Computer Organization and Architecture

Study Material for **MS-07/MCA/204**

Directorate of Distance Education
Guru Jambheshwar University of Science &Technology, Hisar

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Unit 1

Principles of Computer Design

Learning Objectives

After completion of this unit, you should be able to :

- describe software and hardware interaction layers in computer architecture
- Describe central processing unit
- Describe various machine language instructions
- Describe various addressing modes
- Describe various instruction types and Instruction cycle

Introduction

Copy from page-12, BSIT-301, PTU

Software

Software, or program enables a computer to perform specific tasks, as opposed to the physical components of the system (*hardware*). This includes application software such as a word processor, which enables a user to perform a task, and system software such as an operating system, which enables other software to run properly, by interfacing with hardware and with other software or custom software made to user specifications.

Types of Software

Practical computer systems divide software into three major classes: system software, programming software and application software, although the distinction is arbitrary, and often blurred.

- **System software** helps run the computer hardware and computer system. It includes operating systems, device drivers, diagnostic tools, servers, windowing systems, utilities and more. The purpose of systems software is to insulate the applications programmer as much as possible from the details of the particular computer complex being used, especially memory and other hardware features, and such accessory devices as communications, printers, readers, displays, keyboards, etc.
- **Programming software** usually provides tools to assist a programmer in writing computer programs and software using different programming languages in a more convenient way. The tools include text editors, compilers, interpreters,

linkers, debuggers, and so on. An Integrated development environment (IDE) merges those tools into a software bundle, and a programmer may not need to type multiple commands for compiling, interpreter, debugging, tracing, and etc., because the IDE usually has an advanced *graphical user interface*, or GUI.

- **Application software** allows end users to accomplish one or more specific (non-computer related) tasks. Typical applications include industrial automation, business software, educational software, medical software, databases, and computer games. Businesses are probably the biggest users of application software, but almost every field of human activity now uses some form of application software. It is used to automate all sorts of functions.

Operation

Computer software has to be "loaded" into the computer's storage (such as a *hard drive*, *memory*, or *RAM*). Once the software is loaded, the computer is able to execute the software. Computers operate by *executing* the computer program. This involves passing instructions from the application software, through the system software, to the hardware which ultimately receives the instruction as machine code. Each instruction causes the computer to carry out an operation -- moving data, carrying out a computation, or altering the control flow of instructions.
Data movement is typically from one place in memory to another. Sometimes it involves moving data between memory and registers which enable high-speed data access in the CPU. Moving data, especially large amounts of it, can be costly. So, this is sometimes avoided by using "pointers" to data instead. Computations include simple operations such as incrementing the value of a variable data element. More complex computations may involve many operations and data elements together.
Instructions may be performed sequentially, conditionally, or iteratively. Sequential instructions are those operations that are performed one after another. Conditional instructions are performed such that different sets of instructions execute depending on the value(s) of some data. In some languages this is known as an "if" statement. Iterative instructions are performed repetitively and may depend on some data value. This is sometimes called a "loop." Often, one instruction may "call" another set of instructions that are defined in some other program or module. When more than one computer processor is used, instructions may be executed simultaneously.
A simple example of the way software operates is what happens when a user selects an entry such as "Copy" from a menu. In this case, a conditional instruction is executed to copy text from data in a 'document' area residing in memory, perhaps to an intermediate storage

area known as a 'clipboard' data area. If a different menu entry such as "Paste" is chosen, the software may execute the instructions to copy the text from the clipboard data area to a specific location in the same or another document in memory.
Depending on the application, even the example above could become complicated. The field of software engineering endeavors to manage the complexity of how software operates. This is especially true for software that operates in the context of a large or powerful computer system.
Currently, almost the only limitations on the use of computer software in applications is the ingenuity of the designer/programmer. Consequently, large areas of activities (such as playing grand master level chess) formerly assumed to be incapable of software simulation are now routinely programmed. The only area that has so far proved reasonably secure from software simulation is the realm of human art- especially, pleasing music and literature.
Kinds of software by operation: computer program as executable, source code or script, configuration.

Hardware

Computer hardware is the physical part of a computer, including the digital circuitry, as distinguished from the computer software that executes within the hardware. The hardware of a computer is infrequently changed, in comparison with software and data, which are "soft" in the sense that they are readily created, modified or erased on the computer. Firmware is a special type of software that rarely, if ever, needs to be changed and so is stored on hardware devices such as read-only memory (ROM) where it is not readily changed (and is therefore "firm" rather than just "soft").

Most computer hardware is not seen by normal users. It is in embedded systems in automobiles, microwave ovens, electrocardiograph machines, compact disc players, and other devices. Personal computers, the computer hardware familiar to most people, form only a small minority of computers (about 0.2% of all new computers produced in 2003).

Personal computer hardware

A typical pc consists of a case or chassis in desktop or tower shape and the following parts:

Typical Motherboard found in a computer 

- Motherboard or system board with slots for expansion cards and holding parts
  - Central processing unit (**CPU**)
    - Computer fan - used to cool down the CPU
  - Random Access Memory (RAM) - for program execution and short term data storage, so the computer does not have to take the time to access the hard drive to find the file(s) it requires. More RAM will normally contribute to a faster PC. RAM is almost always removable as it sits in slots in the motherboard, attached with small clips. The RAM slots are normally located next to the CPU socket.
  - Basic Input-Output System (BIOS) or Extensible Firmware Interface (EFI) in some newer computers
  - Buses
- Power supply - a case that holds a transformer, voltage control, and (usually) a cooling fan
- Storage controllers of IDE, SATA, SCSI or other type, that control hard disk, floppy disk, CD-ROM and other drives; the controllers sit directly on the motherboard (on-board) or on expansion cards
- Video display controller that produces the output for the computer display. This will either be built into the motherboard or attached in its own separate slot (PCI, PCI-E or AGP), requiring a Graphics Card.
- Computer bus controllers (parallel, serial, USB, FireWire) to connect the computer to external peripheral devices such as printers or scanners
- Some type of a removable media writer:
  - CD - the most common type of removable media, cheap but fragile.
    - CD-ROM Drive
    - CD Writer
  - DVD
    - DVD-ROM Drive
    - DVD Writer
    - DVD-RAM Drive
  - Floppy disk
  - Zip drive
  - USB flash drive AKA a Pen Drive
  - Tape drive - mainly for backup and long-term storage
- Internal storage - keeps data inside the computer for later use.
  - Hard disk - for medium-term storage of data.
  - Disk array controller
- Sound card - translates signals from the system board into analog voltage levels, and has terminals to plug in speakers.

- Networking - to connect the computer to the Internet and/or other computers
    - Modem - for dial-up connections
    - Network card - for DSL/Cable internet, and/or connecting to other computers.
- Other peripherals

In addition, hardware can include external components of a computer system. The following are either standard or very common.

- Input devices
    - Text input devices
        - Keyboard
    - Pointing devices
        - Mouse
        - Trackball
    - Gaming devices
        - Joystick
        - Game pad
        - Game controller
    - Image, Video input devices
        - Image scanner
        - Webcam
    - Audio input devices
        - Microphone
- Output devices
    - Image, Video output devices
        - Printer: Peripheral device that produces a hard copy. (Inkjet, Laser)
        - Monitor: Device that takes signals and displays them. (CRT, LCD)
    - Audio output devices
        - Speakers: A device that converts analog audio signals into the equivalent air vibrations in order to make audible sound.
        - Headset: A device similar in functionality to that of a regular telephone handset but is worn on the head to keep the hands free.

Student-Activity

1. What is computer Software?
2. What is computer Hardware?
3. List various Input and Output devices.
4. Describe various Audio Output devices.
5. What is the function of RAM

Software-Hardware Interaction layers in Computer Architecture

In computer engineering, **computer architecture** is the conceptual design and fundamental operational structure of a computer system. It is a blueprint and functional description of requirements (especially speeds and interconnections) and design implementations for the various parts of a computer – focusing largely on the way by which the central processing unit (CPU) performs internally and accesses addresses in memory.

It may also be defined as the science and art of selecting and interconnecting hardware components to create computers that meet functional, performance and cost goals.

"Architecture" therefore typically refers to the fixed internal structure of the CPU (i.e. electronic switches to represent logic gates) to perform logical operations, and may also include the built-in interface (i.e. opcodes) by which hardware resources (i.e. CPU, memory, and also motherboard, peripherals) may be used by the software.

It is frequently confused with computer organization. But computer architecture is the *abstract* image of a computing system that is seen by a machine language (or assembly language) programmer, including the instruction set, memory address modes, processor registers, and address and data formats; whereas the computer organization is a lower level, more *concrete*, description of the system that involves how the constituent parts of the system are interconnected and how they interoperate in order to implement the architectural specification.

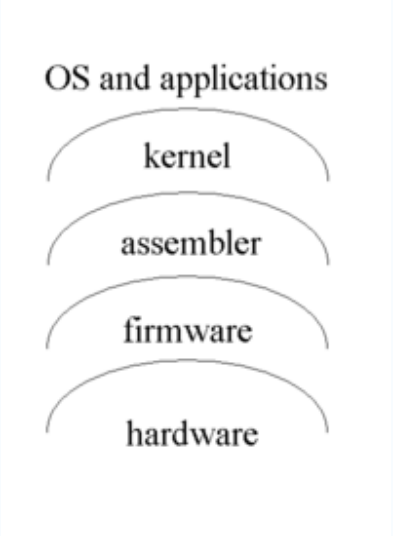

Fig : A typical vision of a computer architecture as a series of abstraction layers: hardware, firmware, assembler, kernel, operating system and applications

Abstraction Layer

An **abstraction layer** (or abstraction level) is a way of hiding the implementation details of a particular set of functionality. Perhaps the most well known software models which use layers of abstraction are the OSI 7 Layer model for computer protocols, OpenGL graphics drawing library, and the byte stream I/O model originated by Unix and adopted by MSDOS, Linux, and most other modern operating systems.

In computer science, an abstraction level is a generalization of a model or algorithm, away from any specific implementation. These generalizations arise from broad similarities that are best encapsulated by models that express similarities present in various specific implementations. The simplification provided by a good abstraction layer allows for easy reuse by distilling a useful concept or metaphor so that situations where it may be accurately applied can be quickly recognized.

A good abstraction will generalize that which can be made abstract; while allowing specificity where the abstraction breaks down and its successful application requires customization to each unique requirement or problem.

Firmware

In computing, **firmware** is software that is embedded in a hardware device. It is often provided on flash ROMs or as a binary image file that can be uploaded onto existing hardware by a user. Firmware is defined as:

- the computer program in a read-only memory (ROM) integrated circuit (a hardware part number or other configuration identifier is usually used to represent the software);
- the erasable programmable read-only memory (EPROM) chip, whose program may be modified by special external hardware, but not by [a general purpose] application program.
- the electrically erasable programmable read-only memory (EEPROM) chip, whose program may be modified by special electrical external hardware (not the usual optical light), but not by [a general purpose] application program.

Assembler

An assembly language program is translated into the target computer's machine code by a utility program called an **assembler**.Typically a modern **assembler** creates object code by translating assembly instruction mnemonics into opcodes, and by resolving symbolic names for memory locations and other entities. The use of symbolic references is a key feature of assemblers, saving tedious calculations and manual address updates after program modifications.

Kernel

In computing, the **kernel** is the central component of most computer operating systems (OSs). Its responsibilities include managing the system's resources and the communication between hardware and software components. As a basic component of an operating system, a kernel provides the lowest-level abstraction layer for the resources (especially memory, processor and I/O devices) that applications must control to perform their function. It typically makes these facilities available to application processes through inter-process communication mechanisms and system calls.

These tasks are done differently by different kernels, depending on their design and implementation. While monolithic kernels will try to achieve these goals by executing all the code in the same address space to increase the performance of the system, micro kernels run most of their services in user space, aiming to improve maintainability and

modularity of the code base. A range of possibilities exists between these two extremes.

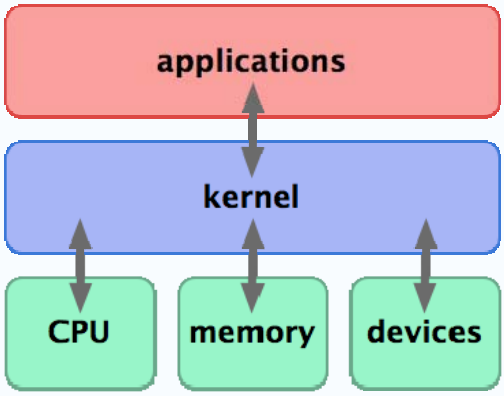

Fig : A kernel connects the application software to the hardware of a computer.

Operating System

An **operating system** (OS) is a computer program that manages the hardware and software resources of a computer. At the foundation of all system software, an operating system performs basic tasks such as controlling and allocating memory, prioritizing system requests, controlling input and output devices, facilitating networking, and managing files. It also may provide a graphical user interface for higher level functions. It forms a platform for other software.

Application Software

Application software is a subclass of computer software that employs the capabilities of a computer directly to a task that the user wishes to perform. This should be contrasted with system software which is involved in integrating a computer's various capabilities, but typically does not directly apply them in the performance of tasks that benefit the user. In this context the term application refers to both the *application software* and its implementation.

Central Processing Unit

Copy introduction from page-66, BSIT-301, PTU

Student Activity

1. Describe various software-hardware interaction layers in computer hardware.
2. Define CPU. Describe its various parts.

Machine Language Instructions

A computer executes machine language programs mechanically -- that is without understanding them or thinking about them -- simply because of the way it is physically put together. This is not an easy concept. A computer is a machine built of millions of tiny switches called transistors, which have the property that they can be wired together in such a way that an output from one switch can turn another switch on or off. As a computer computes, these switches turn each other on or off in a pattern determined both by the way they are wired together and by the program that the computer is executing.

Machine language instructions are expressed as binary numbers. A binary number is made up of just two possible digits, zero and one. So, a machine language instruction is just a sequence of zeros and ones. Each particular sequence encodes some particular instruction. The data that the computer manipulates is also encoded as binary numbers. A computer can work directly with binary numbers because switches can readily represent such numbers: Turn the switch on to represent a one; turn it off to represent a zero. Machine language instructions are stored in memory as patterns of switches turned on or off. When a machine language instruction is loaded into the CPU, all that happens is that certain switches are turned on or off in the pattern that encodes that particular instruction. The CPU is built to respond to this pattern by executing the instruction it encodes; it does this simply because of the way all the other switches in the CPU are wired together.

Addressing Modes

Copy from page-66 to page-69, upto student activity, BSIT-301, PTU

Instruction Types

The type of instruction is recognized by the computer control from the four bits in position 12 through 15 of the instruction. If the three opcode bits in positions 12 through 14 are not equal to 111, the instruction is a memory reference type and the bit in the position 15 is taken as the addressing mode. If the bit is 1, the instruction is an input-output instruction.

Only three bits of the instruction are used for the operation code. It may seem that the computer is restricted to a maximum of eight distinct operations. Since register reference and input output instructions use the remaining 12 bits as part of the total number of instruction chosen for the basic computer is equal to 25.

Data Movement Instructions:

Assembly Language Instruction:	Example:	Meaning:	Machine Language Instruction:
LOAD [REG] [MEM] STORE [MEM] [REG] MOVE [REG1] [REG2]	LOAD R2 13 STORE 8 R3 MOVE R2 R0	R2 = M[13] M[8] = R3 R2 = R0	1 000 0001 0 RR MMMMM 1 000 0010 0 RR MMMMM 1 001 0001 0000 RR RR

Arithmetic and Logic Instructions:

Instruction:	Example:	Meaning:	Machine Language Instruction:
ADD [REG1] [REG2] [REG3] SUB [REG1] [REG2] [REG3] AND [REG1] [REG2] [REG3] OR [REG1] [REG2] [REG3]	ADD R3 R2 R1 SUB R3 R1 R0 AND R0 R3 R1 OR R2 R2 R3	R3 = R2 + R1 R3 = R1 - R0 R0 = R3 & R1 R2 = R2 | R3	1 010 0001 00 RR RR RR 1 010 0010 00 RR RR RR 1 010 0011 00 RR RR RR 1 010 0100 00 RR RR RR

Branching Instructions:

Instruction:	Example:	Meaning:	Machine Language Instruction:
BRANCH [MEM] BZERO [MEM] BNEG [MEM]	BRANCH 10 BZERO 2 BNEG 7	PC = 10 PC = 2 IF ALU RESULT IS ZERO PC = 7 IF ALU RESULT IS NEGATIVE	0 000 0001 000 MMMMM 0 000 0010 000 MMMMM 0 000 0011 000 MMMMM
Other Instructions:			
Instruction:	Example:	Meaning:	Machine Language Instruction:
NOP HALT	NOP HALT	Do nothing. Halt the machine.	0000 0000 0000 0000 1111 1111 1111 1111

Student Activity

1. How will you express machine level instructions?
2. How does the computer control recognize the type of instruction?
3. Describe various types of machine level instructions.
4. Describe the addressing mode of computer instructions.

Instruction Set Selection

Copy from page-30, MCA-204, GJU
(While designing …….. upto 4 points, before timing and control)

Instructions on a RISC architecture are structured in a systematic way. They can be categorized into ALU operations, memory operations, and control operations. ALU operations always work on registers, and every register from the register set can be addressed by every ALU operation. Memory operations move values between the register set and memory. This structure makes instruction selection relatively easy, and the Java data types map 1:1 to the instruction architecture.

The optimal selection of instructions is more complex on x86 than it is on Alpha for the following reasons:

- *Different addressing modes:* Because a lot of operations exist in different addressing modes, unlike a RISC processor, the correct kind of instruction needs to be chosen in order to avoid any additional instructions for moving values. For example if the values for an addition operation are in a memory and in a register

the instruction selection algorithm always picks an add instruction that adds a memory and a register location.

- *Limited set of registers per instruction:* When picking the next instruction, the code generator always checks in which registers the current values are in and chooses the instruction appropriately. If the current register allocation doesn't fit to the instruction at all, values need to be moved. This scheme could be improved with more global analysis, but at the expense of a larger compile-time cost.
- *Efficient 64-bit operations:* The Java bytecode contains 64-bit integer and floating-point operations that the x86 platform needs to support. For each of these bytecode operations the number of temporary registers and the amount of memory accesses need to be minimized. For example, the following code is one possible implementation of the `add` (64-bit integer addition) bytecode instruction.
- `mov 0x0(%esp,1),%eax`
- `add 0x8(%esp,1),%eax`
- `mov 0x4(%esp,1),%ecx`
- `adc 0x10(%esp,1),%ecx`

Timing and control

Copy from page-30, MCA-204, GJU

Instruction Cycle

Copy from page-63-64, Instruction Cycle, MCA-301, PTU

Execution Cycle

Copy from page-50 to 54, (Instruction Execution), BSIT-301, PTU

Student Activity

1. Define an instruction cycle. Describe its various parts.
2. While designing the instruction set of a computer, what are the important things to be kept in mind? When is a set of instructions said to be complete?
3. Describe the execution cycle of an instruction.

Summary

- Our computer system consists of software and hardware. Software, or program enables a computer to perform specific tasks, as opposed to the physical components of the system (*hardware*).
- **Computer hardware** is the physical part of a computer, including the digital circuitry, as distinguished from the computer software that executes within the hardware.
- **Computer architecture** is defined as the science and art of selecting and interconnecting hardware components to create computers that meet functional, performance and cost goals.
- **A** computer architecture is considered as a series of abstraction layers: hardware, firmware, assembler, kernel, operating system and applications
- (copy summary from page-33, MCA-204, GJU)

- A program has a sequence of instructions which gets executed through a cycle , called instruction cycle. The basic parts of and instruction cycle include fetch, decode, read the effective address from memory and execute.

Keywords

Copy the following from page-33, MCA-204, GJU

- Instruction code
- Computer register
- System bus
- External bus
- Input/Output
- Interrupt

Copy the following from page-69, MCA-301, PTU

- Common Bus
- Fetch
- Control Flow Chart

Review Questions

1. Define software and hardware.
2. Describe the function of firmware.
3. What is the role of kernel.
4. What are applications?
5. Describe various machine language instructions.
6. Give different phases of instruction cycle.
7. What is the significance of instruction?
8. How are computer instructions identified.
9. What do you understand by the term instruction code?
10. Describe the time and control of instructions.

