation between that customer and silk shirts. The sales department will look at that information and may begin direct mail marketing of silk shirts to that customer, or it may alternatively attempt to get the customer to buy a wider range of products. In this case, the data mining system used by the retail store discovered new information about the customer that was previously unknown to the company. Another widely used (though hypothetical) example is that of a very large North American chain of supermarkets. Through intensive analysis of the transactions and the goods bought over a period of time, analysts found that beers and diapers were often bought together. Though explaining this interrelation might be difficult, taking advantage of it, on the other hand, should not be hard (e.g., placing the high-profit diapers next to the high-profit beers). This technique is often referred to as *Market*

Basket Analysis

In statistical analyses, in which there is no underlying theoretical model, data mining is often approximated via stepwise regression methods wherein the space of 2^k possible relationships between a single outcome variable and k potential explanatory variables is *smartly* searched. With the advent of parallel computing, it became possible (when k is less than approximately to examine all 2^k models.) This procedure is called *all subsets* or *exhaustive* regression. Some of the first applications of exhaustive regression involved the study of plant data.

Data dredging

Used in the technical context of data warehousing and analysis, the term "data mining" is neutral. However, it sometimes has a more pejorative usage that implies imposing patterns (and particularly causal relationships) on data where none exist. This imposition of irrelevant, misleading or trivial attribute correlation is more properly criticized as "data dredging" in statistical literature. Another term for this misuse of statistics is *data fishing.*

Used in this latter sense, data dredging implies scanning the data for any relationships, and then when one is found coming up with an interesting explanation. (This is also referred to as "over fitting the model".) The problem is that large data sets invariably happen to have some exciting relationships peculiar to that data. Therefore, any conclusions reached are likely to be highly suspect. In spite of this, some exploratory data work is always required in any applied statistical analysis to get a feel for the data, so sometimes the line between good statistical practice and data dredging is less than clear.

One common approach to evaluating the fitness of a model generated via data mining techniques is called *cross validation*. Cross validation is a technique that produces an estimate of generalization error based on resampling. In simple terms, the general idea behind cross validation is that dividing the data into two or more separate data subsets allows one subset to be used to evaluate the *generalize ability* of the model learned from the other data subset(s). A data subset used to build a model is called a *training set*; the evaluation data subset is called the *test set*. Common cross validation techniques include the *holdout method*, *k-fold cross validation*, and the *leave-one-out method*.

Another pitfall of using data mining is that it may lead to discovering correlations that may not exist. "There have always been a considerable number of people who busy themselves examining the last thousand numbers which have appeared on a roulette wheel, in search of some repeating pattern. Sadly enough, they have usually found it." However, when properly done, determining correlations in investment analysis has proven to be very profitable for statistical arbitrage operations (such as pairs trading strategies), and furthermore correlation analysis has shown to be very useful in risk management. Indeed, finding correlations in the financial markets, when done properly, is not the same as finding false patterns in roulette wheels.

Most data mining efforts are focused on developing highly detailed models of some large data set. Other researchers have described an alternate method that involves finding the minimal differences between elements in a data set, with the goal of developing simpler models that represent relevant data.

Notable uses of data mining

- Data mining has been cited as the method by which the U.S. Army unit Able Danger supposedly had identified the 9/11 attack leader, Mohamed Atta, and three other 9/11 hijackers as possible members of an al Qaeda cell operating in the U.S. more than a year before the attack.

Software (Commercial Software available)

- R programming language R is statistical environment and programming language that fits well for machine learning and data mining.
- Microsoft Analysis Services - Microsoft SQL Server 2005 contains a full suite of data mining algorithms and tools integrated with the database, OLAP, Reporting, ETL pipeline, and the development environment.
- Weka Open source data mining software written in Java.
- Neural network software.
- Java Data Mining.

Business performance management

Business performance management (BPM) is a set of processes that help organisations optimize business performance. BPM is seen as the next generation of business intelligence (BI). BPM is focused on business processes such as planning and forecasting. It helps businesses discover efficient use of their business units, financial, human, and material resources.

BPM involves consolidation of data from various sources, querying, and analysis of the data, and putting the results into practice.