Further Readings

Copy from page-34, MCA-204, GJU

Unit-2
Control Unit and Microprogramming

Learning Objectives
After completion of this unit, you should be able to :

- describe control unit
- describe data path and control path design
- describe microprogramming
- comparing microprogramming and hardwired control
- comparing RISC and CISC architecture
- Describe pipelining in CPU Design
- Describe superscalar processors

Introduction
Copy from page-97-98, MCA-301, PTU

Control Unit

As the name suggests, a control unit is used to control something. In this case, the control unit provides instructions to the other CPU devices (previously listed) in a way that causes them to operate coherently to achieve some goal as shown in Fig. (2.1). Basically, there is one control unit, because two control units may cause conflict. The control unit of a simple CPU performs the FETCH / DECODE / EXECUTE / WRITEBACK von Neumann sequence.

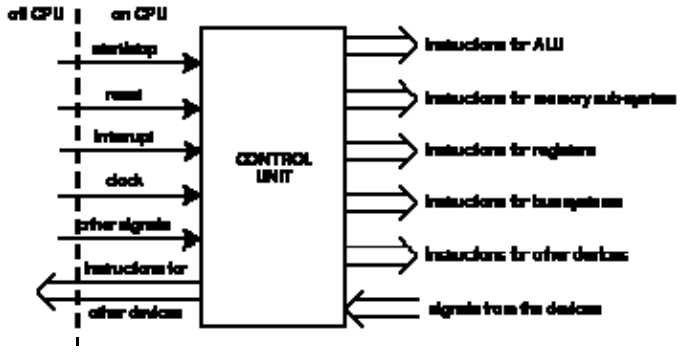

Figure 2.1: A general control unit.

To describe how the CPU works we may describe what signals the control unit issues and when. Clearly these instructions are more complicated than those that the control unit receives as input. Thus the control unit must store the instructions within itself, perhaps using a memory or perhaps in the form of a complicated network.

In either case, let us describe what the control unit does in terms of a program (for ease of understanding) called the *micro-program*, consisting naturally of *micro-instructions*. Let the micro-program be stored in a *micro-memory*.

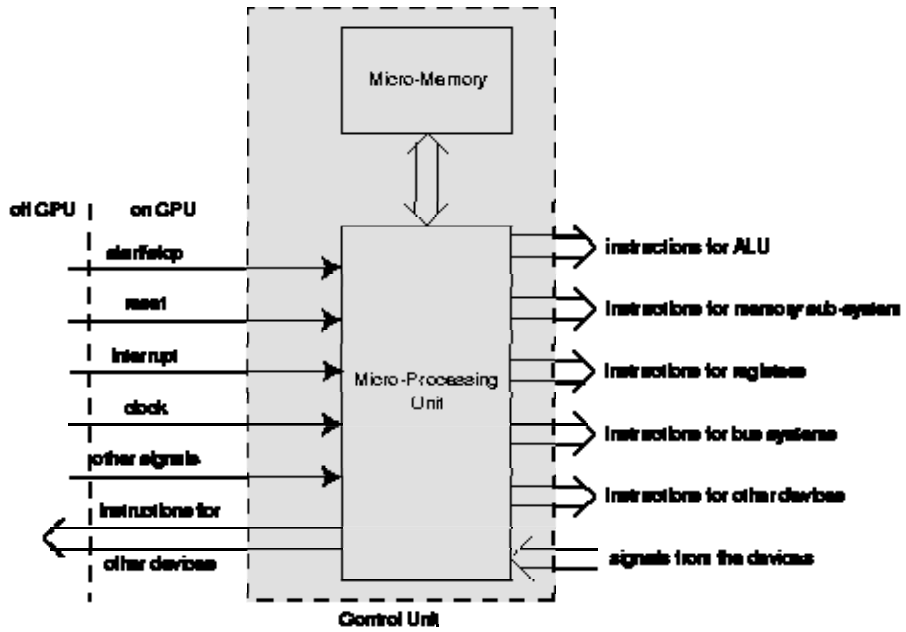

Figure 2.2: Micro-architectural view of the control unit.

The control unit may not be micro-programmed, however we can still use micro-instructions to indicate what the control unit is doing. In this case we take a logical view of the control unit. The possible instructions are dictated by the architecture of the CPU. Different architectures allow for different instructions and this is a major concept to consider when examining CPU design and operation. We are not interested in design in this subject, but we concentrate on operation.

Basic control unit operation

You should recall that the basic operation of the CPU is described by the FETCH / DECODE / EXECUTE / WRITEBACK sequence. The control unit is used to implement this sequence using a micro-program. Of the following registers, the first two are a normally only available to the control unit.

- *Instruction Register*, ***IR***: Stores the number that represents the *machine* instruction the Control Unit is to execute. (note that this is not the micro-instruction)

- *Program Counter,* PC: Stores the number that represents the address of the next instruction to execute (found in memory).
- *General Purpose Registers*: Examples are A, B, Acc, X, Y, to store intermediate results of execution.

Consider the example of a $PDP8$as shown in Fig. (2.3). The control unit is not shown.

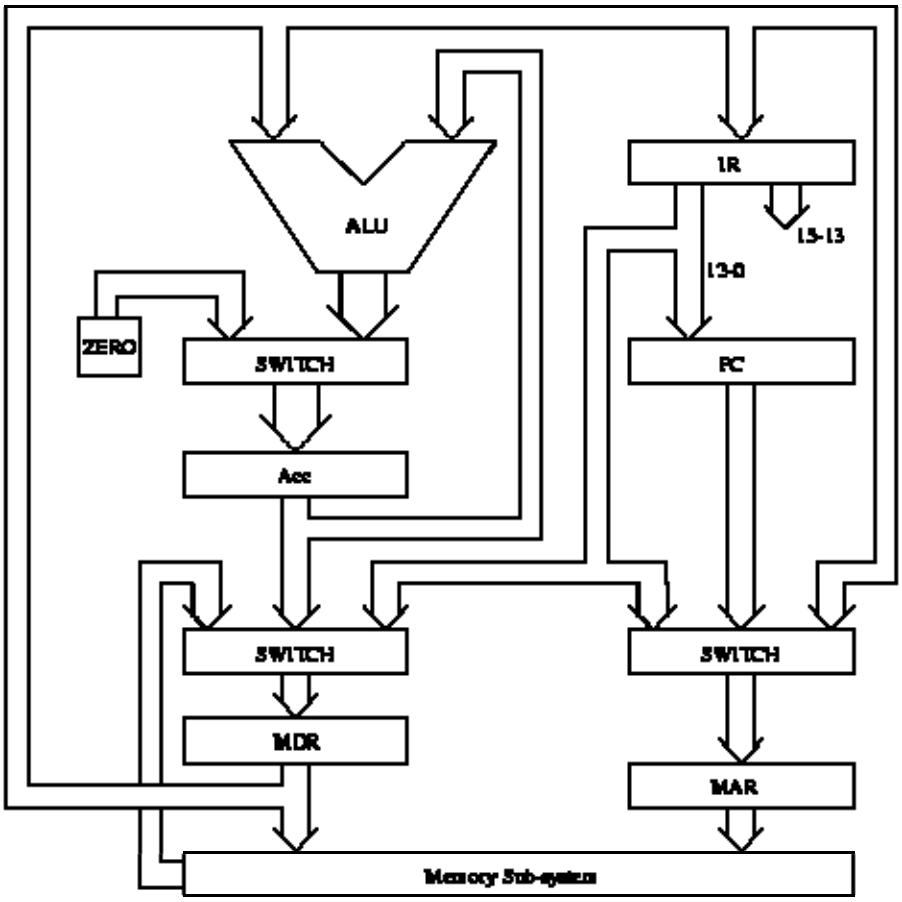

Figure 2.3: PDP8 micro-architecture.

Modern computers are more complex, but the operation is essentially the same. First consider the micro-program executed by the Control Unit to provide the FETCH:

1. $\{PC \rightarrow MAR\}$
2. $\{READ\}$
3. $\{MDR \rightarrow IR, PC + 1 \rightarrow PC\}$

Note the first line may be written $\{PC \rightarrow SWITCH, SWITCH \rightarrow MAR\}$, but in this case the path is inferred from the diagram. The second line instructs the memory sub-system to retrieve the contents of the memory at address given by MAR, the contents is put into MDR. The third line does two things at the same time, moves the MDR into the IR for DECODING and EXECUTING plus it instructs the PC to increase by 1, so as to point to the next instruction for execution. This increment instruction is available for some registers like the PC. The ALU does not have to be used in this case. Consider some more small examples of micro-programs which use the PDP8 micro-architecture.

Example zero into the Acc register:

1. $\{ZERO \rightarrow Acc\}$

□

Example the contents of the Acc to the MDR and put the result in the Acc.

1. $\{MDR \rightarrow ALU, Acc \rightarrow ALU, ADD\}$
2. $\{ALU \rightarrow Acc\}$

□

Example the two's complement of Acc.

1. $\{Acc \rightarrow ALU, COM\}$
2. $\{ALU \rightarrow Acc\}$

□

Example the Acc to obtain the next instruction.

1. $\{Acc \rightarrow MDR, MDR \rightarrow MAR\}$
2. $\{FETCH\}$

Where $FETCH$ is previously defined. □

Function of Control Unit

Copy from page-36, (third para after figure)
The function of a Control unit in a digital system …… upto page -37, Student activity-1, MCA-204, GJU

Data path and control path design

A stored program computer consists of a p*rocessing unit* and an attached *memory system*. Commands that instruct the processor to perform certain operations are placed in the memory along with the data items to be operated on. The processing unit consists of d*ata-path* and *control*. The data-path contains *registers* to hold data and *functional units*, such as arithmetic logic units and shifters, to operate on data. The control unit is little more than a finite state machine that sequences through its states to

(1) fetch the next instruction from memory,
(2) decode the instruction to interpret its meaning, and
(3) execute the instruction by moving and/or operating on data in the registers and functional units of the data-path.

The critical design issues for a data-path are how to "wire" the various components together to minimize hardware complexity and the number of control states to complete a typical operation. For control, the issue is how to organize the relatively complex "instruction interpretation" finite state machine.

Microprogramming

Copy from page-102 to page-111, upto student activity, MCA-301, PTU

RISC Vs. CISC

Copy overview of RISC/CISC from page-111

Reduced Instruction Set Computer (RISC)
Copy section 4.3, page-38, MCA-204, GJU

RISC Characteristics
Copy from page-112, MCA-301, PTU

RISC Design Philosophy

Copy section-7.4, page-60 to 62, upto student activity-2, MCA-204, GJU

Complex Instruction Set Computer (CISC)

CISC, which stands for **Complex Instruction Set Computer**, is a philosophy for designing chips that are easy to program and which make efficient use of memory. Each instruction in a CISC instruction set might perform a series of operations inside the processor. This reduces the number of instructions required to implement a given program, and allows the programmer to learn a small but flexible set of instructions.

Since the earliest machines were programmed in assembly language and memory was slow and expensive, the CISC philosophy made sense, and was commonly implemented in such large computers as the PDP-11 and the DECsystem 10 and 20 machines.

Most common microprocessor designs --- including the Intel(R) 80x86 and Motorola 68K series --- also follow the CISC philosophy.

The advantages of CISC

At the time of their initial development, CISC machines used available technologies to optimize computer performance.

- Microprogramming is as easy as assembly language to implement, and much less expensive than hardwiring a control unit.
- The ease of microcoding new instructions allowed designers to make CISC machines upwardly compatible: a new computer could run the same programs as earlier computers because the new computer would contain a superset of the instructions of the earlier computers.
- As each instruction became more capable, fewer instructions could be used to implement a given task. This made more efficient use of the relatively slow main memory.
- Because microprogram instruction sets can be written to match the constructs of high-level languages, the compiler does not have to be as complicated.

The disadvantages of CISC

Still, designers soon realized that the CISC philosophy had its own problems, including:

- Earlier generations of a processor family generally were contained as a subset in every new version --- so instruction set & chip hardware become more complex with each generation of computers.
- So that as many instructions as possible could be stored in memory with the least possible wasted space, individual instructions could be of almost any length---this means that different instructions will take different amounts of clock time to execute, slowing down the overall performance of the machine.
- Many specialized instructions aren't used frequently enough to justify their existence --- approximately 20% of the available instructions are used in a typical program.
- CISC instructions typically set the condition codes as a side effect of the instruction. Not only does setting the condition codes take time, but programmers have to remember to examine the condition code bits before a subsequent instruction changes them.

A CISC Microprocessor-the Motorola MC68000

Copy from page-62 to 67, upto student activity-4, MCA-204, GJU

THE Bridge from CISC to RISC

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Pipelining in CPU Design

Copy section-6.2, page-50 to page-53, before student activity-1, MCA-204, GJU

A Typical Pipeline

Consider the steps necessary to do a generic operation:

- Fetch opcode.
- Decode opcode and (in parallel) prefetch a possible displacement or constant operand (or both)
- Compute complex addressing mode (e.g., [ebx+xxxx]), if applicable.
- Fetch the source value from memory (if a memory operand) and the destination register value (if applicable).
- Compute the result.
- Store result into destination register.

Assuming you're willing to pay for some extra silicon, you can build a little "mini-processor" to handle each of the above steps. The organization would look something like Figure 2.5.

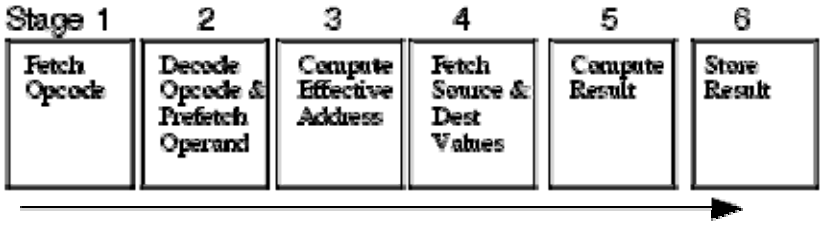

Figure 2.5 A Pipelined Implementation of Instruction Execution

Note how we've combined some stages from the previous section. For example, in stage four of Figure 2.5 the CPU fetches the source and destination operands in the same step. You can do this by putting multiple data paths inside the CPU (e.g., from the registers to

the ALU) and ensuring that no two operands ever compete for simultaneous use of the data bus (i.e., no memory-to-memory operations).

If you design a separate piece of hardware for each stage in the pipeline above, almost all these steps can take place in parallel. Of course, you cannot fetch and decode the opcode for more than one instruction at the same time, but you can fetch one opcode while decoding the previous instruction. If you have an n-stage pipeline, you will usually have n instructions executing concurrently.

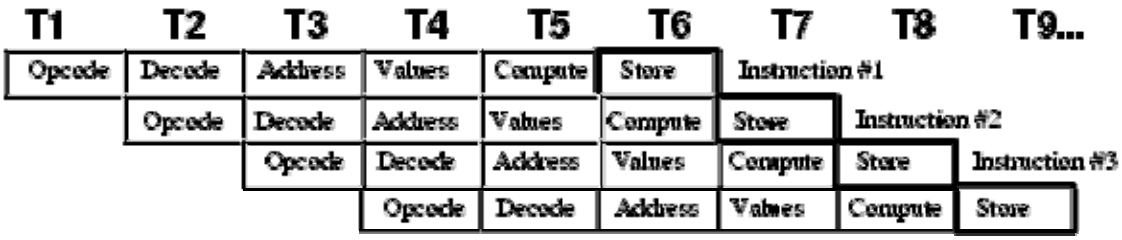

Figure 2.6 Instruction Execution in a Pipeline

Figure 2.6 shows pipelining in operatoin. T1, T2, T3, etc., represent consecutive "ticks" of the system clock. At T=T1 the CPU fetches the opcode byte for the first instruction.

At T=T2, the CPU begins decoding the opcode for the first instruction. In parallel, it fetches a block of bytes from the prefetch queue in the event the instruction has an operand. Since the first instruction no longer needs the opcode fetching circuitry, the CPU instructs it to fetch the opcode of the second instruction in parallel with the decoding of the first instruction. Note there is a minor conflict here. The CPU is attempting to fetch the next byte from the prefetch queue for use as an operand, at the same time it is fetching operand data from the prefetch queue for use as an opcode. How can it do both at once? You'll see the solution in a few moments.

At T=T3 the CPU computes an operand address for the first instruction, if any. The CPU does nothing on the first instruction if it does not use an addressing mode requiring such computation. During T3, the CPU also decodes the opcode of the second instruction and fetches any necessary operand. Finally the CPU also fetches the opcode for the third instruction. With each advancing tick of the clock, another step in the execution of each instruction in the pipeline completes, and the CPU fetches yet another instruction from memory.

This process continues until at T=T6 the CPU completes the execution of the first instruction, computes the result for the second, etc., and, finally, fetches the opcode for the sixth instruction in the pipeline. The important thing to see is that after T=T5 the CPU completes an instruction on every clock cycle. Once the CPU fills the pipeline, it completes one instruction on each cycle. Note that this is true even if there are complex addressing modes to be computed, memory operands to fetch, or other operations which use cycles on a non-pipelined processor. All you need to do is add more stages to the pipeline, and you can still effectively process each instruction in one clock cycle.

A bit earlier you saw a small conflict in the pipeline organization. At T=T2, for example, the CPU is attempting to prefetch a block of bytes for an operand and at the same time it is trying to fetch the next opcode byte. Until the CPU decodes the first instruction it doesn't know how many operands the instruction requires nor does it know their length. However, the CPU needs to know this information to determine the length of the instruction so it knows what byte to fetch as the opcode of the next instruction. So how can the pipeline fetch an instruction opcode in parallel with an address operand?

One solution is to disallow this. If an instruction as an address or constant operand, we simply delay the start of the next instruction (this is known as a *hazard* as you shall soon see). Unfortunately, many instructions have these additional operands, so this approach will have a substantial negative impact on the execution speed of the CPU.

The second solution is to throw (a lot) more hardware at the problem. Operand and constant sizes usually come in one, two, and four-byte lengths. Therefore, if we actually fetch three bytes from memory, at offsets one, three, and five, beyond the current opcode we are decoding, we know that one of these bytes will probably contain the opcode of the next instruction. Once we are through decoding the current instruction we know how long it will be and, therefore, we know the offset of the next opcode. We can use a simple data selector circuit to choose which of the three opcode bytes we want to use.

In actual practice, we have to select the next opcode byte from more than three candidates because 80x86 instructions take many different lengths. For example, an instruction that moves a 32-bit constant to a memory location can be ten or more bytes long. And there are instruction lengths for nearly every value between one and fifteen bytes. Also, some opcodes on the 80x86 are longer than one byte, so the CPU may have to fetch multiple bytes in order to properly decode the current instruction. Nevertheless, by throwing more hardware at the problem we can decode the current opcode at the same time we're fetching the next.

Stalls in a Pipeline

Unfortunately, the scenario presented in the previous section is a little too simplistic. There are two drawbacks to that simple pipeline: bus contention among instructions and non-sequential program execution. Both problems may increase the average execution time of the instructions in the pipeline.

Bus contention occurs whenever an instruction needs to access some item in memory. For example, if a "mov(reg, mem);" instruction needs to store data in memory and a "mov(mem, reg);" instruction is reading data from memory, contention for the address and data bus may develop since the CPU will be trying to simultaneously fetch data and write data in memory.

One simplistic way to handle bus contention is through a *pipeline stall*. The CPU, when faced with contention for the bus, gives priority to the instruction furthest along in the pipeline. The CPU suspends fetching opcodes until the current instruction fetches (or stores) its operand. This causes the new instruction in the pipeline to take two cycles to execute rather than one (see Figure 2.7).

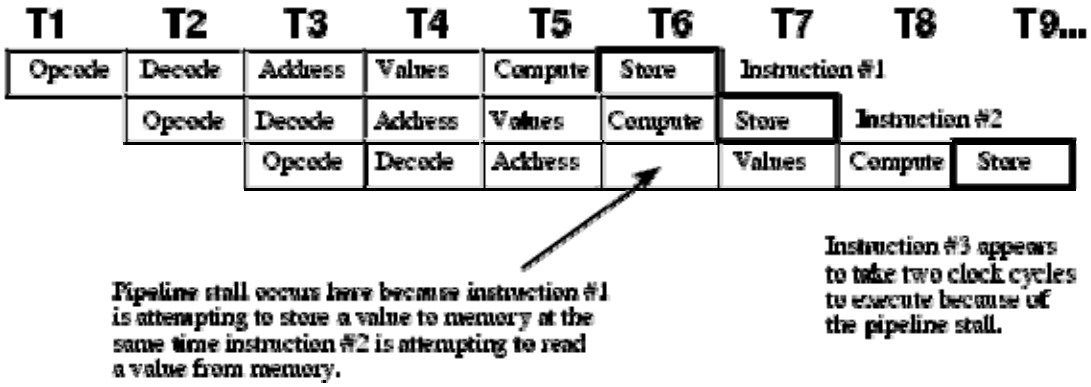

Figure 2.7 A Pipeline Stall

This example is but one case of bus contention. There are many others. For example, as noted earlier, fetching instruction operands requires access to the prefetch queue at the same time the CPU needs to fetch an opcode. Given the simple scheme above, it's unlikely that most instructions would execute at one clock per instruction (CPI).