BPM enhances processes by creating better feedback loops. Continuous and real-time reviews help to identify and eliminate problems before they grow. BPM's forecasting abilities help the company take corrective action in time to meet earnings projections. Forecasting is characterized by a high degree of predictability which is put into good use to answer *what-if* scenarios. BPM is useful in risk analysis and predicting outcomes of merger and acquisition scenarios and coming up with a plan to overcome potential problems.

BPM provides key performance indicators (KPI) that help companies monitor efficiency of projects and employees against operational targets.

Metrics / Key Performance Indicators

BPM often uses key performance indicators (KPIs) to assess the present state of business and to prescribe a course of action. More and more organisations have started to make data available more promptly. In the past, data only became available after a month or two, which did not help to suggest to managers that they should adjust activities in time to hit targets. Recently, banks have tried make data available at shorter intervals and have reduced delays. For example, for businesses which have higher operational/credit risk loading (for example, credit cards, A large multi-national bank makes KPI-related data available weekly, and sometimes offers a daily analysis of numbers. This means data usually becomes available within 24 hours, necessitating automation and the use of IT systems.

Most of the time, BPM simply means use of several financial/non-financial metrics/key performance indicators to assess the present state of business and to prescribe a course of action.

1) Some of the areas in which top management analysis could gain knowledge from BPM:
   a) Customer-related numbers:
   b) New customers acquired
   c) Status of existing customers.
2) Attrition of customers (including breakup by reason for attrition)
3) Turnover generated by segments of the customers - these could be demographic filters.
4) Outstanding balances held by segments of customers and terms of payment - these could be demographic filters.
5) Collection of bad debts within customer relationships.
6) Demographic analysis of individuals (potential customers) applying to become customers, and the levels of approval, rejections and pending numbers.
7) Delinquency analysis of customers behind on payments.

This is more an inclusive list than an exclusive one. The above more or less describes what a bank would do, but could also refer to a telephone company or similar service sector company.

What is important?

1) KPI related data which is consistent and correct.
2) Timely availability of KPI-related data.
3) Information presented in a format which aids decision making
4) Ability to discern patterns or trends from organised information.

BPM integrates the company's processes with CRM or ERP. Companies become able to gauge customer satisfaction, control customer trends and influence shareholder value.

BI Vendors: Some of the BI vendors are shown below:

- Business Objects
- Cognos
- EFM Software
- Hyperion Solutions Corporation
- OutlookSoft
- Prophix Software Inc.
- Saksoft
- SAP AG
- SAS Institute
- Systems Union.

3.9 BUSINESS INTELLIGENCE REPORTS

Reporting is a fundamental business requirement as every transaction-based enterprise application, every database, and each process that workers perform on a day-to-day basis needs reporting in some fashion. Reporting allows the users to access, format, and securely deliver data as meaningful information. The power of Business Objects reporting provides the user with the information they need, when they need it — inside and outside the organisation. Reporting and analysis have become persistent in business, and they must be seen as a core requirement and be held to the same standards as all core technologies.

The reporting and analysis market is mature. Companies have a wide variety of technology options, from a plethora of BI vendors to platform and application vendors. The participation by so many vendors reflects two issues:

- *Companies want a single BI reporting and analysis solution:* Every company and government organisation wants a single, standard reporting and analysis solution for the entire organisation as they need to drive down IT support costs and simultaneously increase the likelihood of a single version of critical data.

- *Vendors want to be selected as the BI reporting and analysis standard:* Simply put, the vendor that offers the most comprehensive BI reporting and analysis solution is in a better position of being selected as the reporting standard. To that extent, there has been a significant amount of activity by the vendors during the past years to deliver a broader BI reporting and analysis platform.

Requirements of the Reporting solution are:

Powerful Authoring: Business Objects reporting requires a powerful, flexible, and open environment for report creation. You need to connect to any data, and then build highly-formatted reports using intuitive, flexible design tools. In addition, you require the ability to integrate end-user report viewing, printing, exporting, and creation capabilities into applications using a comprehensive set of software developer kits and powerful report processing services.

Flexible Sharing: Once a report is created, you need to publish it on the web, portals, printers, email, and applications. In enterprise reporting, Business Objects need to provide a BI platform for secure, highly scalable information delivery to handle large numbers of end users around the world. For embedded reporting, we need to provide open application integration and flexible deployment. Our products are required to integrate tightly with existing infrastructure to meet even the most demanding

enterprise and embedded reporting requirements. Reports may be required to be integrated into Java, .NET, and COM applications and deployed on Windows, UNIX, and Linux.