Fortunately, the intelligent use of a cache system can eliminate many pipeline stalls like the ones discussed above. The next section on caching will describe how this is done. However, it is not always possible, even with a cache, to avoid stalling the pipeline. What you cannot fix in hardware, you can take care of with software. If you avoid using memory, you can reduce bus contention and your programs will execute faster. Likewise, using shorter instructions also reduces bus contention and the possibility of a pipeline stall.

What happens when an instruction *modifies* the EIP register? This, of course, implies that the next set of instructions to execute do not immediately follow the instruction that modifies EIP. By the time the instruction

```
JNZ             Label;
```

completes execution (assuming the zero flag is clear so the branch is taken), we've already started five other instructions and we're only one clock cycle away from the completion of the first of these. Obviously, the CPU must not execute those instructions or it will compute improper results.

The only reasonable solution is to *flush* the entire pipeline and begin fetching opcodes anew. However, doing so causes a severe execution time penalty. It will take six clock cycles (the length of the pipeline in our examples) before the next instruction completes execution. Clearly, you should avoid the use of instructions which interrupt the sequential execution of a program. This also shows another problem - pipeline length. The longer the pipeline is, the more you can accomplish per cycle in the system. However, lengthening a pipeline may slow a program if it jumps around quite a bit. Unfortunately, you cannot control the number of stages in the pipeline. You can, however, control the number of transfer instructions which appear in your programs. Obviously you should keep these to a minimum in a pipelined system.

Student Activity

Copy student activity from page-53, MCA-204, GJU

5. Describe various stalls of pipelining.

Superscalar processors

Superscalar is a term coined in the late 1980s. Superscalar processors arrived as the RISC movement gained widespread acceptance, and RISC processors are particularly suited to superscalar techniques. However, the approach can be used on non-RISC processors (e.g. Intel's P6-based processors, the Pentium 4, and AMD's IA32 clones.), with considerable effort. All current desktop and server market processors are now superscalar.

The idea, basically, is: as a logical development of pipelined design, where a new instruction starts on successive machine cycles, start up a number of machine instructions on the *same* machine cycle. By taking advantage of available memory bandwidth (*if* it is available), fetch a number of instructions simultaneously, and start executing them. [In practice, instructions need to be in a dedicated high-speed cache to be available at a high enough rate for this to work.]

The development of superscalar from 'vanilla' pipelining came about via more sophisticated, though still non-superscalar, pipelining technologies - most of which were seen on supercomputers from the mid 60s onwards. However, true superscalar processors are a concept that is unique to microprocessor-based systems.

The first developmental step is to observe that as resources grew in availability, high-performance computer systems (we are really talking about the most powerful machines of their day - Control Data 6600 and 7600, Cray-1, top-of-the-range IBM mainframes) started to acquire dedicated hardware to execute different types of instruction. So for example there may be separate execution units (EX) for floating point and integer operations. See fig 2.11.

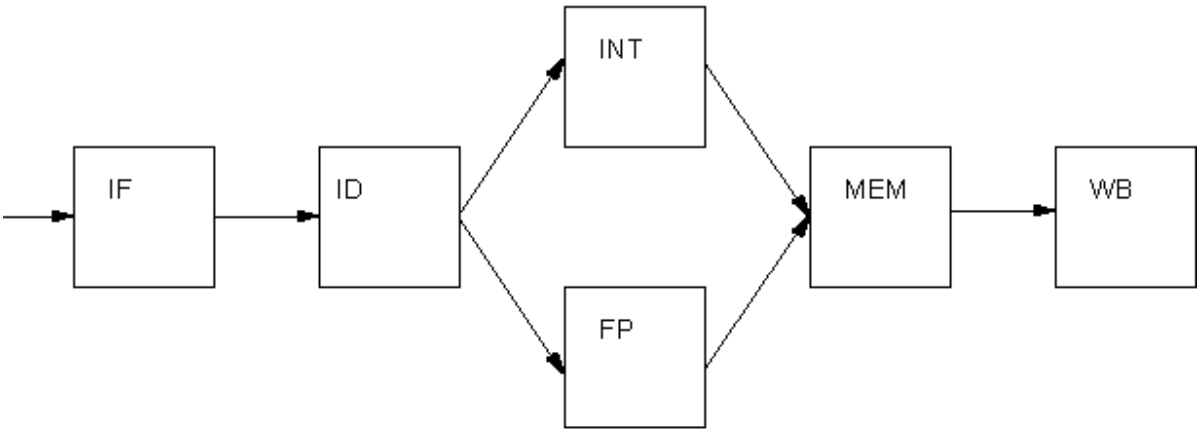

Fig.2.11. Multiple Execution Units

Once instructions had been decoded, they would be sent to the appropriate execution unit. In general, floating point operations are more complex than integer ones (though integer multiply/divide can also be time consuming), and an FP unit would be broken down into further pipeline stages. Suppose we have an FP operation followed by an integer one. Our basic pipeline would simply halt execution until the FP operation had exited the EX phase, effectively stalling the pipeline because the FP EX stage takes several cycles. However, there is no real need to [always] do that. We could allow the following integer operation to enter the Integer EX unit. Since integer operations typically take quite a bit less time than FP ones, this means that the integer result may well be available *before* the FP one that *preceeded* it in program

order. This is known as *out-of-order completion*, and brings potential performance benefits as well as big problems, as we will see.

A further step would be to observe that now we have admitted the possibility of at least partially executing instructions out of program order, we have a potential mechanism for reducing the impact of data dependencies (i.e. pipeline stalling). Instead of just leaving a pipeline idle while we are waiting for a dependency to resolve, we could pick other, later instructions and execute them instead. We have moved from a situation, with the simple pipeline, where instructions are *statically scheduled* or ordered, by the compiler, to one where they may be *dynamically scheduled* by the hardware. (Actually, the situation is a bit more complex than this and we will return to it below.)

Superscalar Concept

As resources continued to grow, yet more execution units could be made available. What is more, these would often be *duplicates*: there might be two integer units, and two FP units, and perhaps others (for example, to handle memory accesses). To justify the existence of such a large number of execution units, it may no longer sufficient to simply attempt to fetch and decode a single instruction at a time. It is necessary to also attempt to fetch, decode and write back multiple instructions as well - see fig 2.

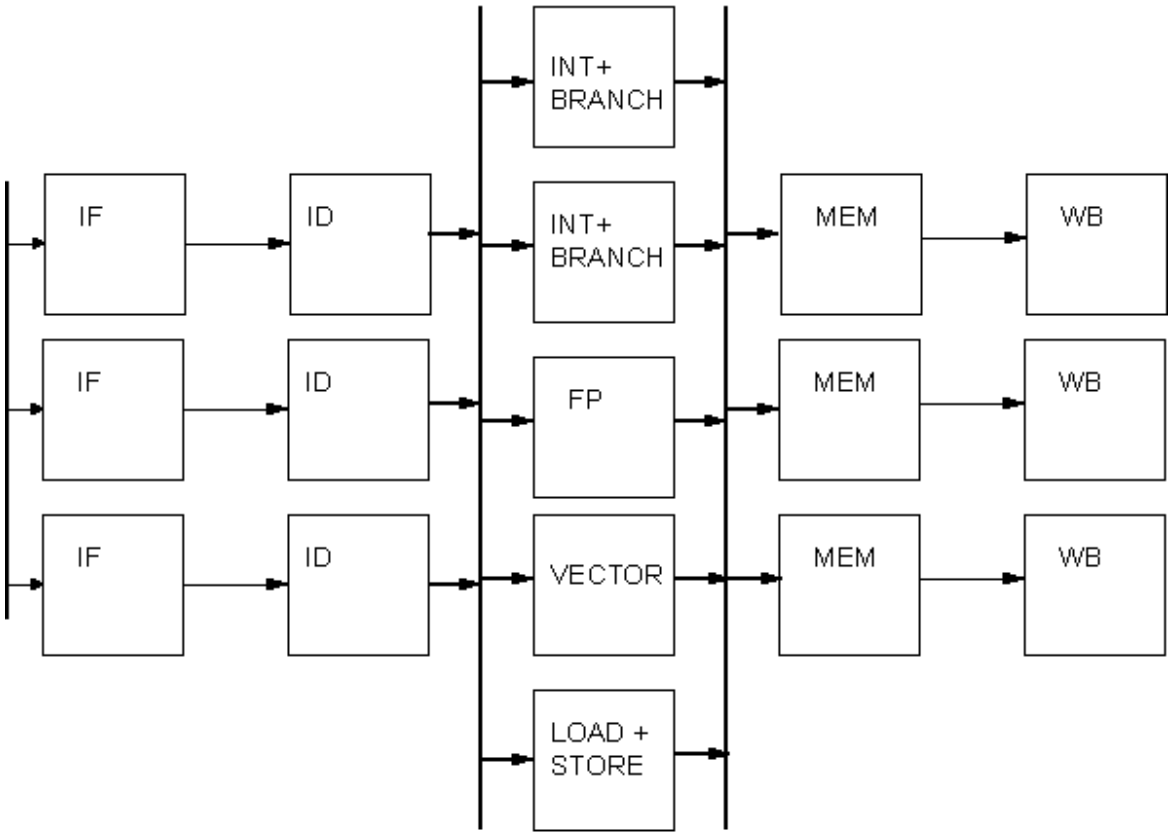

Fig.2.12. Basic Superscalar Structure

Note however that it is *not* the case that we would typically be able to fetch, decode etc. as many instructions as there are execution units - for example, in fig 2.12 most of the pipeline can handle three instructions, but there are five execution units.

We can ask ourselves: how many instructions can we profitably attempt to execute in parallel? Like less sophisticated pipelined machines, there seem to be limits on the number of instructions that can effectively be executed in parallel, before speed-up advantages become small - typically, between 2 and 8. All current superscalar machines lie within this band (for example, P6-derived processors and the Pentium 4 have three parallel pipelines). However, techniques are being looked at - and some workers are optimistic - that *may* increase this dramatically. It has to be said though that other workers are very pessimistic. A processor that attempts to execute n instructions simultaneously is said to be of degree n, or n-way. Of course, a superscalar processor will be pipelined as well: for example, a Pentium 3 has 14 pipeline stages. as well as being degree 3. Notice that a key word is 'attempts': there is

no guarantee that a superscalar processor will succeed in executing as many instructions as is, in principle, possible.

Before proceeding, we will define some useful terminology and concepts. The key problems we have to solve when building superscalar machines concern the various data dependencies, resource conflicts, and branches (especially conditional ones). However, not all phases of instruction execution are equally affected. For example, we can happily fetch and decode instructions regardless of any dependencies. Even though we may be fetching/decoding the *wrong* instructions, doing so will not affect the state of a program. However, other phases are more critical.

- **Scheduing** - this refers to the process of deciding in what order to execute instructions. The choices are *static*, when the hardware has no control, and *dynamic*, when the hardware is permitted to re-order instructions to at least some degree.
- **Issue** - this is essentially when we *fetch operands* for an instruction. Before we do this, we must be sure that they are either actually available (that is, they have already been computed and stored - either in their final destination or at least somewhere we can access them) or we at least know where they will be available in the future. In practice, resource constraints can also stop instruction issue. In our simple five-stage pipeline, the issue phase occurs when instructions leave the decode stage and enter the execute stage. Instruction issue is generally in program order.
- **Execution** - once issued, instructions can be executed once all their operands are actually available. Execution may in program order (*in-order execution*) or out of program order (*out-of-order execution*), depending on the machine.
- **Speculation and Committal** - because we are predicting the outcome of branches (and maybe other things), we do not necessarily know for sure that when we execute an instruction we will actually end up using the result. This process is known as *speculation*. Once we for sure an instruction is going to be executed then it is *committed*, or enters the *committal phase*. The next stage is to store the result.
- **Write Back** - ultimately we must store instruction results in their final destinations. (Actually, it is possible to not do this in all cases - for example, if a result actually represents a temporary, intermediate value that will be soon overwritten. However, as we will see, this raises awkward questions when dealing with exceptions, so in general all results are stored.) This phase is known as *write back* and before proceeding we must be sure that (a) the instruction will actually be committed, and (b) the destination is free to be overwritten - that is, no other instruction is waiting to use its current value as a source operand. Note in some machines, (a) does not necessarily hold - they are prepared to write uncommitted results and then 'back out' of them later on. However, we will not deal with such machines in this module. It is relatively easy to establish (b) when the destination

is a register, but difficult when it is a memory word because of the possibility of pointers creating *aliases*.
- **Retirement or Completion** - finally, an instruction finishes and leaves the pipeline. Typically this happens immediately after write back and we say the instruction is *completed* or *retired*.

Classification

We can divided superscalar processors into a number of classes of varying complexity.

- **Static Superscalar** - these processors issue and execute instructions in program order. So for example, in a degree 2 machine, it is possible to issue and two instructions simultaneously: given instructions `i1` and `i2`, we may choose to issue both, or only `i1` (depending on the presence of hazards). We may *not* just issue `i2`. To complicate and confuse matters, because the hardware has a choice (albeit limited) about issuing instructions, we say that *instruction issue* is *dynamic*. However, the actual execution of instructions is in-order we say that scheduling is *static*.
- **Dynamic Superscalar** - these machines permit out-of-order program execution, but they generally still *issue* instructions in program order. Because we can potentially re-order execution, we now say scheduling is dynamic.
- **Dynamic with Speculation** - these machines add the ability to speculate beyond branches.

Superscalar Operation- Executing Instructions in Parallel

With the pipelined architecture we could achieve, at best, execution times of one CPI (clock per instruction). Is it possible to execute instructions faster than this? At first glance you might think, "Of course not, we can do at most one operation per clock cycle. So there is no way we can execute more than one instruction per clock cycle." Keep in mind however, that a single instruction is *not* a single operation. In the examples presented earlier each instruction has taken between six and eight operations to complete. By adding seven or eight separate units to the CPU, we could effectively execute these eight operations in one clock cycle, yielding one CPI. If we add more hardware and execute, say, 16 operations at once, can we achieve 0.5 CPI? The answer is a qualified "yes." A CPU including this additional hardware is a *superscalar* CPU and can execute more than one instruction during a single clock cycle. The 80x86 family began supporting superscalar execution with the introduction of the Pentium processor.

A superscalar CPU has, essentially, several execution units (see Figure 2.12). If it encounters two or more instructions in the instruction stream (i.e., the prefetch queue) which can execute independently, it will do so.

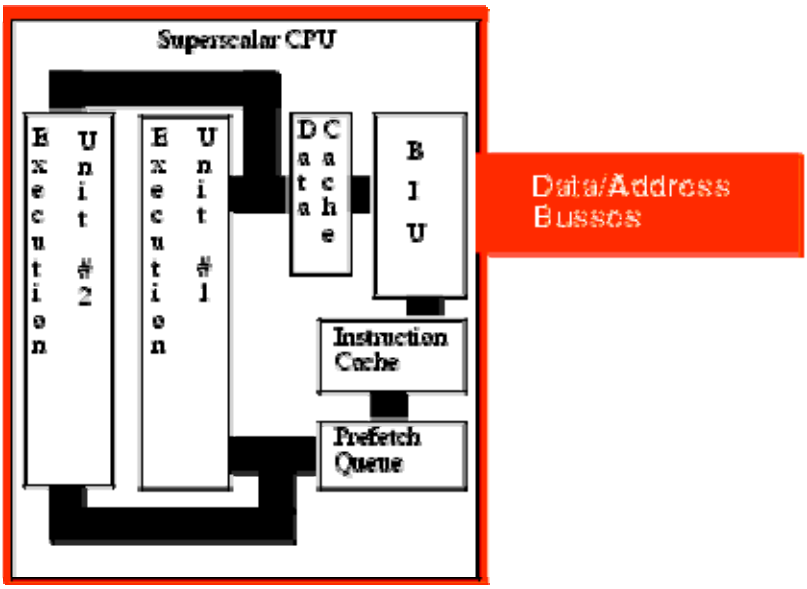

Figure 2.12 A CPU that Supports Superscalar Operation

There are a couple of advantages to going superscalar. Suppose you have the following instructions in the instruction stream:

```
mov( 1000, eax );

mov( 2000, ebx );
```

If there are no other problems or hazards in the surrounding code, and all six bytes for these two instructions are currently in the prefetch queue, there is no reason why the CPU cannot fetch and execute both instructions in parallel. All it takes is extra silicon on the CPU chip to implement two execution units.

Besides speeding up independent instructions, a superscalar CPU can also speed up program sequences that have hazards. One limitation of superscalar CPU is that once a hazard occurs, the offending instruction will completely stall the pipeline. Every instruction which follows will also have to wait for the CPU to synchronize the execution of the instructions. With a superscalar CPU, however, instructions following the hazard may continue execution through the pipeline as long as they don't have hazards of their own. This alleviates (though does not eliminate) some of the need for careful instruction scheduling.

As an assembly language programmer, the way you write software for a superscalar CPU can dramatically affect its performance. First and foremost is that rule you're probably sick of by now: *use short instructions*. The shorter your instructions are, the more instructions the CPU can fetch in a single operation and, therefore, the more likely the CPU will execute faster than one CPI. Most superscalar CPUs do not completely duplicate the execution unit. There might be multiple ALUs, floating point units, etc. This means that certain instruction sequences can execute very quickly while others won't. You have to study the exact composition of your CPU to decide which instruction sequences produce the best performance.

Out of Order Execution

In a standard superscalar CPU it is the programmer's (or compiler's) responsibility to schedule (arrange) the instructions to avoid hazards and pipeline stalls. Fancier CPUs can actually remove some of this burden and improve performance by automatically rescheduling instructions while the program executes. To understand how this is possible, consider the following instruction sequence:

```
mov( SomeVar, ebx );

mov( [ebx], eax );

mov( 2000, ecx );
```

A data hazard exists between the first and second instructions above. The second instruction must delay until the first instruction completes execution. This introduces a pipeline stall and increases the running time of the program. Typically, the stall affects every instruction that follows. However, note that the third instruction's execution does not depend on the result from either of the first two instructions. Therefore, there is no reason to stall the execution of the "mov(2000, ecx);" instruction. It may continue executing while the second instruction waits for the first to complete. This technique, appearing in later members of the Pentium line, is called "out of order execution" because the CPU completes the execution of some instruction prior to the execution of previous instructions appearing in the code stream.

Clearly, the CPU may only execute instruction out of sequence if doing so produces exactly the same results as in-order execution. While there a lots of little technical issues that make this problem a little more difficult than it seems, with enough engineering effort it is quite possible to implement this feature.

Although you might think that this extra effort is not worth it (why not make it the programmer's or compiler's responsibility to schedule the instructions) there are some situations where out of order execution will improve performance that static scheduling could not handle.

Register Renaming

One problem that hampers the effectiveness of superscalar operation on the 80x86 CPU is the 80x86's limited number of general purpose registers. Suppose, for example, that the CPU had four different pipelines and, therefore, was capable of executing four instructions simultaneously. Actually achieving four instructions per clock cycle would be very difficult because most instructions (that can execute simultaneously with other instructions) operate on two register operands. For four instructions to execute concurrently, you'd need four separate destination registers and four source registers (and the two sets of registers must be disjoint, that is, a destination register for one instruction cannot be the source of another). CPUs that have lots of registers can handle this task quite easily, but the limited register set of the 80x86 makes this difficult. Fortunately, there is a way to alleviate part of the problem: through *register renaming*.

Register renaming is a sneaky way to give a CPU more registers than it actually has. Programmers will not have direct access to these extra registers, but the CPU can use these additional register to prevent hazards in certain cases. For example, consider the following short instruction sequence:

```
mov( 0, eax );

mov( eax, i );

mov( 50, eax );

mov( eax, j );
```

Clearly a data hazard exists between the first and second instructions and, likewise, a data hazard exists between the third and fourth instructions in this sequence. Out of order execution in a superscalar CPU would normally allow the first and third instructions to execute concurrently and then the second and fourth instructions could also execute concurrently. However, a data hazard, of sorts, also exists between the first and third instructions since they use the same register. The programmer could have easily solved this problem by using a different register (say EBX) for the third and fourth instructions. However, let's assume that the programmer was unable to do this because the other registers are all holding important values. Is this sequence doomed to executing in four cycles on a superscalar CPU that should only require two?

One advanced trick a CPU can employ is to create a bank of registers for each of the general purpose registers on the CPU. That is, rather than having a single EAX register, the CPU could support an array of EAX registers; let's call these registers EAX[0], EAX[1], EAX[2], etc. Similarly, you could have an array of each of the registers, so we could also have EBX[0]..EBX[n], ECX[0]..ECX[n], etc. Now the instruction set does not give the programmer the ability to select one of these specific register array elements for a given instruction, but the CPU can automatically choose a different register array

element if doing so would not change the overall computation and doing so could speed up the execution of the program. For example, consider the following sequence (with register array elements automatically chosen by the CPU):

```
mov( 0, eax[0] );
mov( eax[0], i );
mov( 50, eax[1] );
mov( eax[1], j );
```

Since EAX[0] and EAX[1] are different registers, the CPU can execute the first and third instructions concurrently. Likewise, the CPU can execute the second and fourth instructions concurrently.

The code above provides an example of *register renaming*. Dynamically, the CPU automatically selects one of several different elements from a register array in order to prevent data hazards. Although this is a simple example, and different CPUs implement register renaming in many different ways, this example does demonstrate how the CPU can improve performance in certain instances through the use of this technique.

Very Long Instruction Word Architecture (VLIW)

Superscalar operation attempts to schedule, in hardware, the execution of multiple instructions simultaneously. Another technique that Intel is using in their IA-64 architecture is the use of very long instruction words, or VLIW. In a VLIW computer system, the CPU fetches a large block of bytes (41 in the case of the IA-64 Itanium CPU) and decodes and executes this block all at once. This block of bytes usually contains two or more instructions (three in the case of the IA-64). VLIW computing requires the programmer or compiler to properly schedule the instructions in each block (so there are no hazards or other conflicts), but if properly scheduled, the CPU can execute three or more instructions per clock cycle.

The Intel IA-64 Architecture is not the only computer system to employ a VLIW architecture. Transmeta's Crusoe processor family also uses a VLIW architecture. The Crusoe processor is different than the IA-64 architecture insofar as it does not support native execution of IA-32 instructions. Instead, the Crusoe processor dynamically translates 80x86 instructions to Crusoe's VLIW instructions. This "code morphing" technology results in code running about 50% slower than native code, though the Crusoe processor has other advantages.

We will not consider VLIW computing any further since the IA-32 architecture does not support it. But keep this architectural advance in mind if you move towards the IA-64 family or the Crusoe family.

Student Activity

1. What are superscalar processors?
2. Describe various types of superscalar processors.
3. What are the problems associated with superscalar processors?

Summary

Copy section 5.6 from page-48, MCA-204, GJU
Copy first two points of summary from page-57, MCA-204,GJU

Keywords

Copy from page-48-49, MCA-204, GJU
Copy Pipelining Processing from page-57, MCA-204, GJU

Review Questions

Copy Q-1 to 5 from page-49, MCA-204, GJU

6. Describe pipeline processing.
7. Describe Superscalar processors, their functioning and classification

Further Readings

Copy from page-58, MCA-204, GJU

Unit-3

Memory Organization

Learning Objectives

After completion of this unit, you should be able to:

- describe memory subsystem
- describe various storage technologies
- describe memory array organization
- understand memory hierarchy and interleaving
- describe cache and virtual memory
- describe various architectural aids to implement cache and virtual memory.

Introduction

Copy from page-149, MCA-301, PTU

Memory Subsystem

Copy from page-150 (Memory System), MCA-301, PTU

Storage Technologies

Copy from page-132-133 (upto Student Activity)

Memory Array Organization

A typical 80x86 processor addresses a maximum of 2^n different memory locations, where *n* is the number of bits on the address bus, as 80x86 processors have 20, 24, 32, and 36 bit address buses (with 64 bits on the way).

Of course, the first question you should ask is, "What exactly is a memory location?" The 80x86 supports *byte addressable memory*. Therefore, the basic memory unit is a byte. So with 20, 24, 32, and 36 address lines, the 80x86 processors can address one megabyte, 16 megabytes, four gigabytes, and 64 gigabytes of memory, respectively.

Think of memory as a linear array of bytes. The address of the first byte is zero and the address of the last byte is 2^n-1. For an 8088 with a 20 bit address bus, the following pseudo-Pascal array declaration is a good approximation of memory:

Memory: array [0..1048575] of byte;

To execute the equivalent of the Pascal statement "Memory [125] := 0;" the CPU places the value zero on the data bus, the address 125 on the address bus, and asserts the write line (since the CPU is writing data to memory), see Figure 1.2.

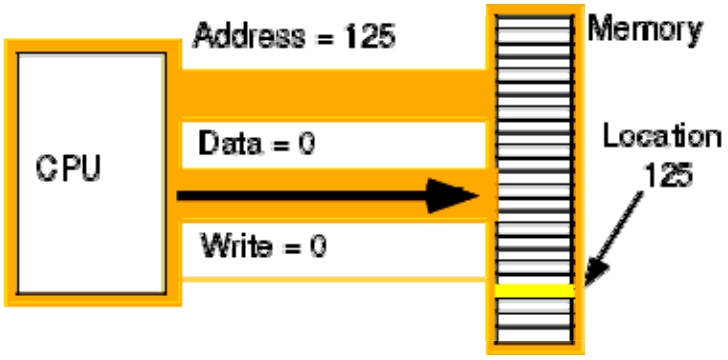

Figure 1.2 Memory Write Operation

To execute the equivalent of "CPU := Memory [125];" the CPU places the address 125 on the address bus, asserts the read line (since the CPU is reading data from memory), and then reads the resulting data from the data bus (see Figure 1.3).

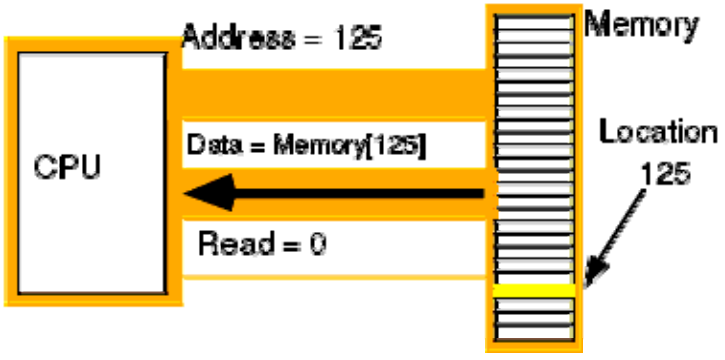

Figure 1.3 Memory Read Operation

The above discussion applies *only* when accessing a single byte in memory. So what happens when the processor accesses a word or a double word? Since memory consists of an array of bytes, how can we possibly deal with values larger than eight bits?

Different computer systems have different solutions to this problem. The 80x86 family deals with this problem by storing the L.O. byte of a word at the address specified and the H.O. byte at the next location. Therefore, a word consumes two consecutive memory addresses (as you would expect, since a word consists of two bytes). Similarly, a double word consumes four consecutive memory locations. The address for the double word is the address of its L.O. byte. The remaining three bytes follow this L.O. byte, with the H.O. byte appearing at the address of the double word *plus three* (see Figure 1.4). Bytes, words, and double words may begin at *any* valid address in memory. We will soon see, however, that starting larger objects at an arbitrary address is not a good idea.

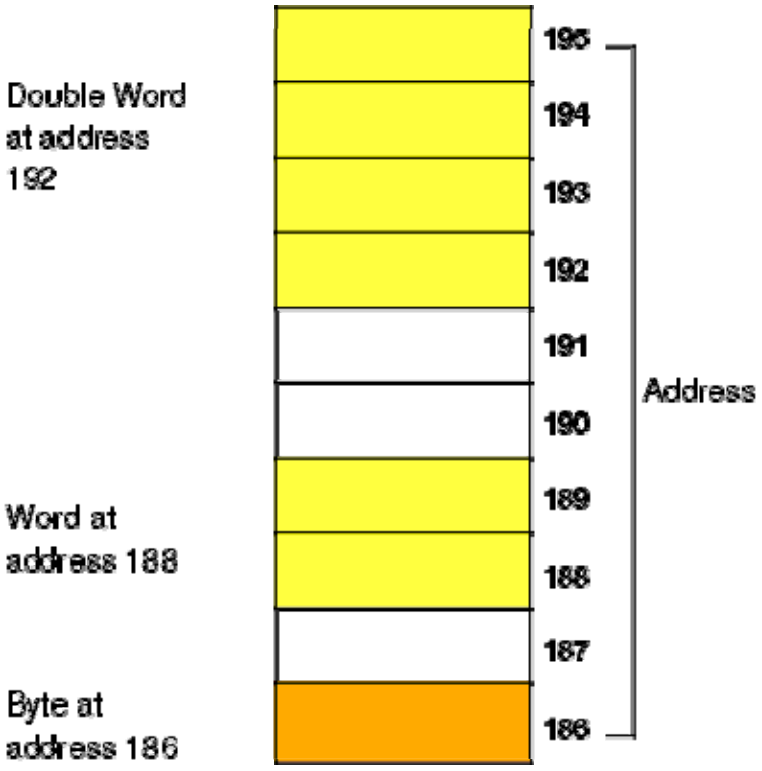

Figure 1.4 Byte, Word, and DWord Storage in Memory

Note that it is quite possible for byte, word, and double word values to overlap in memory. For example, in Figure 1.4 you could have a word variable beginning at address 193, a byte variable at address 194, and a double word value beginning at address 192. These variables would all overlap.

By carefully arranging how you use memory, you can improve the speed of your program on these CPUs.

Memory Management

Copy section 8.6 from page 74 to 87, upto student activity-2, MCA-204, GJU

Memory Hierarchy

Copy section 8.10 onwards (from page-91 to page-105), upto student activity-5, MCA-204, GJU

Cache Memory

Copy from page – 159 to 161, upto set associative mapping, MCA-301, PTU

Summary

Copy from page-105 (delete first two points), MCA-204, GJU

Key Words

Copy from page-105-106 (delete first two definitions), MCA-204, GJU

Review questions

copy question 1 to 8, from page-165, MCA-301, PTU

Further Readings

Copy from page-106, MCA-204, GJU

Unit-4
Input-Output Devices and Characteristics

Learning Objectives
After completion of this unit, you should be able to :

- describe input-output processing
- describe bus interface
- describe I/O Interrupt channels
- Describe performance evaluation-SPEC-MARKS
- Describe various benchmarks of transaction processing

Introduction
Copy from page-117 to 118 (Introduction and I/O and their brief description), MCA-301, PTU

Input-Output Processing
Copy from page-118 (I/O Processing), MCA-301, PTU

Input-Output Processor
Copy from page-139 to page-144 (upto figure-5.23), MCA-301, PTU

Bus Interface
Copy from page-118 (Bus Interface) to Student Activity, Page-129, MCA-301, PTU

I/O Interrupts Channels
Copy from page-129(Interrupt-Initiated I/O) , MCA-301, PTU

Communication between the CPU and the channel
Copy from page-73-74, MCA-204, GJU

I/O Interrupts
Copy from page-130 to 136 (before DMA), MCA-301, PTU

Student Activity
1. What is an Interrupt?
2. What is the purpose of having a channel?
3. The CPU and the channel are usually in a master-slave relationship. Explain.
4. Explain the CPU I/O instructions executed by the CPU.
5. (Copy question-1 to 5 of student activity, page-144, MCA-301, PTU)

Performance Evaluation- Benchmarks
copy from section-10.2 to section-10.4, page-114 to 118, MCA-204, GJU

Student Activity

1. Describe the following :
    (a) Spec-Mark
    (b) TPC-H
    (c) TPC-R
    (d) TPC-W

Summary

Copy from page-145, Summary (copy para 1,2 and 4 only), Page-145, MCA-301, PTU
Copy from page-118, summary, MCA-204, GJU

Keywords

Copy keywords from page-145, (Delete DMS), MCA-301, PTU
Copy keywords from page-118, MCA-204, GJU

Review Questions

Copy Q-1,2,3,5,6,7 from page-145-146, MCA-301, PTU
Copy Q-1to5 from page-118-119, MCA-204, GJU

Further Readings

Copy from page-146, MCA-301, PTU and page-119, MCA-204, GJU

UNIT 1

INTRODUCTION TO HUMAN RESOURCE MANAGEMENT

L E A R N I N G O B J E C T I V E S

After completion of this unit, you should be able to:

- Define HRM, personnel management and HRD.
- Outline the objectives and importance of HRM.
- Discuss the impact of technological changes on HRM.
- Examine the role of HR managers in a changing economic scenario.
- Trace the implications of workforce diversity in HRM.
- Identify the components of internal environment and their impact on HRM.

U N I T S T R U C T U R E

1.1 INTRODUCTION

One of the important duties of the modern manager is to get things done through people. He has to bring employees into contact with the organisation in such a way that the objectives of both groups are achieved. He must be interested in the people, the work and the achievement of assigned objectives. To be effective, he must balance his concerns for people and work. In other words, he must know how to utilise human as well as non-human resources while translating goals into action. It is in managing human assets that the manager's capabilities are tested fully, because:

Table 1.1: People are Different !

- Human resources are heterogeneous. They consist of many different individuals, each of whom has a unique personality, a combination of different emotional responses to different stimuli and different values, attitudes, motives and modes of thought.
- Human beings behave in widely differing and complicated ways. Their reactions to promises, praise or criticism, for example, can be quite different. It is very difficult to predict their behaviour especially in an organisation where they work in groups. Their behaviour is neither consistent nor readily predictable.
- Modern employees are better educated, possess greater skills, have more sophisticated technology available for their use and enjoy higher standards of living than previous generations.
- A human being himself determines what he contributes. If he is motivated, he will work for an organisation more efficiently and effectively.

So, it must be recognised by the manager that individuals, not organisations, create excellence. Recognising the importance of the human element in the production process, PF Drucker had remarked that "man, of all the resources available to man, can grow and develop". The problem of establishing the right climate to maximise employee motivation and commitment is still with us.

1.2 THE CHALLENGE OF HUMAN RESOURCE MANAGEMENT

The most significant resource of any organisation is often said to be its people. Such claims appear in organisations' annual reports and mission statements. Of course, an organisation is nothing but a group of people whose activities have been planned and coordinated to meet organisational objectives. An organisation that exists to produce goods and services has a good chance to survive and prosper if it consists of the Right People. This is true for all organisations. In a similar fashion, people need organisations. The vast majority of people must work to support themselves and their families. But people work for many reasons other than economic security. For example, many also work to keep busy and feel useful, to create and achieve something. They want to gain recognition and achieve status or to test and stretch their capabilities. To meet these multifarious needs, people and organisations join forces. Unfortunately, this union seldom approaches perfection. Organisations encounter several obstacles in meeting their goals and in a similar way all employees report some problems in their attempts to be productive and efficient in their jobs and to feel satisfied in their work lives. The challenge of human resource management is to minimise these obstacles and problems.

Box 1.1: Personnel Directors are New Corporate Heroes

The name of the game in business today is personnel . . . . You can't hope to show a good financial or operating report unless your personnel relations are in order and I don't care what kind of a company you are running. A chief executive is nothing without his people. You got to have the right ones in the right jobs for them and you got to be sure employees at every level are being paid fairly and being given opportunities for promotion. You can't fool them and any chief executive who tries is going to hurt himself and his company.

— Herbert E Meyer, Fortune, Feb. 1976, p.88.

The central challenge facing society is the continued improvement of our organisations, both private and public. Another important purpose of human resource management is to improve the contribution made by people to organisations, (Davis, p. 24) through effective and efficient use of resources. Efficient means that it must use the minimum amount of resources needed to produce results. Effective means producing right things through right ways. The resultant productivity (ratio of output to input) gains obtained through HR efforts enable managers to reduce costs, save scarce resources, enhance profits and offer better pay, benefits and working conditions to employees.

Meaning

Human Resource Management is a process of bringing people and organisations together so that the goals of each are met. It is that part of the management process which is concerned with the management of human resources in an organisation. It tries to secure the best from people by winning their wholehearted cooperation. In short, it may be defined as the art of procuring, developing and maintaining competent workforce to achieve the goals of an organisation in an effective and efficient manner.

According to Invancevich and Glueck, HRM is concerned with the most effective use of people to achieve organisational and individual goals. It is a way of managing people at work, so that they give their best to the organisation. It has the following features:

a. ***Pervasive force:*** HRM is pervasive in nature. It is present in all enterprises. It permeates all levels of management in an organisation.

b. ***Action oriented:*** HRM focuses attention on action, rather than on record keeping, written procedures or rules. The problems of employees at work are solved through rational policies.

c. ***Individually oriented:*** It tries to help employees develop their potential fully. It encourages them to give out their best to the organisation. It motivates employees through a systematic process of recruitment, selection, training and development coupled with fair wage policies.

d. ***People oriented:*** HRM is all about people at work, both as individuals and groups. It tries to put people on assigned jobs in order to produce good results. The resultant gains are used to reward people and motivate them toward further improvements in productivity.

e. ***Development oriented:*** HRM intends to develop the full potential of employees. The reward structure is tuned to the needs of employees. Training is offered to sharpen and improve their skills. Employees are rotated on various jobs so that they gain experience and exposure. Every attempt is made to use their talents fully in the service of organisational goals.

f. ***Integrating mechanism:*** HRM tries to build and maintain cordial relations between people working at various levels in the organisation. In short, it tries to integrate human assets in the best possible manner in the service of an organisation.

g. ***Comprehensive function:*** HRM is, to some extent, concerned with any organisational decision which has an impact on the, workforce or the potential workforce (Bernardin, p.15). The term 'workforce' signifies people working at various levels, including workers, supervisors, middle and top managers. It is concerned with managing people at work. It covers all types of personnel. Personnel work may take different shapes and forms at each level in the organisational hierarchy but the basic objective of achieving organisational effectiveness through effective and efficient utilisation of human resources, remains the same. "It is basically a method of developing potentialities of employees so that they get maximum satisfaction out of their work and give their best efforts to the organisation". (Pigors and Myers)

h. ***Auxiliary service:*** HR departments exist to assist and advise the line or operating managers to do their personnel work more effectively. HR manager is a specialist advisor. It is a staff function.

i. ***Inter-disciplinary f unction:*** HRM is a multi-disciplinary activity, utilising knowledge and inputs drawn from psychology, sociology, anthropology, economics, etc. To unravel the

mystery surrounding the human brain, managers, need to understand and appreciate the contributions of all such 'soft' disciplines.

j. ***Continuous function:*** According to Terry, HRM is not a one short deal. It cannot be practised only one hour each day or one day a week. It requires a constant alertness and awareness of human relations and their importance in every day operations.

Scope of HRM

The scope of HRM is very wide. Research in behavioural sciences, new trends in managing knowledge workers and advances in the field of training have expanded the scope of HR function in recent years. The Indian Institute of Personnel Management has specified the scope of HRM thus:

- ***Personnel aspect:*** This is concerned with manpower planning, recruitment, selection, placement, transfer, promotion, training and development, lay off and retrenchment, remuneration, incentives, productivity, etc.
- ***Welfare aspect:*** It deals with working conditions and amenities such as canteens, creches, rest and lunch rooms, housing, transport, medical assistance, education, health and safety, recreation facilities, etc.
- ***Industrial relations aspect:*** This covers union-management relations, joint consultation, collective bargaining, grievance and disciplinary procedures, settlement of disputes, etc.

1.3 MISCONCEPTIONS ABOUT HUMAN RESOURCE MANAGEMENT

Unfortunately many top managers continue to depreciate the worth of human resource specialists in an organisation. The human resource function is seen as encompassing primarily the staffing and employment activities that no one else really wants to do. These activities generally include such things as maintaining a vast array of records required by government, directing employee recreation programmes and presiding at retirement parties. It is precisely because of this jaundiced view that the term human resource is being employed nowadays in place of personnel, with a view to eliminate the negative flavour associated with the word personnel. The reasons for discounting the utility of human resource specialists are not far to seek.

a. ***Lack of expertise:*** Many managers criticise human resource people for having little interest in or knowledge of other important areas of the organisation. Human resource people suffer from ivory tower thinking. They have a fairly high regard for theoretical prescriptions but when it comes to translating the sterile rhetoric into concrete action they tend to develop cold feet and seek shelter behind a mountain of rules and regulations. Referring to a group of surveys, Faulkes reported that – "although they always know without exception the number of employees, a majority of major corporation personnel directors couldn't state the dollar volume of sales for their company, didn't know the profit level and had little idea of the rate of return". In other terms, human resource people have good theories but lack a basic understanding of the business principles necessary to implement them.

b. ***Alienation from the mainstream:*** Operating managers quite often view human resource specialists as 'do-gooders'. Managers holding such views develop a natural aversion toward personnel managers, why the latter talk about poor working conditions and injustices that stare at the less fortunate employees from time to time. Even when the human resource people are right, it is often their approach that bothers operating managers. When human resource people try to look at things in terms of the company ("they") vs the employees and themselves ("we") they also, unwittingly commit the folly of alienating themselves from operating managers.

c. ***Fascination with latest fads:*** Many operating managers think that human resource people have an obsession with promoting the latest fads in the human resource field. In an attempt to find a 'personnel cure-all', personnel people try to harp on the latest HRM buzzwords without really making a serious attempt to look into the dark side of the moon.

d. ***Lack of respect:*** Personnel positions do not always attract the best in many organisations. Often the human resource area is viewed as a demotion or a dead-end job (of late, the situation has changed), especially in those organisations where unsuccessful operating managers are planted in human resource areas. "Staffing the human resource department with people who have little or no expertise in the field results in a continual down-grading of the department". Sometimes, human resource people tend to dispense with important issues in a reactionary fashion. They tend to look into the problem seriously, only when it tries to show its ugly face. Such actions can lead to top management lacking respect for the human resource department. It is small wonder, human resource people are sometimes excluded from long range planning and other strategic decision-making activities of the organisation.