Reporting — the Way Users Work: For end users, reports need to include built-in interactivity, creating a clean and efficient process where one report will satisfy the needs of many different individuals. Users need to not only view reports in web portals, but they also need to explore the information by moving easily from static consumption to insightful interaction. What's more, users may require embedding and securely sharing live reports or parts of reports inside Microsoft Office Word, PowerPoint, and Excel documents.

Proven Technology: The vendor needs to adopt proven technology which has evolved over time to become the de facto accepted standard for reporting. It should have compatibility with leading enterprise application software like SAP, IBM, Microsoft, Oracle/PeopleSoft, Borland, and BEA.

Types Of Reporting and Analysis Solutions: There are three types of solutions available as shown below. Some of the vendors who supply solutions have also been indicated.

At its core, reporting technology is required to be designed for information distribution. Whether it's ad-hoc or predefined, the reporting paradigm have to address the information delivery, publishing and distribution. That is why reporting products generally have menu items that predefine the query, format the resulting data and then publish that report to the people it was designed for.

When describing BI technologies, reporting is often lumped together with analysis to categorize a technology as "reporting and analysis." This makes some sense because analysis is what users ultimately do with a report once it is received. If the user knows ahead of time what data is needed and considers the job complete once the report has been published, then reporting technology is the right tool for the job. Every information consumer in the organisation, from executives to production workers, will use these reporting systems.

However, if the user's job is to make decisions, this "delivery" model may only be adequate in certain circumstances and be significantly inadequate in others. The most popular feature in any reporting system is the "Export to Excel" button simply because the decision maker's job with the data is not done when the information is delivered - the job has just begun.

Using the Repository for More Productive Report Development

Many report designers keep a set of reports that contain pieces of reports that they would use over and over. In many cases, these reports would contain corporate logos, commonly used objects (like a company's address), and even some typical formula logic. Report designers copy and paste these objects between these "warehouse reports" and the newly created reports on a regular basis. This technique saves the designer some time, as they do not have to recreate these objects for each new report. But, what happens when business logic changes and needs to be updated? This happens quite often and is a critical piece of the reporting puzzle. The only tried-and-true method of the past does not solve the problem of how to update business logic or formulas in reports that has already been created. The report designer has to remember which reports may have been affected, open each individual report, and update them by hand-coding the changes. This process is cumbersome and time-consuming but mission critical. One common location to store and update report objects can dramatically improve this situation.

For accomplishing improvement of the productivity of the report design process a centrally managed location is required so that report designers can access, update, reuse and share report objects. To extend this concept, report objects can also be shared and reused among multiple report designers for even greater efficiency.

The **Repository** is a central database that contains common report objects that can be shared and reused. The types of report objects that can be shared via the repository are:

- *Text Objects:* Reusable text, such as company addresses or confidentiality statements
- *Images: Pictures or logos*
- *Custom Functions: Business logic that can be reused by passing in new fields as variables*
- *SQL Commands: Encapsulated database commands that produce tables to report from. These SQL statements can also be parameter driven.*

The Repository is independent from all other databases connected to any report. It manages logic, is a standalone database formatting, and objects. But most importantly, by its very nature as a separate library (or database), it is referenced by the report when the report is opened, and, as a result, it can actually update the repository objects automatically for the report designer so that the added overhead of copying new logic and objects is eliminated.

To add an object to the Repository, it's as simple as dragging and dropping the object into a folder in the Repository Explorer. The Repository Explorer represents the repository database as a tree structure made up of folders and objects. The structure of the repository folders is up to the person working with the repository. Within the Repository Explorer, the report designer has to have access to the repository objects that can be placed on the report design surface. Text objects and image objects are visible from the Repository Explorer. To use Repository Objects in your reports, simply drag-and-drop these objects on to the report as required.

SQL commands and their properties are visible in the Repository Explorer. You do not drag-and-drop these objects on the report as they are used in the Database Expert. You can use SQL Commands like database tables when you're designing your report. You can save your SQL statements in the repository for later use with the SQL Command in Repository feature.

Trends

Quality reports are critical. It is not a very unusual scene to find that executives arrive at meetings armed with spreadsheets only to find that each has different values for the same metrics. The rest of the meeting is then spent arguing over whose numbers are correct, rather than in actual decision making based on consistent numbers. This malaise is largely an offshoot of data fragmentation, the fracture of a single version of operational truth into multiple data sources, often not correlated with each other. The most significant part of providing quality reports is the choice and architecture of your reporting solution.