The preceding paragraphs show a rather severe criticism of human resource departments as they allegedly have performed in some organisation. These problems should compel personnel people to introspect, find out suitable remedies and gain acceptance in the corporate world.

1.4 OBJECTIVES OF HRM

Although managers and supervisors in the past often were arbitrary and autocratic in their relations with subordinates, today this type of leadership is being increasingly rejected. The present generation of employees is more enlightened and better educated than were preceding ones. Today's employees demand more considerate treatment and a more sophisticated form of leadership. Furthermore, because of the protection that is provided by the unions and government or because their skills are in short supply, many group of employees are in a position to demand and obtain more favourable employment conditions and treatment. In the light of these emerging trends, HRM's objectives have been expanding all these years. Let's examine these in detail.

a. ***To help the organisation reach its goals:*** HR department, like other departments in an organisation, exists to achieve the goals of the organisation first and if it does not meet this purpose, HR department (or for that matter any other unit) will wither and die.

b. ***To employ the skills and abilities of the workforce efficiently:*** The primary purpose of HRM is to make people's strengths productive and to benefit customers, stockholders and employees.

c. ***To provide the organisation with well-trained and well-motivated employees:*** HRM requires that employees be motivated to exert their maximum efforts, that their performance be evaluated properly for results and that they be remunerated on the basis of their contributions to the organisation.

d. ***To increase to the fullest the employee's job satisfaction and self-actualisation:*** It tries to prompt and stimulate every employee to realise his potential. To this end suitable programmes have to be designed aimed at improving the quality of work life (QWL).

e. ***To develop and maintain a quality of work life:*** It makes employment in the organisation a desirable personal and social situation. Without improvement in the quality of work life, it is difficult to improve organisational performance.

f. ***To communicate HR policies to all employees:*** It is the responsibility of HRM to communicate in the fullest possible sense both in tapping ideas, opinions and feelings of customers, non-customers, regulators and other external public as well as in understanding the views of internal human resources.

g. ***To help maintain ethical policies and behaviour:*** The Chief Personnel Officer in a large American Corporation put it thus: Personnel's purpose is "to practice morality in management in preparing people for change, dealing with dissent and conflict, holding high standards of productivity, building acceptance of standards that determine progression and adhering to the spirit and letter of high professional conduct".

Thus, HRM in short should try to (a) attain economically and effectively the organisational goals; (b) serve to the highest possible degree the individual goals; and (c) preserve and advance the general welfare of the community. The above eight objectives (drawn from Ivancevich and Glueck) should ultimately lead to employee satisfaction and fulfillment. This is however

easier said than done. Unless HR people are thoroughly conversant with the social, legal and economic trends in the economy, managing people in today's world of work would always prove to be a ticklish affair.

1.5 IMPORTANCE OF HRM

Human resources, along with financial and material resources, contribute to the production of goods and services in an organisation. Physical and monetary resources, by themselves, cannot improve efficiency or contribute to an increased rate of return on investment. It is through the combined and concerted efforts of people that monetary or material resources are harnessed to achieve organisational goals. But these efforts, attitudes and skills have to be sharpened from time to time to optimise the effectiveness of human resources and to enable them to meet greater challenges. This is where Human Resource Management plays a crucial role. It helps an organisation in multifarious ways:

i. At the enterprise level:

- Good human resource practices can help in attracting and retaining the best people in the organisation. Planning alerts the company to the types of people it will need in the short, medium and long run.

ii. At the individual level: Effective management of human resources helps employees thus:

- It promotes team work and team spirit among employees.
- If offers excellent growth opportunities to people who have the potential to rise.
- It allows people to work with diligence and commitment.

Box 1.2: A Driver is Worth Rs 3 Crores at Infosys!

When it was listed in 1992, Infosys Technologies Ltd had a turnover of Rs 12 crore. In 1999 Infosys clocked sales of Rs 513 crore. During the last 7 years it had 2,000 millionaires and billionaires on its rolls. The software powerhouse has very low attrition rates, thanks to its stock option plans and employee-focused strategies. The chairman's driver, Mr Kannan, owns stock worth Rs 3 crore and continues to work as the driver currently. (Business India, Jan. 24 – Feb. 6, 2000)

iii. At the society level: Society, as a whole, is the major beneficiary of good human resource practices.

- Employment opportunities multiply.
- Scarce talents are put to best use. Companies that pay and treat people well always race ahead of others and deliver excellent results.

1.6 SYSTEMS APPROACH TO HRM

A system is a set of a interrelated but separate elements or parts working toward a common goal. A university, for example, is made up of students, teachers, administrative and laboratory staff who relate to one another in an orderly manner. What one group does has serious implications for others. So must be communicating with each other in order to achieve the overall goal of imparting education. The enterprise operations, similarly, must be viewed in terms of interacting and interdependent elements. The enterprises procure and transform inputs such as physical, financial and human resources into outputs such as products, services and satisfactions offered to people at large. To carry out its operations, each enterprise has certain departments known as subsystems such as production subsystem, finance subsystem, marketing subsystem, HR subsystem, etc. Each subsystem consists of a number of other subsystems. For example, the HR subsystem may have parts such as procurement, training, compensation, appraisal, rewards, etc. If we were to

view HR subsystem as crucial to organisational performance, an organisation presents itself thus:

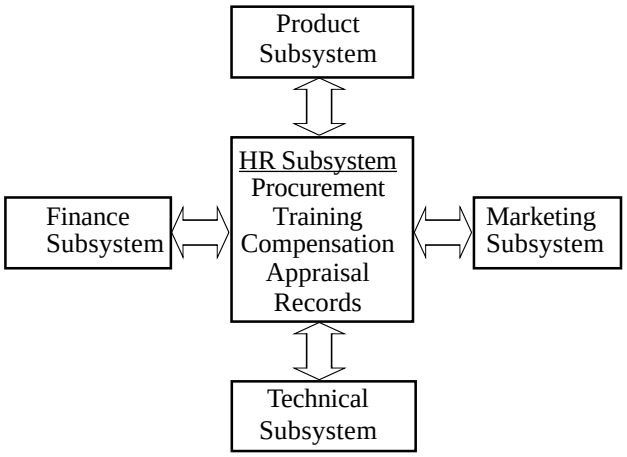

Fig. 1.1: HRM as a Central Subsystem in an Enterprise

The various internal subsystems, it should be noted here, of an organisation operate within the framework of external environment consisting of political, social, economic and technological forces operating within and outside a nation.

1.7 THE CHANGING ROLE OF HR MANAGEMENT

In an organisation, there are tall people, short people, fat people, thin people, black people, white people, elderly people, young people and so on. Even within each category there are enormous individual differences. Some will be intelligent, others not so intelligent; some are committed to jobs, others are not; some will be outgoing, others reserved and so on. "The point is that these differences demand attention so that each person can maximise his or her potential, so that organisations can maximise their effectiveness and so that the society as a whole can make the wisest use of its human resources" (Cascio p.5). The challenge of HR managers today is to recognise talent and nurture the same carefully and achieve significant productivity gains over a period of time. The enterprise is nothing but people. Technological advances, globalised competition, demographic changes, the information revolution and trends toward a service society have changed the rules of the game significantly. In such a scenario, organisations with similar set of resources gain competitive advantage only through effective and efficient management of human resources (Dessler p.14 – 15).

Table 1.2: New Management Practices

- New organisational forms (teams, boundaryless organisations) have come in place of pyramid-shaped units.
- Employees are being empowered to make more and more decisions. Employees are at the top now. They are equipped to take prompt decisions in line with customers' needs.
- Corporate layers have vanished overnight. Organisations have demolished the hierarchical levels with a view to facilitate quick communications and decisions.
- The bases of power have changed. Position, title, authority are no longer adequate to get the jobs done. Instead managers have to tap sources of good ideas, strike collaborations to implement those ideas and get results.
- The new manager, as pointed out by P F Drucker, should increasingly think of himself as a sponsor, team leader and internal consultant instead of viewing his position and power as unchallenged, unique and super normal.
- According to General Electrick's Jack Welch, managers today must work toward building commitment among employees. "The only way I see to get more productivity is by getting people involved and excited about their jobs".

(R M Kanter, "The New Managerial Work", HBR, Nov. – Dec. 1989)
(P F Drucker, The Coming of the New Organisation", HBR, Jan. – Feb. 1988.

The role of a HR manager is shifting from a protector and screener to the planner and change agent. In present day competitive world, highly trained and committed employees are often a firm's best bet. HR professionals play a key role in planning and implementing downsizing, restructuring and other cost-cutting activities. They enable a firm to be more responsive to product innovations and technological changes. For example, team based work assignments and productivity linked rewards could replace manufacturing systems. In service enterprises like banking, hotels, insurance firms, etc., discourteous employee responses may ruin the relationships with customers. Employees who lack the temperament, maturity, social skills and tolerance for frequent contact should not be selected at all for service-oriented activities. HR professionals can help an organisation select and train employees for such emerging roles. Employees are the primary pillars of corporate success. Machines neither have new ideas nor they can solve problems or grasp opportunities. Only people who are involved and thinking can make a difference. Through open communications, proper feedback and fair treatment of all employees' grievances and discipline matters, HR professionals promote employee commitment at various levels. In such a case employees perform the assigned tasks willingly and enthusiastically and thus offer a competitive advantage to the organisation. As rightly pointed out by Charles Creer, (Strategy and Human Resources, Prentice Hall 1995, p.105) "In a growing number of organisations human resources are now viewed as a source of competitive advantage. ……..Increasingly it is being recognised that competitive advantage can be obtained with a high quality workforce that enables organisations to compete on the lines of market responsiveness, product and service quality, differentiated products and technological innovation".

Student Activity 1

1. State whether the following statements are true or false.

   a) The modern manager should be interested in getting work done not in the people doing the work.

   b) Effectiveness means that minimum amount of resources should be used to produce results.

   c) An HR manager is a specialist advisor.

   d) The personnel aspect of HRM deals with grievance and disciplinary procedures, settlement of disputes etc.

   e) The primary objective of HRM is to increase to the fullest the employees' job satisfaction and self actualization.

   f) At the individual level, HRM promotes team work and team spirit among employees.

   g) The HR subsystem cannot be viewed as a silo.

   h) The role of a HR manager is shifting from a protector to planner.

2. Fill in the blanks.

   a) According to Drucker, the new manager must think of himself as team leader,_____ and _____.

   b) The _____ hierarchy is the traditional view of organizational structuring.

   c) Human behavior is neither _____ nor _____.

   d) A ____ is a set of interrelated but separate elements working towards a common goal.

   e) _____ are considered the primary pillars of corporate success.

3. What is your opinion of the role of HR managers in modern organizations? Discuss in light of the misconceptions around HRM.

4. Study the mission and vision of any multinational company available on the net. Analyze its relevance in the HRM context.

1.8 HRM IN INDIA

The Dynamics of Personnel/ Human Resource Management (P/HRM)

P/HRM (both terms used interchangeably) is a dynamic discipline as it mostly deals with ever-changing work settings, characterised by people having varied cultural, social and religious backgrounds, diverse goals, multifarious expectations and attitudes. The personnel scene itself has been changing quite dramatically over the years. Government regulations, competitive pressures, unionisation of employees, do exert a strong influence on the way the personnel function is carried out in various organisations. Further, the nature of the work goals, make-up of the workgroup, leadership style and experience also determine the effectiveness of P/HRM function in the long run. Over the years, employees have become more sophisticated in their demands for high quality work environments, adequate pay and benefits, proper training and career growth opportunities. All these factors compel human resource professionals to look for ways to improve their interactions with employees, other managers and outside groups in order to maximise worker productivity and satisfaction. However, as pointed out by Rudrabasavaraj, personnel administration in India, as it is interpreted, discussed and practised is largely static, legalistic and ritualistic. There seems to be a lot of confused thinking and a plain lack of awareness of what P/HRM is and how it can contribute to an organisation. To clear the 'fog' let's quickly run through the historical origins of personnel management followed by the evolution of the concept of HRM in India.

History of Personnel/Human Resource Management (P/HRM)

The field of P/HRM as it currently exists, represents a crystalisation of a variety of historical and contemporary factors:

1. ***The industrial revolution:*** During this period machines were brought in; technology made rapid progress; jobs were more fragmented where the worker did only a small portion of the total job; and specialisation increased speed and efficiency but left workers with dull, boring and monotonous jobs. Workers were treated like 'glorified machine tools'. Employers were keen to meet production targets rather than satisfy workers' demands. Government did very little to protect the interests of workers.

2. ***Scientific management:*** To improve efficiency and speed F W Taylor advocated scientific management. Scientific management is nothing but a systematic analysis and breakdown of work into its smallest mechanical elements and rearranging them into their most efficient combination. In addition to the scientific study of the task itself, Taylor argued that individuals selected to perform the tasks should be as perfectly matched, physically and mentally, to the requirements of the task as possible and that overqualified individuals should be excluded. Employees should also be trained carefully by supervisors to ensure that they performed the task exactly as specified by prior scientific analysis. A differential piece rate system was also advocated by Taylor to provide an incentive for employees to follow the detailed procedures specified by supervisors.

3. ***Trade unionism:*** Workers joined hands to protect against the exploitative tendencies of employers and the prohibitive, unfair labour practices through unions. Unions tried to improve the lot of workers through collective bargaining, resolving the grievances of workers relating to working conditions, pay and benefits, disciplinary actions, etc.

4. ***Human relations movement:*** The famous Hawthorne experiments conducted by Elton Mayo and his Harvard colleagues during 1930s and 1940s demonstrated that employee productivity was affected not only by the way the job was designed and the manner in which employees were rewarded economically, but by certain social and psychological factors as well. The human relations movement led to the wide scale implementation of behavioural science techniques in industry for the first time which included supervisory training programmes, emphasizing support and concern for workers, programmes to strengthen the bonds between labour and management and counselling programmes whereby employees were encouraged to discuss both work and personal problems with trained counsellors. The movement was also influenced by the growing strength of unions during the late 1930s and 1940s. The rise of unionism during this period was due to the passage of the Wagner Act which gave workers the legal right to bargain collectively with employers over matters concerning, wages, job security, benefits and many other conditions of work.

5. ***Human resources approach:*** However, during early 60s the 'pet milk theory', (advocating that happy workers are productive workers or happy cows give more milk) of human relationists had been largely rejected. Recognising the fact that workers are unique in their own way – having individual needs. It was recognised that each employee is a unique and highly complex individual with different wants, needs and values. What motivates one employee may not motivate another and being happy or feeling good may have little or no impact on the productivity of certain employees. Slowly but steadily, the trend towards treating employees as resources or assets emerged.

   "The Human Resource Approach assumes that the job or the task itself is the primary source of satisfaction and motivation to employees . . . the emphasis in the human resource approach is on individual involvement in the decisions made in the organisation". In addition, this approach emphasises the following things.

   - People do not inherently dislike work if they have helped establish objectives they want to achieve them.
   - Most people can exercise a great deal more self-direction, self-control and creativity than are required in their current jobs (Theory Y).
   - The managers' basic job is to use the untapped human potential in the service of the organisation.
   - The manager should create a healthy environment wherein all subordinates can contribute to the best of their capacities. The environment should provide a healthy, safe, comfortable and convenient place to work.
   - The manager should provide for self-direction by the subordinates and they must be encouraged to participate fully in all important matters.
   - Expanding subordinates' influence, self-direction and self-control will lead to direct improvements in operating efficiency.
   - Work satisfaction may improve as a 'by-product' of subordinates making full use of their potential.

The contribution of behavioural science to management practice consists primarily of producing new insights rather than new techniques. It has developed or expanded a useful way of thinking, about the role of the manager, the nature of organisations and the behaviour of an individual within an organisation.

Evolution of the Concept of HRM

The early part of the century saw a concern for improved efficiency through careful design of work. During the middle part of the century emphasis shifted to the availability of managerial personnel and employee productivity. Recent decades have focused on the demand for technical personnel, responses to new legislation and governmental regulations increased concern for the quality of working life, total quality management and a renewed emphasis on productivity. Let us look into these trends more closely by examining the transformation of personnel function from one stage to another in a chronological sequence:

Table 1.3: Evolution of the Personnel Function

Concept	What is it all about?
The Commodity concept	Labour was regarded as a commodity to be bought and sold. Wages were based on demand and supply. Government did very little to protect workers.
The Factor of Production concept	Labour is like any other factor of production, viz, money, materials, land, etc. Workers are like machine tools.
The Goodwill concept	Welfare measures like safety, first aid, lunch room, rest room will have a positive impact on workers' productivity

Contd...

The Paternalistic concept/Paternalism	Management must assume a fatherly and protective attitude towards employees. Paternalism does not mean merely providing benefits but it means satisfying various needs of the employees as parents meet the requirements of the children.
The Humanitarian concept	To improve productivity, physical, social and psychological needs of workers must be met. As Mayo and others stated, money is less a factor in determining output, than group standards, group incentives and security. The organisation is a social system that has both economic and social dimensions.
The Human Resource concept	Employees are the most valuable assets of an organisation. There should be a conscious effort to realise organisational goals by satisfying needs and aspirations of employees.
The Emerging concept	Employees should be accepted as partners in the progress of a company. They should have a feeling that the organisation is their own. To this end, managers must offer better quality of working life and offer opportunities to people to exploit their potential fully. The focus should be on Human Resource Development.

Human Resource Development vs Personnel Function

According to Prof T V Rao, HRD is a process by which the employees of an organisation are helped in a continuous and planned way to: (1) acquire or sharpen capabilities required to perform various functions associated with their present or expected future roles; (2) develop their general capabilities as individuals and discover and exploit their own inner potentials for their own and/or organisational development purposes; (3) develop an organisational culture in which superior-sub-ordinate relationships, team work and collaboration among sub units are strong and contribute to the professional well-being, motivation and pride of employees.

In short, HRD aims at helping people to acquire competencies required to perform all their functions effectively and make their organisation do well.

The differences between the traditional personnel management functions and HRD are given below (see Pareek and Rao 1981).

Table 1.4: Points of Difference between HRD and Personnel

Personnel Function	Points of distinction	HRD
Maintenance oriented	Orientation	Development oriented.
An independent function with independent sub-functions	Structure	Consists of inter-dependent parts.
Reactive function, responding to events as and when they take place	Philosophy	Proactive function, trying to anticipate and get ready with appropriate responses.
Exclusive responsibility of personnel department	Responsibility	Responsibility of all managers in the organisation.
Emphasis is put on monetary rewards	Motivators	Emphasis is on higher-order needs such as – how to design jobs with stretch, pull and challenge; how to improve creativity and problem solving skills, how to empower people in all respects, etc.
Improved performance is the result of improved satisfaction and morale	Outcomes	Better use of human resources leads to improved satisfaction and morale.
Tries to improve the efficiency of people and administration.	Aims	It tries to develop the organisation as a whole and its culture.

Growth in India

Early phase: Though it is said that P/HRM is a discipline is of recent growth, it has had its origin dating back to 1800 B.C. For example: the minimum wage rate and incentive wage plans were included in the Babylonian Code of Hammurabi around 1800 B.C. The Chinese, as early as 1650 B.C had originated the principle of division of labour and they understood labour turnover even in 400 B.C. The span of management and related concepts of organisation were well understood by Moses around 1250 B.C and the Chaldeans has incentive wage plans around 400 B.C. Kautilya, in India (in his book Arthasastra) made reference to various concepts like job analysis, selection procedures, executive development, incentive system and performance appraisal.

Legal phase: The early roots of HRM in India could be traced back to the period after 1920. The Royal commission on labour in 1931 suggested the appointment of labour officers to protect workers' interests and act as a spokesperson of labour. After Independence, The Factories Act 1948, made it obligatory for factories employing 500.

Table 1.5: Responsibilities of the Welfare Officer

The model rules framed under the Factories Act, 1948, which was the pioneering legislation to provide for the appointment of Welfare Officers, had laid down a chart of responsibilities for them. These responsibilities are:

1. Supervision of
   - (a) Safety, health and welfare programmes, such as housing, recreation, sanitation services as provided under law or otherwise.
   - (b) Working of joint committees,
   - (c) Grant of leave with wages as provided and
   - (d) Redressal of workers' grievances
2. Counselling workers in
   - (a) personal and family problems,
   - (b) adjusting to the work environment and
   - (c) understanding rights and privileges
3. Advising the management in
   - (a) formulating labour and welfare policies,
   - (b) apprenticeship-training programmes,
   - (c) meeting the statutory obligation to workers,
   - (d) developing fringe benefits and
   - (e) workers' education and the use of communication media.
4. Liasion
   - (a) with workers so as to
     - (i) understand various limitations under which they work,
     - (ii) appreciate the need for harmonious industrial relations in the plant,
     - (iii) interpret company policies to workers and
     - (iv) persuade them to come to a settlement in case of a dispute.
   - (b) with the management so as to
     - (i) appreciate the workers' viewpoints in various matters in the plant,
     - (ii) intervene on behalf of the workers in matters under consideration of the management.
     - (iii) Help different departmental heads to meet their obligations under the Act.
     - (iv) Maintain harmonious industrial relations in the plant and
     - (v) Suggest measures for promoting the general well-being of workers,
   - (c) with workers and the management so as to
     - (i) maintain harmonious industrial relations in the plant,
     - (ii) have the way for prompt redressal of grievances and the quick settlement of disputes and
     - (iii) improve the productive efficiency of the enterprise.
   - (d) with outside agencies, such as
     - (i) factory inspectors, medical officers and other inspectors for securing the people enforcement of various acts as applicable to the plant and
     - (ii) other agencies in the community, with a view to helping workers to make user of community services.

"In view of legal compulsions and the enumeration of duties the entire approach of organisations toward their personnel was to comply with the laws and keep the welfare officers busy with routine functions (N.K Singh p.7)" Meanwhile two professional bodies, viz., the Indian Institute of Personnel Management (11PM) Calcutta and the National Institute of Labour Management (NILM) Mumbai have come into existence in 1950s.

Welfare phase: During the 1960s the scope of personnel function has expanded a bit, covering labour welfare, participative management, industrial harmony, etc. "In this period, the human relations movement of the West had also had its impact on Indian organisations". The legalistic preoccupations slowly gave way to harmonious industrial relations and good HR practices.

Development phase: In 1960s and 70s the HR professionals focused more on developmental aspects of human resources. The emphasis was on striking a harmonious balance between employee demands and organisational requirements. HRD has come to occupy a centre stage and a focal point of discussion in seminars, conferences and academic meets. The two professional bodies, IIPM and NILM, were merged to form the National Institute of Personnel Management (NIPM) at Calcutta.

The following table captures the picture more accurately:

Table 1.6: Personnel Function: Changing Scenario

Period	Emphasis	Status	Roles
1920 – 30	Welfare management Paternalistic practices	Clerical	• Welfare administrator • Policeman
1940 – 60	Expanding the role to cover Labour, Welfare, Industrial Relations and Personnel Administration	Administrative	• Appraiser • Advisor • Mediator • Legal advisor • Fire fighting
1970 – 80	Efficiency, effectiveness dimensions added Emphasis on human values, aspirations, dignity, usefulness	Developmental	• Change agent • Integrator • Trainer • Educator
1990s onwards	Incremental productivity gains through human assets	Proactive, growth-oriented	• Developer • Counsellor • Coach • Mentor • Problem solver

1.9 HUMAN RESOURCES MANAGEMENT IN PRACTICE IN INDIA

i. ***Low status:*** Though much has been said in the literature about the significance of human resources, i.e., it is superior to all other resources, it has not been given as much importance as financial and material resources. Consequently, personnel managers are assigned lower status compared to Finance Managers, Production Managers and Marketing Managers. In some other organisations, though he is given equal status in the organisational hierarchy, he is normally looked down and at times discounted by the General Manager in his interaction with his immediate subordinates. Many a time, HRM is branded as a clerical activity only. In recent years, however, the situation in most private sector units and some of the public sector units has changed dramatically with personnel professionals being preferred to others while assuming top managerial assignments.

ii. ***No initiative:*** Much has been said about the modern techniques in the literature like sensitivity training, grid system, management by objectives, structured insight, business games, operations research in manpower planning, mathematical models for manpower planning, psychological tests, performance appraisal based on MBO concept, quality circle, career planning and development, improving the quality of work-life and the like. But very few organisations in India have taken initiative to practise these modern techniques.

iii. ***Split personalities:*** The personnel men in various organisations now are torn between fancied notions of modern techniques and tools (MBO, grid training, performance appraisal techniques, sensitivity training etc.) and their environment having medieval organisational structures and practices (N.K. Singh p.15).

iv. ***Lip service:*** Quite often, personnel managers do not practice leadership techniques in a fair manner, though they try to sermonise in management seminars. They pose that they are just, equal and fair to all employees in executing various personnel policies. But, in practice, they show favouritism to some, do injustice to others and in the process discriminate one against another in implementing personnel policies like promotion, transfer, performance appraisal, etc.

v. ***Non-cooperation:*** It is also pointed out that top management as well as employees do not whole-heartedly cooperate with the Personnel Manager in implementing various new techniques. Managers take the training programmes as paid holidays. Participation is not sincere and wholehearted. Their contributions in the quality circles programmes and participative management techniques in most cases are mediocre. Management is also equally responsible for this sorry state of affairs as it does not motivate/encourage them to participate.

1.10 IMPEDIMENTS TO THE PROGRESS OF P/HRM IN INDIA

The above analysis shows that there has been a yawning gulf between the theory and practice of P/HRM in India. Several factors are responsible for this situation. The important among them are:

- Section 49 of the Factories Act, 1948, requires Personnel officers to perform the functions relating to welfare, day-to-day personnel activities, industrial relations, etc. But the Personnel officers, who possess legal status, quite often, failed to secure the cooperation of line managers as personnel management is a line responsibility with staff functions. Thus, the function of personnel management cannot be properly performed by a designated Personnel Manager alone.
- The attitude of employees, management and particularly line managers is not always favourable towards personnel manager. Peter F Drucker rightly stated that "The personnel manager tends to conceive his job partly as a file clerk's job, partly as a house keeping job, partly as a social worker's job and partly as a fire fighter to head off union trouble or settle it". Thus, the Personnel Manager is expected to advise, counsel and assist line managers. Such diverse roles could not be performed by people having very little power and authority.
- Personnel managers have to invariably depend on lawyers due to excessive legalistic approach to labour problems. In view of his preoccupation with litigation, he cannot to other important duties.
- India's tradition-bound family management and authoritarian culture prevents the development of personnel management, along sound lines as the former's objective has always been profit maximisation through exploitation of labour.
- Absence of training facilities necessary for the development of personnel management as a profession, absence of job security and job satisfaction, absence of professional attitude towards the personnel management also contribute to the pathetic state of affairs that surround personnel people everywhere.
- Personnel executives generally have a short range perspective and as a result they confine themselves to internal needs.
- The educational and research institutes have not yet taken concrete steps to work with the industries actively so as to speed up the process of professionalisation of personnel management in the country.
- Personnel people find themselves in low status positions because of lack of exposure to various challenging assignments and tasks in and outside the organisation.
- Reluctance on the part of personnel people to adapt, accept challenging jobs and to move from organisation job to another for betterment.

- The legalistic approach to personnel management, wherein management tries to solve labour problems by depending heavily on various pieces of labour legislation has impeded the growth of personnel management along desired lines in India.
- Tradition-bound family management aims at profit maximisation even today. Its mode of profit maximisation is through the minimisation of cost, including labour cost, as it views human resources as a cost centre rather than as a profit centre.
- Most of the personnel managers do not have the requisite qualifications, abilities, creative skills, talents, etc., to win over the line managers. As such the line managers look down upon the personnel managers in most organisations.
- In some organisations, personnel function is placed at third or fourth level in the organisational hierarchy or in some organisations even under the supervision of production managers.

These troubling impediments have prevented the development of personnel management along sound lines in the recent past. However, the situation is not all that bad if the following measures are kept in mind while positioning the personnel departments in present-day organisations.

1.11 MEASURES TO SPEED UP THE GROWTH OF P/HRM IN INDIA

Employers, managers, workers and the various institutes imparting personnel management education and training should take up the challenging task of developing the techniques, literature on P/HRM and practice them in Indian organisations.

1. At the first instance, institutes like National Institute of Personnel Management, Calcutta, Xavier Labour Relations and Human Resources, New Delhi, various universities, Ministry of Human Resources Development should be charged with the obligation of developing, changing and moulding the attitudes, values, ethics, traits, aspirations, demands and the like of owner managers, employed managers, personnel managers and personnel towards the growth and vitality of personnel management function.
2. Further, top management should place the personnel department at a level equal to other functional departments in the organisational hierarchy and give importance to personnel managers at par with other functional managers in marketing, finance, etc.
3. The legal and welfare roles of the personnel managers should be adequately integrated with human relations and management roles.
4. The job analysis of personnel manager should be written strictly in accordance with the job and latest developments. Candidates for personnel manager's job should be selected strictly in accordance with the requirements of the job.
5. Candidates selected for personnel roles should invariably hail from reputed institutes.
6. Personnel managers should be creative and adaptive. They should act as change agents rather than confining themselves to conventional roles of welfare officers, labour law officer, canteen supervisors, etc.
7. Personnel management function should be professionalised in industries and organisations of various sizes.

Student Activity 2

1. Match the following with the most appropriate option.

a) Paternalism	a. Employees are the most valuable assets of an organization
b) Human resource concept	b. Emphasis on striking a balance between employee demands and organizational requirements
c) Scientific management	c. Social and psychological factors affect employee productivity
d) Development phase of HRM growth	d. Protective attitude towards employees
e) Hawthorne experiments	e. A systematic analysis and breakdown of work into its smallest mechanical elements

2. Choose the most appropriate option in each case:

i) Identify the factor that is not an impediment to the progress of HRM in India.
   a) Legalistic approach to personnel management
   b) Absence of training facilities
   c) Tradition bound family management
   d) Specialization of HR as a function

ii) The following are relatively modern management techniques, except:
   a) Management by objectives
   b) Performance appraisal
   c) Scientific management
   d) Quality circles

iii) The period of classified that of welfare management is:
   a) 1920
   b) 1960
   c) 1970
   d) 1990

iv) The following are characteristics of the commodity concept of HRM:
   a) Labor is like any other factor of production
   b) The organization is a social system with social and economic dimensions
   c) Employees are assets of an organization
   d) Government does not protect workers

v) The following are not considered to be points of distinction between the personnel function and HRD:
   a) Orientation
   b) Objective
   c) Motivators
   d) Type of worker

vi) The following are measures to speed up the growth of HRM in India:
   a) Job analysis of personnel manager
   b) Quota system
   c) Centralization of authority
   d) Wage regulation

1.12 INTRODUCTION TO HRM TRENDS IN A DYNAMIC ENVIRONMENT

A number of environmental factors influence the work of a HR manager. He cannot perform his job in a vacuum. These factors influence the organisation through human resources. The term 'environment' here refers to the "totality of all factors which influence both the organisation and personnel sub-system".

Table 1.7: External and Internal Factors influencing the Personnel Function

External factors	Internal factors
• Technological factors	• Mission
• Economic challenges	• Policies
• Political factors	• Organisational culture
• Social factors	• Organisation structure
• Local and Governmental issues	• HR systems
• Unions	
• Employers' demands	
• Workforce diversity	

The external environment consists of those factors (Table 1.7) which affect an organisation's human resources from outside the organisation. Each of these external factors separately or in combination can influence the HR function of any organisation. The job of a HR manager is to balance the demands and expectations of the external groups with the internal requirements and achieve the assigned goals in an efficient and effective manner. Likewise, the internal environment also affects the job of a HR manager. The functional areas, structural changes, specific cultural issues peculiar to a unit, HR systems, corporate policies and a lot of other factors influence the way the HR function is carried out. The HR manager has to work closely with these constituent parts, understand the internal dynamics properly and devise ways and means to survive and progress. In addition to these, the personnel man has to grapple with the problem of workforce diversity. Let us examine these issues in detail.

1.13 TECHNOLOGICAL CHANGES

The term technology refers to how an organisation transforms its inputs into outputs. Every organisation has at least one technology for transforming its resources into products or services. Maruti Udyog Limited uses the assembly-line process to convert its financial, human and physical resources into products. Management institutes employ a variety of instructional technologies (including cases, games, exercises, role plays, presentations, etc.) for imparting knowledge to young students.

As we all know, the workspot of 2000 is significantly different from its counterpart in early 70s, chiefly because of computerisation. The invention and development of microchips has brought a dramatic revolution in workplace. Microchips are tiny components of electrical circuits which can be combined to form much larger and more complex electronic systems. They have made it possible to build such systems simply and cheaply at only tiny fraction of the weight and size that would formerly have been required. Industrial robots have begun to invade the assembly line in a big way – doing such tasks as welding, spray-painting, precision cutting or even playing snooker. Many cars are now fitted with on-board computers, especially in the developed world, that diagnose problems in seconds that used to take hours for mechanics. IBM has built a plant in Austin, Texas that can produce laptop computers without the help of a single worker. If you look at the banking industry, automated teller machines, for example, have replaced thousands of human tellers in banks. The impact of new technology on the total number of jobs available has been quite devastating. It has placed power in the hands of a small group of elite people in most large scale organisations. This has taken place because of deskilling of most jobs, where a few individuals tend to control the organisations through the increased availability of information. Lower and middle level positions are the worst hit in this scenario, because computers do the compilation and processing of information now. Work roles have also become more integrated. New technologies generally compel people to learn a new set of skills altogether and also learn to work together in project teams time and again. Some of the top technological breakthroughs that have changed the life on earth during the last three decades may be catalogued thus:

Table 1.8: Top Ten Technological Breakthroughs

1. The moon landing
2. Application satellites (weather and communication satellites)
3. Microprocessors
4. Computer aided design and manufacturing
5. The CAT scan (computer imaging for medical diagnosis)
6. Advanced composite materials
7. The Jumbo Jet
8. Lasers (applications include CD players, computer printers, telecommunications and surgery)
9. Fibre optics
10. Genetic engineering

Source: The National Academy of Engineers, USA.

In the present day world, information is the key resource. Organisations that employ appropriate technologies (to get the right information to the right people at the right time) will enjoy a competitive advantage. Recent innovations in the form of total quality management, reengineering work processes, flexible manufacturing systems have only one thing in common – serving the customer well through improved operational efficiency.

1.14 TOTAL QUALITY MANAGEMENT (TQM)

Until a few years ago, Indian industry was roundly criticised for paying insufficient attention to the quality of goods and services. Today things have come full circle and the quality movement is at a feverish pitch. Companies such as BPL, Wipro, Carrier Aircon, Maruti, Thermax, Bata, Philips, Titan, etc., trumpet their steadfast devotion to quality in their advertisements. Quality has become the most important word in the corporate lexicon and companies have realised the importance of investing in processes that contribute to better quality and customer relationships. The term 'quality' refers to a sense of appreciation that something is better than something else. It means doing things right the first time, rather than making and correcting mistakes. According to Edward Deming, TQM is a way of creating an organisational culture committed to the continuous improvement of skills, teamwork, processes, product and service quality and customer satisfaction. TQM is anchored to organisational culture because successful TQM is deeply embedded in virtually every aspect of organisational life.

Deming's Advice on Achieving Quality

W E Deming was originally trained as a statistician and started teaching process control (a method of measuring variation and continuously improving work processes before the final inspection stage to prevent the production of flawed products) in Japan shortly after World War II. He is recognised internationally as an important contributor to Japanese quality improvement programmes. Deming advocates that the way to achieve product quality is to continuously improve the design of a product and the process used to manufacture it. According to Deming, top management has the primary responsibility of achieving product quality. Deming advocates that management should follow fourteen principles to achieve a high level of success in improving product quality:

a. Create and publish to all employees a statement of objectives of the company. The management must demonstrate constantly their commitment to this statement.

b. Learn the new philosophy, top management and everybody.

c. Understand the purpose of inspection, for improvement of processes and reduction of cost.

d. End the practice of awarding business on the basis of price tag alone.

e. Improve constantly and forever the system of production and service.

f. Institute training.

g. Teach and institute leadership.

h. Drive out fear. Create trust. Create a climate for innovation.

i. Optimise toward the aims of the company, the efforts of teams, groups and staff areas.

j. Eliminate exhortations for the workforce.

k. Eliminate numerical quotas for production. Instead learn and institute methods for improvement. Eliminate management by objectives. Instead, learn the capabilities of processes and how to improve them.

l. Remove barriers that rob people of pride of workmanship.

m. Encourage education and self improvement for everyone.

n. Take action to accomplish the transformation.

TQM: The Main Ideas

TQM is built around four main ideas: Do it right the first time, be customer centered, make continuous improvement a way of life and build teamwork and empowerment. Let's examine these in detail:

a. ***Do it right the first time:*** Managers have been interested in the quality of their products, atleast as an afterthought, since the Industrial Revolution. Thanks to the sustained efforts of quality gurus like Deming and Kaoru Ishikawa, product/service quality has become both a forethought and a driving force in effective organisations of all kinds nowadays. Today's hospitals, universities and public sector organisations are as interested in improving product/service quality as are manufacturing organisations, mines, airlines and railways. In its most basic form, the emphasis on quality has come through four distinct phases since World War II – from 'fix it in' to 'inspect in' to 'build it in' to 'design it in'. Present day managers are moving away from the first two approaches and toward the 'build it in' and 'design it in' approaches. Let's look into the differences in these approaches:

- ***The fix it in approach to quality:*** Rework any defective products identified by quality inspectors at the end of the production process.
- ***The inspect it in approach to quality:*** Here quality inspectors sample work in process and prescribe machine adjustments to avoid substandard output.
- ***The build it in approach to quality:*** Make everyone who touches the product responsible for spotting and correcting defects. Emphasis is on identifying and eliminating causes of quality problems.
- ***The design it in approach to quality:*** Intense customer and employee involvement drives the entire design production cycle. Emphasis is on continuous improvement of personnel, processes and product.

Each stage of this evolution has broadened the responsibility for quality, literally turning quality improvement into a true team effort. Also, the focus has shifted from reactively fixing product defects to proactively working to prevent them and to satisfy the customer completely. Just having 'zero things gone wrong' is not sufficient now, to offer something of value to customer and buy his loyalty. Today's quality leaders strive to exceed, not just meet, the customers expectations. Putting quality first is the new slogan.

b. ***Be customer-centered:*** Organisations have to meet the expectations of both the internal and external customers. Internal customers are other members of the organisation who depend on your work to get their job done. For example, a corporate lawyer employed by Maurya hotel does not directly serve the hotel chains' customers by changing beds, serving meals or carrying luggage. But that lawyer has an internal customer when a Maurya manager needs to be defended in court. As far as external customers are concerned, TQM demands all employees who deal directly with outsiders to be customer-centered. Being customer-centered means:

- Anticipating the customer's needs;
- Listening to the customer;
- Learning how to satisfy the customer; and
- Responding appropriately to the customer.

c. ***Make continuous improvement a way of life:*** The Japanese word for continuous improvement is Kaizen, which means improving the overall system by constantly improving the little details. Kaizen practitioners look at quality as an endless journey, not a final destination. In order to improve things, they experiment, measure, adjust continuously. Rather than naively assuming that zero defects means perfection, they try to put the finger on the problem causing trouble. There are four ways of achieving improvements:

- Improved and more consistent product and service quality.
- Faster cycle times (in cycles ranging from product development to order processing to payroll processing).

- Greater flexibility (for example, faster response to changing customer demands and new technology). Sensing trouble from competing automobile giants – Daewoo Motors, Hyundai, Mitsubishi and Telco who are planning to launch a small car for Indian market – Maruti Udyog Ltd has joined hands with Countrywide Financial Services with a view to offer attractive financing schemes for prospective buyers. The additional duties imposed by the Government in 1998 Budget have also been included in the price of different models at the lower and middle end of the market. The Maruti Zen VX model hit the market in 1998 without carrying the cost of additional accessories and excise duty running to over Rs 30,000. To exhaust the demand during the intervening period, the Zen model came with the 100 per cent financing option. Such agile and smart moves have kept the company far ahead of its competitors in the past and there is no evidence of the company taking rest on its past laurels as yet – despite having a phenomenal market share of over 90 per cent in India!