Quality aside, another important facet of reporting is delivery. Users want reports to be personalized, organised, timely, easily accessible and in their preferred format. For example, in today’s business environment it is desirable to be able to e-mail reports to colleagues, create spreadsheets from report results and access reports securely over the internet.

One aspect of reporting that is frequently overlooked is its integration with other IT infrastructure elements. We have seen some customer departments so completely

focused on "solving the reporting problem" — evaluating checklists of features from various vendors, reading analyst reports on each vendors – that they fail to coordinate this effort with the bigger company wide picture of how that reporting piece fits into other infrastructure (such as the central security repository or caching strategy). These customers then find themselves in the position of having to stitch together their data warehouse, reporting, security and portal solutions and own the problem of identifying the correct vendor to call.

Check Your Progress 2

1) State whether True or False

(a) Expert System can be defined as *"A computer program with the expertise embodied in it, based on the expertise of the knowledge worker"*. True ☐ False ☐

(b) Artificial intelligence is defined as intelligence exhibited by an artificial entity like a computer. True ☐ False ☐

(c) Distinction between the terms "Neural Network" and "Artificial Neural Network" can be "Neural network" indicates networks that are software based and "Artificial Neural Network" normally refers to those which are hardware-based. True ☐ False ☐

(d) Evolutionary Algorithms is "an algorithm that maintains a population of structures (usually randomly generated initially) that evolves according to rules of selection, recombination, mutation and survival referred to as genetic operators. True ☐ False ☐

(e) Business analytics solutions available must have at least three 3 components i.e. Executive dashboards with drilldown analysis capabilities, OLAP tools and Reporting generation facilities. True ☐ False ☐

(f) On Line Analytical Processing is an approach to quickly providing the answer to analytical queries that are dimensional in nature.

(g) Data Mining can be defined as the science of extracting useful information from large data sets or databases. True ☐ False ☐

(h) Business performance management is the management technique which helps organisations to optimize business performance. True ☐ False ☐

(i) The types of report objects that can be shared via the repository are Text Objects, Images, Custom Functions and SQL Command . True ☐ False ☐

2) Answer the Following Questions:

(a) For Business Intelligence programme implementation, what questions must be asked / answered to ensure that BI goals are achieved?

……
……
……

(b) Name the minimum essential requirements for Reporting Solution to be selected.

……
……
……

3.10 SUMMARY

In this unit we have discussed the most recent and talked about topics of knowledge management, artificial intelligence and business intelligence. These topics in this unit have been discussed in detail to make students ready for the real professional life also list of the vendors who offer these commercial packages has been given. So that you

can through more detailed information about these commercial packages from the websites which will definitely improve your knowledge about these softwares.

Artificial / business intelligence areas are presently at the further developing stage and are becoming more complex, particularly the area of neuro networks which has many options; therefore, the discussion has been confined more to uses rather than development aspects, as those do not fit in this course.

3.11 SOLUTIONS / ANSWERS

Check Your Progress 1

1) True or False

(a) True, (b) True, (c) False, (d) True, (e) False,
(f) False, (g) True.

2) Solutions/Answers

(a) The factors which make knowledge management implementation difficult in an organisation are:

- Geographically different locations for offices / units.
- language
- areas of expertise
- internal conflicts (e.g., professional territoriality)
- generational differences
- union-management relations
- incentives
- the use of visual representations to transfer knowledge (Knowledge visualization)

Check Your Progress 2

1) True or False

(a) False, (b) True, (c) False, (d) True, (e) True,
(f) True, (g) True, (h) False,

2) Solutions/Answers

(a) For Business Intelligence programme implementation, the questions that must be asked / answered to ensure that BI goals are achieved

- *Goal Alignment queries*:
- *Baseline queries:*
- *Cost and risk queries:*
- *Customer and Stakeholder queries:*
- *Metrics-related queries:*
- *Measurement Methodology-related queries:*
- *Results-related queries.*

(b) The minimum essential requirements for Reporting Solution to be selected are:

- *Powerful Authoring*
- *Flexible Sharing*
- *Reporting—the Way Users Work*
- *Proven Technology.*

3.12 FURTHER READINGS/REFERENCES

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