- Lower costs and less waste (for example, eliminating needless steps, scrap rework and non-value adding activities).

TQM advocates emphasise the importance of achieving greater quality, speed and flexibility at lower cost and waste. You need not sacrifice something in order to give another thing. All things are possible, provided you work with a clear-cut focus, i.e., improving things.

d. ***Build teamwork and empowerment:*** TQM is built around employees, their needs, aspirations and expectations. It is employee-driven. It allows employees to exploit their full potential. Empowerment takes place when employees are properly trained, provided with all relevant information and the best possible tools, fully involved in key decisions and fairly rewarded for results. In order to carry out work effectively and efficiently, teams have to be created, drawing talent from various departments in a cooperative way.

Table 1.9: Quality Snaps of Indian Companies

	Name of Company	Efforts toward TQM
1.	Indo-Gulf Fertilizers Ltd	Upgrading technology; training people; monitoring cost, quality and delivery criteria; participative management, HRD; ISO 9002 Certification, first fertilizer co. to get this in India; Shaktiman Krishi Seva Kendras in UP, Bihar and West Bengal.
2.	Bharat Heavy Electricals Ltd (BHEL)	First to get ISO 9001 certification in Dec 93; Strict metal parts quality control; 100% checking of insulators for testing their strength; strict quality assurance tests; high quality testing labs, etc.
3.	TELCO (Lucknow)	SUMO model Jeeps manufactured here according highest priority to ISO 9000 certifications; training and self-inspection given top priority.
4.	Philips India Ltd	Implemented TQM in 1995; first step was moving toward international quality system standards ISO 9000; total employee involvement; creation of self managing mini, micro and mega-teams; got the European Quality Award; Kaizen and suggestion schemes introduced followed by rewards and recognition system; regular surveys of employee motivation levels accompanied by customer surveys

Source: D.D. Sharma, TQM, Sultan Chand, New Delhi, 2000.

Implications for Managers

The search for continual improvement, it should be noted here, puts organisational members in a race without a finish line. They can no longer afford to take rest on past laurels and glory. Complacency becomes a prohibitive word and each one is expected to move ahead, seeking constant improvements while achieving goals. They have to scale new heights year after year. Some people may like such situations where they are made to stretch themselves fully. But to a large majority, pressure-cooker-like-environments produce frustration and anxiety. A race with no finish line means a race that's never over – producing constant friction and tension. The pressures arising out of an unrelenting search for process improvements may have serious consequences for employees, if adequate care is not taken. Employee involvement programmes, therefore, have become part and parcel of TQM.

Benchmarking

Competitive benchmarking is the first requirement to effective TQM. It is comparatively new to Indian companies. The essence of benchmarking is the striving to be the best of the best in one's area of operations (dontootsu). It is a continuous process of measuring products, services and practices against the toughest competitors or industry leaders with the aim of mutual improvement.

- Benchmarking is a continuous process. It is not a one-shot deal because industry practices change constantly. Complacency may be suicidal.
- Benchmarking implies measurement of the gap between the practices of two companies so as to uncover significant differences.
- Benchmarking can be applied to products, services, practices, processes and methods.

Thus, benchmarking is a systematic investigation, a fruitful learning experience which ensures that the best of industry practices are uncovered, analysed, adopted and implemented. Companies such as Modi Xerox, HDFC, IFB, Infosys, Indal, SRF, TELCO, Thermax, Bombay Dyeing have successfully applied competitive benchmarking to meet the rising expectations of customers in their respective areas.

The benchmarking process involves twelve steps: identifying benchmarking candidates, identifying best competitor, collecting data, finding the gap, projecting the future performance, communicating benchmark findings, establishing functional goals, developing action plans, implementing plans, recalibrating benchmark's attaining leadership position and integrating into processes.

1.15 REENGINEERING WORK PROCESSES

The primary focus of TQM is on continuous improvement or ongoing incremental change. There is a constant search for achieving things in a better way. However, many organisations operate in a dynamic environment characterised by rapid and constant change. The problem with continuous process improvements is that it may create a false sense of security. Managers may begin to think that what they are doing is positive. This may be true in majority of cases. But where an organisation requires a drastic, quantum change in order to survive in a fiercely competitive market, managers have to search for solutions elsewhere.

Table 1.10: Reengineering vs Total Quality Management

Reengineering	Total Quality Management
• Looks for quantum leaps in performance	• Seeks incremental improvements
• Driven by top management. When it is complete, workplace is self-managed. To complete the process, however, management has to follow autocratic methods. You either get on the train or we will be over you with the train.	• Relies on bottom-up, participative decision-making in both the planning of a TQM programme and its execution.

The term reengineering (referring to radical, quantum change in an organisation) comes from the historical process of taking apart electronics product and designing a better version. Michael Hammer coined the term for organisations. When he found companies using computers simply to automate outdated processes, rather than finding fundamentally better ways of doing things, he realised the same principles could be used in business as well. Actually reengineering takes place when more than 70 per cent of the work processes in an organisation are evaluated and altered. It demands organisational members to rethink what work should be done, how it is to be done and how best to implement these decisions. The focus is on simplifying the operations and making them more efficient and more customer-focused.

Key Elements

According to Michael Hammer and James Champy, reengineering involves a significant reassessment of what a particular organisation is all about. They urge managers to ask a very fundamental question about what they do: "If I were recreating this company today, given what I know and given current technology, what would it look like?" In other words, managers should imagine that they are starting with a "clean piece of paper!"

Identify Distinctive Competencies

The process of reengineering comprises of three important elements: finding organisations' distinctive competencies; assessing core processes and reorganising horizontally by-processes. Initially, the organisation has to identify its distinctive competencies. These may include superior location (Gujarat Ambuja Cement using sea routes for transporting cement, as against its rivals like ACC, India Cements), a more efficient distribution system (Bata, BPL, Godrej, etc.), a technically superior product (Gillette shaving systems, air-conditioners from Carrier Aircon, etc.) or a superior service network (Wipro Ltd in the computer industry). It is important to identify the core competencies of an organisation, because it guides decisions regarding what activities are crucial to the organisation's success.

Assess Core Processes

It is equally important to assess the important processes that add value to organisational activities. Hammer and Champy contend that organisations can tend to stagnate when organisational members focus attention on their own immediate neighbourhoods, such as their jobs and departments, rather than on the larger patterns of relationships in which they work and influence the lives of others. Reengineering thus involves redefining processes as patterns of relationships connecting organisational members with people outside the organisation. Reengineering becomes necessary when, despite the fact that individual jobs are well defined and well performed, the sum effect on other people of those efforts is inefficient for the organisation and unsatisfactory for customers and clients. For example, reengineering efforts in an insurance corporation may focus attention on making its customer insurance applications process more effective. To this end, a new process may empower the case managers to take care of everything from the time an application is made till the policy is issued. This may save time and avoid bureaucratic delays involved in movement of files from one person to another and from one department to another within the same organisation. According to Hammer, "reengineering means radically rethinking and redesigning those processes by which we create value for customers and work". He mentions speed, quality of service and overhead expenses as today's important competitive issues that reengineering can address. To this end, managers must come out of the shell and say boldly: 'This is not the way. We must do it differently". Hammer passionately argues: "the hallmark of a really successful company is its willingness to abandon what has been successful in the past. There is no such thing as a permanently winning formula". Just as the director of a management institute thinks about a number of activities, including admission policy, operating procedures, orientation for new students, classroom discipline, syllabi restructuring, faculty arrangements, business promotion events, placement efforts, liaison with reputed companies and recruiting agencies – manager also must think about the entire process of doing things in an organisation constantly. When the organisation is viewed as a series of processes ranging from strategic planning to after-sales customer support, management can decide to what extent each adds value. Such a search would highlight activities that have little contributory value and whose only reason for existence is "we have always done it this way!".

Reorganise Around Horizontal Processes

Reengineering requires management to reorganise around horizontal processes. The focus must be on the process, not the function. Functional focus promotes narrow, sectional loyalties. They are not willing to experiment, because it is against the established procedures and norms. If we reorganise around horizontal processes, we have to create cross-functional, self–managed teams. It may also mean cutting out levels of middle management. However, reengineering should not be used as a ploy to simply downsize the organisation. Instead, it is a continuous review of the organisation's processes and practices to increase productivity and meet specific organisational objectives. To create value for customers, managers may have to reinvent the organisations every day. Reengineering implies that organisations are shifting patterns of relationships, not fixed entities like machines and buildings.

Table 1.11: Commandments of Reengineering

- Give people a mission; a clear view of how to achieve that mission.
- Either serve the customer superbly or don't even try.
- Change is the way of life. It is not a process, it is a value.
- Technology is never really a problem. The problem is how to use technology effectively.
- The wrong answer rarely kills you. What it does is waste time.
- The weak link in reengineering is will.
- Once people catch on to reengineering, you can't hold them back. It's a life time opportunity.
- In India TELCO, TISCO, L&T, Ranbaxy and Crompton Greaves have successfully brought about radical changes through Reengineering.

Source: Ronald E. Crompton, CEO, Aetna Life and Casualty

1.16 FLEXIBLE MANUFACTURING SYSTEMS

The term 'Flexible Manufacturing' refers to the ability of computerised machines to perform a variety of programmed functions. It is the integration of computer aided design, engineering and manufacturing to produce low volume products at mass production costs. Here a single machine can make dozens or even hundreds of different parts in any order the management wants. When management wants to produce a new part, it need not change machines – it has to just change the computer programme. Robots operate the computer controlled mechanical arms that can be equipped with grippers, vacuum cups, painting gums, welding torches or other tools. They take care of tasks that require precision under hazardous conditions (spray painting, welding), handle dangerous materials (hot ingots, radioactive rods) and paint, repair, or carry out any other task under inhuman conditions without suffering any ill effects.

Here is an example of how the computer aided manufacturing works. A machine tool operator can select, and combine from a colour graphics screen, the geometric shapes that match the shape in which the metal is to be cut and provide the location and dimensions of the cut. Conventional machine tools, by contrast, require every single machine tool movement to be specially plotted. By eliminating programming steps, the system makes it easier to get a machine tool to perform new tasks.

The implications of flexible manufacturing are fairly obvious. Employees require more training and higher skills. Since there are fewer employees, each one has to be able to do a greater variety of tasks. Additionally, they are supposed to keep away from interdepartmental competition, conflict and politics and get along with other members as teammates. Cross functional team work is essential in factories of the future where, for example, engineers may have to design products by working hand in hand with market research and manufacturing specialists.

The impact of technology on the HR function, thus, is quite profound. Hazardous and risky jobs could be turned over to robots increasingly in the days ahead. Repetitive jobs could also be handed over to sophisticated robots. As organisations turn to computerisation and full-scale

automation, the demand for people with multi-skills will grow. One negative impact of technology would be the growing worker alienation, since job opportunities may shrink along with opportunities for socialisation on the job. High-paying factory work for skilled and unskilled categories may become scarce as organisations begin to use lighter, faster, stronger and more intelligent robots in the years ahead.

1.17 ECONOMIC CHALLENGES

Nowadays the world is shrinking in all major respects. People, goods, capital and information are moving around the globe as never before. Companies are trying to become global players just to survive; let alone prosper. Coca cola, a leader in this respect, derives roughly 80 per cent of its profits from foreign sales. IBM, Mobil, Citicorp, Motorola, Gillette too earn more than half of their revenues from operations outside USA. International borders have been ruthlessly ignored or thoroughly discounted when it comes to serving business interests. Todays' managers in big firms are quite comfortable transacting business in multiple languages and cultures. In the new global marketplace HR managers are required to play challenging roles and create a competitive advantage for the firm. Competitive advantage refers to the ability of an organisation to formulate strategies to exploit profitable opportunities, thereby maximising its return on investment. To this end, global firms are continually reorganising their operations and refocusing their energies around their crucial areas of competence. AT&T, for example, has a global operations team of top executives to look into country-specific demands. Infosys technologies, NIIT, Ranbaxy, Dr Reddy Laboratories have created such global operations teams long back to explore overseas markets and exploit available opportunities.

Box 1.3: The World: A Global Village?

Euro-Disney: The huge theme park outside Paris, France employs people from eighty five countries who speak a total of thirty five languages.

McDonald: The global fast food giant maintains uniform product quality wherever it goes. It operates in about 70 countries now, roughly 1,800 restaurants in Asia alone. People attribute its success to its cross-cultural sensitivity. In India, for example, 4 out of 5 do not eat beef. So it has developed 'grilled lamb.' As a substitute for its famous beef burgers.

Digital Equipment Corporation: The Boston factory of Digital consists of 350 employees from 44 countries who speak 19 languages. The written instructions to employees are printed in 7 languages.

They have also been sending key management members to attend global seminars, workshops, training sessions regularly. Companies like Colgate even proclaim, "we want to build a common corporate culture. We want them all to be Colgaters" – while trying to bridge the cultural gap between domestic employees and those in international operations. Global alliances, cross-country mergers, acquisitions have become quite routine affairs now. India has become a sourcing centre for many global giants. Sundaram Fasteners in Radiator caps, many software firms, bulk drug firms have successfully utilised the services of skilled labour here in order to create distinct cost advantages for their products. In a volatile environment, changes of various kinds hit the firms from all corners. Successful managers have to anticipate and adjust to such changes quickly rather than being passively swept along or caught unprepared. If firms hire people who do not like surprises, probably they are not hiring the right people. Agility pays rich dividends and HR managers have an important role in creating a favourable work climate to initiate and implement changes quickly. Falling sales and high labour costs stared at Volkswagen, Germany, in early 90s. Massive layoffs were expected. To avoid this, the company introduced 4 day work week, the labour hours per day were enhanced, the base pay was cut. This ultimately prevented laying off nearly one-third of its workforce. In 1998, Ashok Leyland also followed this policy, with active cooperation from workers and unions with a view to fight recessionary conditions and stay fit. Firms which were unable to read the signals clearly (HMT, Allwyn, Ambassador, Scooters India Ltd) and undertake rectificational steps in time have already been thrown out of gear in the market place. Overstaffing (SAIL, SBI, DTC, NTC), bloated benefit programmes, high wage bills (in most public sector firms) have become pressing issues now – thanks to increased competition in almost all fields. To compound the problems further, recessionary conditions have set in, in sectors like paper, steel, electronics, pharmaceuticals etc. The need to remain 'lean and clean' is

being increasingly felt. HR professionals have an important role to play here – whether reducing hours of work, laying off workers, making unions and workers agree for a wagecut etc. To remain competitive, most HR managers nowadays anticipate such cyclical changes in advance and initiate proactive steps that are less painful. In the long run, how effectively a company uses its human resources can have a dramatic impact on its ability to compete or survive in an increasingly competitive environment.

Table 1.12: What HR Managers can Do?

- Use workforce skills and abilities in order to exploit environmental opportunities and neutralise threats.
- Employ innovative reward plans that recognise employee contributions and grant enhancements.
- Indulge in continuous quality improvement through TQM and HR contributions (training, development, counselling, coaching etc.).
- Utilise people with distinctive capabilities to create unsurpassed competence in an area (Xerox in photocopier, 3M's in adhesives, Telco in Trucks, Britannia in Biscuits, Nestle in Coffee, McDonald in fast foods, etc.).
- Decentralise operations and rely on self managed teams to deliver goods in difficult times (Motorola is famous for short product development cycles. It has quickly commercialised ideas from its research labs).
- Lay off workers in a smooth way, explaining facts (IBM, Kodak, Xerox, AT&T, Steel and Textile firms in India etc.) to unions, workers and other affected groups.

Political Factors

Political stability, political parties and their ideologies, formation of new political parties (Telugu Desam Party in Andhra Pradesh, Trinamul Congress in West Bengal, Shiva Sena in Maharashtra, Janata Dal in Bihar), splits in and amalgamation of existing parties influence the functioning of trade unions in an organisation. This in turn, leads to formation of new unions or splitting up of existing unions. Bhartiya Kamgar Sena (BKS) floated by Thakeray in 1960s, owes its popularity now in Maharashtra due to the ascendancy of Shiv Sena, in recent times. The other two unions, Shramik Sena and Maharashtra Shramik Sena also believe in 'production, productivity and discipline' and have a following of nearly 2.5 lakh workers. The changes in unions have serious implications for HR managers. Rahul Bajaj, for example, feels that BKS is very positive to suggestions from employers and conducts wage negotiations in a business like manner. In Oct 1996, after 12 years of unsuccessful negotiations with its own internal union, Bajaj Auto signed a difficult wage and productivity agreement at its Vatry plant with BKS. Thanks to the awareness of workers, companies like Polychem, Otis, Philips, Mahindra and Mahindra, Premier etc. have successfully implemented a VRS scheme. In case of Shri Ram Mills, despite union pressure, the workers accepted voluntary retirement scheme (each worker got upward of Rs 2 lakhs) and allowed the management to sell its property to realtors.

Similarly, defying Datta Samant, workers of Premier Automobiles Ltd have accepted proposals advanced by the management. HR managers from Ingersoll Rand Blue Star strongly feel that the days of single-skilled worker are over. There is more demand for multi-skilled workers. The new class of workers is neither gullible nor excited about trade unionism. Wage-linked productivity agreements have become common, as workers are more keen to sink or swim along with the company (Mahindra and Mahindra for example). Pure commercial interests have come to play a dominating role now in place of political and non-economic factors in union-management relations (Business India, Nov. 4-17, 1996).

Social Factors

HR managers have long realised the importance of conducting their business in a socially relevant and responsible manner. What do you do when the company operates in an area where large army of unemployed people live? A philosophy of hiring workers who are capable of being trained as against hiring only qualified applicants may help reduce unemployment. It may also improve profitability in the long run. Is it possible for a person to buy a firm's products or services

if he remains unemployed? The society at large nowadays is more demanding. The actions of business are being monitored and evaluated closely. If a manufacturer claims that his product has one hundred per cent juice content (e.g., Onjus) and the rival (Tropicana) tries to contest this issue openly, the customer is ready to evaluate the issue dispassionately and decide about the future course of action. If the expectations are not met or the tall claims do not stand the test, the fate of the firm/brand is automatically sealed (as it happened in the case of Bajaj's motor cycle, 'Cheetah', technologically-outdated Ambassador car model, etc.). Firms do not operate in isolation. They are stuck with society. Social impacts have to be carefully evaluated before undertaking any action programme. And society here includes the firms' own employees and their friends, relations, neighbours as well. Before cutting jobs in a big way (where, for example, in National Textile Corporation 40,000 jobs have been slashed voluntarily), HR managers have to assess reactions beforehand and come out with certain proactive steps (explain facts, train or retrain them, give outplacement help, etc.). Considerable pressure can be exerted on a firm to alter its practices (for example, in Steel Authority of India, SBI and other State owned Banks, DTC the slashing of jobs did not take place in a big way) if the public believes that it is not operating in the best interests of society. A firm, after all, operates by public consent to satisfy society's needs.

Local and Governmental Factors

Governments all over the world had neither the time nor the interest to care for the problems pertaining to labour arising in industry till the end of 1940s. But the need for Governmental interference arose out of the belief that Government is the custodian of industrial and economic activities. The emergence of problems on the industrial front in the form of trade union movement, failure of many employers to deal fairly with workers, non-fulfillment of plan targets and the like, forced the governments to intervene in human resource management and to enact various pieces of labour legislation. Consequently, the Government in India, too, has come out with a complex set of rules and regulations on the employment policy of the organisations by reserving certain number of jobs of all categories to certain sections of the community. Hence, the management cannot manage the personnel unilaterally as it used to do, because it has to abide by the rules and regulations imposed by the Government from time to time.

One of the most important external factors that affects HRM is the legal environment, i.e., awareness of legislations enacted by the government at the Centre and the States. The important legislations enacted in India affecting HRM are: Factories Act, 1948; Trade Unions Act, 1926; The Payment of Wages Act, 1936; The Minimum Wages Act, 1948; The Employment State Insurance Act, 1948; Workmen's Compensation Act, 1923; The Payment of Bonus Act, 1965; The Industrial Employment (Standing Orders) Act, 1946; The Employment Exchange (Compulsory Notification of Vacancies) Act, 1959; Payment of Gratuity Act, 1972; The Maternity Benefit Act, 1961; The Apprentice Act, 1961, etc.

Unions

Unions have also gained strength after the advent of Industrial Revolution. At present, these organisations constitute one of the power blocks in many countries, including India. With the formation and recognition of these organisations, the issues relating to employee interests are no longer determined by the unilateral actions of management. These have to be discussed with union representatives invariably. In addition, unions have shifted their emphasis from economic tactics to the political pressures. Thus "….the unions have turned increasingly to governmental action as a means of achieving their objectives in addition to using the more traditional actions". In consequence, the scope of managerial discretion in personnel activities has been narrowed down.

1.18 WORKFORCE DIVERSITY

Composition

Diversity in the field of HRM can be defined as the situation that arises when employees differ from each other in terms of age, gender, ethnicity, education, etc. Workforce diversity means that organisations are becoming more heterogeneous in terms of age gender, race, ethnicity.

The composition of the workforce is changing in India. Young, skilled and knowledgeable employees are occupying positions of importance. At the same time, thanks to the opening up of

private sector, employees are no more fascinated by secure, less-paying, routine and standardised jobs offered by the public sector and other government-owned and controlled organisations. Old employees have grown in number now, thanks to the improved medical and health care. Big private sector firms have been exploiting their talents to conceive, operate and develop new ventures in emerging areas such as oil, telecom, insurance, banking, health care, etc.

Table 1.13: Young vs Old

• Inexperienced	• Difficult to bend and change
• Impulsive	• Traditional
• Inpatient	• Go by the rule book
• Unethical/ Not always ethically conscious	• Workaholic
• Selfish	• Inflexible
• Manipulative.	• Prefer safe, steady work environments; less risky activities.

Organisations now cannot discriminate on the basis of age. They must listen to their experienced employees, to draw from their expertise and initiate programmes that meet these needs. At the same time companies have to understand and appreciate the changing values of the young workers who join the company with lot of expectations. The days of life time employment, total loyalty to company and commitment to work seem to be a thing of the past. To attract and retain young brains, organisations have to institute appropriate HR policies, supported by attractive compensation offers.

Diversity issues in Indian companies are somewhat peculiar owing to differences in social ethos, religious origins, cultural differences and regional origins. Certain sections of society enjoy a preferential treatment, guaranteed by constitution, right at the entry level itself, such as:

Table 1.14: Minority Groups Reserved Category Employees in India

Scheduled casts and scheduled tribes (SCs & STs)
Other backward castes (OBCs)
Sons of the soil
Ex-Defence and Para-military personnel
Physically disabled
Displaced persons (DPs)
Gender issues
Contract labour
Child labour
Minority groups

The job reservation for SCs and STs have been extended for another 10 years, starting from 2,000 through a recent government notification, in all public sector undertakings. The list of OBCs has also been expanded now by the Vajpayee-led BJP government, to extend employment benefits to other neglected sections of society. The sons of the soil policy ensures reservation of certain category of lower level jobs to local people in preference to outsiders. Shiv Sena, for example, is a strong supporter of this policy ever since its inception as a political party in Maharashtra. Displaced persons too get preferential treatment for lower level positions advertised by the company which has acquired their land/house sites, etc. (Essar Steel, Reliance, etc.), for building factories/production facilities. In addition, HR managers have to deal with issues of child labour (a sensitive issue in industries such as carpet making, crackers industry, etc.) and contract labour where the various pieces of labour legislation are being conveniently ignored by the employers.

Women at Work

(See Praxis, Women in Management, Nov. 1999)

Women employees today constitute a major share of the workforce. In India alone over 400 million are employed in various streams due to a combination of factors like:

- Women's emancipation
- Growing economic needs

- Greater equality of sexes
- Increased literacy rate
- Suitability for certain soft jobs (public relations, telephone operations, reception counters, etc.).

Box 1.4: The Invisible Workforce

> Women hold up more than half the sky. Far from being just a vigorously uttered slogan, government studies reveal that the female workforce in India does indeed make a significant contribution to the nation's economy and family welfare. Yet, at the same time, this economic contribution is either abjectly unrecognised or where taken note of, is qualitatively unprotected. According to 1981 census, 89.5 per cent of women workers are engaged in the unorganised sector, of which a huge chunk – 82.3 per cent – actively participate in agricultural and allied operations. This massive segment of the female workforce contributes as much as 60-70 per cent to total agricultural activity in our village.
>
> —Business India, March 6 to 19. Special Feature.

The initial reluctance of employers to give jobs to women seems to be a thing of the past (due to increased financial burden in the form of maternity benefits, creches, prohibition of women in night shifts and in hazardous jobs, etc.). They handle both 'hard' and 'soft' jobs now in areas such as accounting, hospitality, banking, insurance, airways, police, teaching, beauty care and even driving. The principle of equal pay for equal work has more or less become the rule now in most industries (barring plantation, construction industry, etc.).

Organisational workforce thus consists of people from different regions, mostly due to increased transportation facilities and the mobile character of people. Further, technological revolution has brought about occupational mobility. These changes in workforce have naturally complicated the task of HRM as the HR manager, has to grapple with employees with vastly different backgrounds.

Changes in Employee Roles and their Values

Traditionally, it was believed that management has got the brains and hence will decide what is good or bad for the employees. The employees are expected to follow the commands of the boss without posing any questions. However, this paternalistic atmosphere has changed with the advent of unions. Employers have also gained consciousness regarding their rights in the workplace.

Further, the changing structure of the workforce has led to the introduction of new values in organisations.

Box 1.5: Changing Work Values

> In our increasingly complex society, people have more educational and developmental opportunities than ever. This in turn has helped create a whole new set of employee expectations. As a result, the traditional employee and the contemporary employee tend to hold markedly different attitudes toward work and authority. Organisations must now advance from general affirmation and enthusiasm for the career development of their personnel to greater precision. The concepts and goals of education and development programmes must be more precise, more widely understood, reflected in formal policy statements and translated into institutional and personnel practice.
>
> –Jack Halloran, Personnel and HRM, Prentice Hall, NJ, 1986.

Among these are moves towards (a) emphasis on quality of life rather than quantity; (b) equity and justice for the employees over economic efficiency; (c) pluralism and diversity over uniformity and centralism; (d) participation over authority; (e) personal convictions over dogma; and (f) the individual over the organisation. Alienation from the job, increasing counter-productive behaviour, rising expectations and changing ideas of employees are some of the other factors responsible for the changing values and roles of human force. Consequently, it has become imperative for the management to include various fringe benefits to improve morale, introduce a machinery to redress grievances, encourage employee participation in decision-making and the like to pave the way for industrial betterment and to meet the ever increasing demands of workforce.

Another change in the values of employees is the declining work ethic. In the days gone by employees regarded job as a central life interest and pursued work assignments with single-minded devotion. In recent years, the work ethic has declined in favour of a more existential view of life. Work is regarded as only one alternative among many as a means for becoming a whole person in order to do one's own thing. Family activities, leisure, avocations and assignments in government and schools are all equally viable means through which a person can find meaning and become self-actualised.

Table 1.15: Values of Employees

What are Americans Like?	What are Indians like? (Fill it yourself)
1. Americans are very informal.	1. ----------
2. They are direct. They don't talk around things.	2. ----------
3. They are competitive, assertive and even overbearing.	3. ---------- ----------
4. They are achievers. They value achievements and like to keep score.	4. ---------- ----------
5. They are independent. They have freedom and uniqueness. They believe that individuals can shape and control their own destinies.	5. ---------- ---------- ----------
6. They have an inquisitive mind. They ask a lot of questions (sometimes pointless also). The purpose of education, according to them is to learn, to think, to analyse and to think.	6. ---------- ---------- ---------- ----------
7. They dislike silence and like to draw others into conversation.	7. ---------- ----------
8. They value punctuality. They are sticklers for schedules and promptness.	8. ---------- ----------
9. They value cleanliness (observed with bathing, eliminating body orders, wearing clean dress, etc.).	9. ---------- ----------
10. They hold ethnocentric values (they believe that their cultural values and customs are superiors to all others).	10. ---------- ---------- ----------
11. Americans suffer from parochialism (i.e., view the world through their own eyes and perspective). They do not recognise that other people have different ways of living and working.	11. ---------- ---------- ---------- ----------

Source: (i) N.J Adler, International Dimensions of Organisational Behaviour, Kent, Boston, 1991.
(ii) T-Cox, cultural Diversity in Organisations, Berret Kochler sna Francisco 1993.

Further, employees are seeking a greater balance between their work lives and their personal lives, more leisure time and greater flexibility in scheduling time away from work especially in 80s. Feeling severely constrained by the Monday-through-Friday, nine-to-five gruelling routine, they find it difficult to schedule doctors' appointments, accommodate children's school schedules and satisfy other personal needs away from work. Employees are demanding that management look more closely at work schedules which accommodate their needs in addition to the needs of the company.

Level of Education

Workers have been entering the organisations with increased level of formal education in recent years. Increased formal education led to the changes in attitudes of employees. The well-educated employees always challenge and question the management's decisions and want a voice in the company's affairs affecting their interests. "As the base of education broadens, management must plan to deal with employees on a higher plane of logical interactions". One implication of an increase in educated and knowledge workers-accountants, engineers, social workers, nurses, computer experts, teachers, researchers, managers is that HRM will be called upon to find innovative ways of keeping these people challenged and satisfied. Knowledge workers often demand more responsibility and autonomy than their employers are willing or able to afford.

1.19 INTERNAL ENVIRONMENT

The internal environment also exerts considerable pressure on human resource management. The internal environment comprises those factors that affect an organisation's human resources from inside the organisation's boundaries. The primary internal factors include the firm's mission, company policies and corporate culture. These factors have a major impact in determining the interaction between human resource management and other departments within the organisation.

Mission and Strategy

The mission is the very reason and justification for the existence of a firm. Mission is usually expressed in terms of the benefits the firm provides to its customers. An organisation's mission statement tells what it is, why it exists and the unique contribution it can make. For example, observe the mission statement of ONGC, "To stimulate, continue and accelerate efforts to develop and maximise the contribution of the energy sector to the economy of the country".

At various levels, people must carry out assigned tasks keeping the overall mission of the firm in mind. Now consider two companies: Company A wants to achieve leadership position through technological superiority, new products and processes on the other hand, Company B does not believe in taking in big risks and prefers steady growth. Company A needs a creative environment where ideas are encouraged. Highly skilled employees need to be picked up to achieve technology-led growth. Constant focus on training and development of workforce is needed. A compensation package designed to attract, motivate and retain the most productive employees is equally important. In Company B, the strategies have to be different, in line with its philosophy. Creative people may not like to work in Company B, because the mission statement puts little emphasis on risk-taking.

Policies

Policies offer guidance for thinking. Policies tell people what they may or may not do. They direct the manner in which activities are to be achieved. Objectives show the destination and policies offer the route. In statements like "we sell only for cash", "customer is always right", some aspects of a recurring problem are isolated and a broad guide is established for dealing with them quickly. Policies offer standing answers to recurring questions and specify the steps to be taken in making a decision. Most policies in large organisations relate to management of human resources only. Some of the important policies that influence the work of a HR manager are listed below:

1. To provide employees with a place of work that is as safe as possible.
2. To encourage all employees to achieve as much of their human potential as possible.
3. To provide compensation that will encourage a high level of performance in the form of increased quality and quantity of production.
4. To ensure that present organisational members are considered first for any vacant position.

This last policy is often referred to as a 'promotion from within' policy. This type of guideline aids managers when they are faced with promotion decisions. Since polices have a degree of flexibility, however, the manager is not necessarily required to promote an employee currently with the firm. The supervisor may determine, for example, that no one in the firm is qualified and choose to look outside the firm for a replacement.

Organisational Culture

Organisational culture is the product of all the organisation's feature: its people objectives, size, technology, unions, policies, its successes and its failures. It is the sum total of shared values, beliefs and habits within an organisation and in short, may be called the organisation's personality.

Box 1.6: Elements of Strong Corporate Cultures

A widely shared philosophy. This philosophy is not an abstract notion of the future but a real understanding of what the firm stands for, often embodies in slogans.

A concerns for individuals. This concern often places individual concerns over rules, policies, procedures and adherence to job duties.

Contd...

A recognition of heroes. Heroes are individuals whose actions illustrate the shared philosophy and concerns of the company.

A belief in ritual and ceremony. Management understands that rituals and ceremonies are real and important to members and to building a common identity.

A well-understood sense of the informal rules and expectations. Employees understand what is expected of them.

A belief that what employees do is important to others. Networking, to share information and ideas, is encouraged.

Source: Developed from Terrence Deal and Allan Kennedy. Corporate Cultures: The Rites and Rituals of Corporate Life (Reading, Mass : Addison – Wesley, 1982).

The challenge for HR professionals is to adjust positively to the culture of the organisation. They have to choose paths that best reflect the culture of the firm and the attitudes of its people. What to do when workers start violating the company norms such as smoking when they are not supposed to smoke? Should it be dismissed as a minor violation and bear with such offences in future too or should the rights of non-smokers be given importance? How to strike a balance between maximising shareholders' returns and workers' concern for job security, especially during a merger or acquisition? A closed and threatening culture goes against the longer interests of employees. Decisions are made at the top; there tends to be a lack of trust and confidence in subordinates, secrecy pervades executive actions, workers are tightly controlled. In organisations where there is an open culture most decisions are taken at lower levels, subordinates are trusted, two-way communication is encouraged, teams are created to solve problems. Understanding the type of culture that prevails within a firm is important in order to frame appropriate HR policies and strategies.

Organisation Structure

Organisations consist of people who are united by a common purpose. To meet the objectives, a structure is created, maintained and used. Structure here is used to refer to the network of relationships among individuals and positions in an organisation. To carry out tasks, managers follow certain steps:

i. Identify the work, delegate it to various people.

ii. Establish relationships between people and positions.

iii. Measure, evaluate and control the work done at various levels.

Generally, there are three levels in organisations, viz., strategic, managerial and operating. At the strategic level, policies are formulated, goals are set, objectives are framed. Strategies are also designed to achieve the objectives taking into consideration the environmental influences on the organisation. At the management level the programmes regarding the procurement and allocation of all types of resources are formulated to achieve the strategies and objectives. At the operating level, the programmes are implemented i.e., the actual operations are carried out in the process of day to day activities in order to carry out the strategies and achieve the objectives.

Basically, there are two types of organisational structures, viz., flat and tall. Tall or pyramid type of organisational structures are suitable to the companies which are labour-oriented. Flat organisations are suitable to the technology-oriented companies. Since most of the modern organisations are technology-based and endowed with capital and highly educated employees they tend to have an organisation structure where the number of employees at the operating level are relatively less. In view of this, personnel management is not only challenging but also significant one in a modern organisation. Moreover, human resources have a plus value in that they can convert the disorganised resources into a useful, productive organisation.

Human Resource Systems

Human resource system in an organisation is not only a unique sub-system but also a principal and central sub-system as it operates upon and controls all other sub-systems. Managers often comment thus: "People are our greatest assets." They are fond of repeating the truism that the

only real difference between one organisation and the other is the performance of people. In essence, the survival, development and performance of an organisation heavily depends on the quality of the personnel. While designing HR systems, management might consider the points given in Table 1.16.

Table 1.16: Designing Appropriate HR Systems

Issue		Focus on
• Nature of employment	:	Job / Career
• Recruitment	:	Internal / external / both
• Selection	:	Merit / other considerations
• Training and employee development actions	:	6 months / yearly Regular / irregular / need based
• Degree of participation	:	Top down / bottom up
• Incentives	:	Individual merit/group output
• Job security	:	Life long employment/ need-based jobs
• Employee welfare	:	Be a model employer (offer those that are needed by laws.

In view of the significance of human resource system, organisations today are creating human resource development (HRD) departments and the status of this department is equated to other functional departments. Most of the organisations have already introduced schemes of Participative Management and Quality Circles with a view to make use of untapped human resources, provide free flow of upward communication and enhance the status of employees. Similarly, the programmes of human resource development, organisation development, etc., have received much attention as the organisations have realised the importance of human resource contributions in organisational success. Further, the increased concern of the organisations about the programmes of quality of work life shows the enhancement of the status of personnel function in general and human resources in particular. This change is not an end but only a humble beginning to the increase in the status of HR function in the years ahead.

1.20 MANAGING DIVERSITY

One way to deal with the problem of diversity is to create a truly multicultural organisation where all members of diverse cultural and social groups are involved in the divisions that shape the mission, operations, interactions, products and services of the organisation. To this end, HR managers must encourage open communication with young and old employees, workers, minorities, disabled, etc. In this way managers can learn more about a group's personal values and understand how individuals like to be treated. When they interact with disabled, for example, they may find that the disabled may not like any special attention or treatment to be given to them. They may want to be treated like everyone else, asking only for equal employment opportunities. Encouraging feedback from various groups regarding how they would like to be treated help HR professionals formulate appropriate strategies. In male dominated offices, sexual harassment has become a nuisance in recent time. Before initiating steps to curb such unhealthy tendencies, HR managers must interact with women employees and elicit their opinions on how to improve relations between males and females. They must develop and communicate a strongly worded policy stating that racial or sexual harassment violates company rules. Certain proactive companies nowadays are developing awareness campaigns to help employees understand the pain and indignity of harassment. At middle and higher management levels, charges of harassment could invite harsh punishment and often lead to termination of employment, followed by law suits. To protect the image and reputation of the company, HR managers must highlight rules in this regard so that everyone understands the policies of the company clearly. To avoid charges of discrimination, managers must: (Luthans, chap 3):

- Ensure that all types of applicants are sought without any discrimination (recruiting).
- Use of valid and non-discriminators selection tools and devices (selecting).
- Emphasise that all employees without exception are eligible to use training and development-oriented facilities (training).

- Apply performance appraisal systems without any bias or prejudice (appraising).
- Reward employee performance emphasising the principle of equity (compensating).
- Fix work schedules in a flexible way so that female employees, dual-career couples, disabled workers can participate in all organisational activities without any problem (scheduling).

Student Activity 3

1. Write one line definition for the following terms:
   a) Organizational environment
   b) Technology
   c) TQM
   d) Benchmarking
   e) Reengineering work processes
   f) Flexible manufacturing
   g) Competitive advantage
   h) Workforce diversity
   i) Organizational mission
   j) Policies
   k) Organizational culture
   l) Organizational structure
2. Fill in the blanks.
   a) To deal with workforce diversity, managers should create a _____ organization.
   b) Firm's mission, company policies and corporate culture are all factors of _____ of an organization.
   c) Workforce diversity prevails on account of the following factors: composition, women at work, _____ and _____.
   d) Flexible manufacturing is the integration of computer aided design and manufacturing to produce _____ products at _____ production costs.
   e) The external environment of an organization comprises political factors, unions, ____ and _____.
3. Briefly explain the four main ideas behind TQM.
4. Managers should imagine that they are staring with a clean piece of paper. Discuss the statement in light of reengineering work processes.
5. In your opinion, is organizational culture and structure interrelated? Give reasons in support of your answer.

1.21 SUMMARY

Today, human resource is considered a unique asset of an organization. Employees of successful organizations are leveraged as its competitive advantage. Thus, the importance and changing role of HR professionals cannot be overemphasized.

This unit introduces you to the field of human resource management, its nature, objectives as well as the complexities and challenges in the current context. It also discusses HRM in the Indian perspective, highlighting the evolution and growth of this field within the country. Concepts like Total Quality Management, Flexible Manufacturing Systems and Workforce Diversity are also discussed in light of their impact on the human resource of the organization.

1.22 KEYWORDS

- ***Management:*** The process of efficiently achieving the objectives of the organisation with and through people.
- ***HRM:*** A process of bringing people and organisations so that the goals of each one is met, effectively and efficiently.
- ***Purpose of HRM:*** HRM seeks to improve the productive contributions of people to the organisation in ways that are ethically and socially responsible.
- ***System:*** Two or more parts working together as an organised whole with clear boundaries.
- ***Productivity:*** The ratio of an organisation's outputs to its inputs.
- ***Reengineering:*** Occurs when more than 70 per cent of the work processes are evaluated and altered.
- ***Empowerment:*** Allowing employees more control over what they do on the job.
- ***HRD:*** A planned way of developing individual employees, groups and the total organisation to achieve organisational goals, in an atmosphere of mutual trust and cooperation.
- ***Job Analysis:*** The systematic collection, evaluation and organisation of information about jobs.
- ***HR Planning:*** Process of identifying human resource needs and formulating plans to meet these needs.
- ***Recruitment:*** The process of finding and attracting capable applicants for employment.
- ***Selection:*** The process of matching the qualifications of applicants with job needs and choosing the most suitable one.
- ***Training:*** A learning process designed to achieve a relatively permanent change in an individual that will improve the ability to perform on the job.
- ***Employee Development:*** A kind of future oriented training, focusing on the individual growth of the employee.
- ***Mission:*** The reason and justification for the existence of a firm, it tells about what a company does to meet customers' expectations.
- ***Structure:*** Framework of an organisation.
- ***Policy:*** Standing answer to a recurring problem.
- ***Technology:*** Refers to how an organisation transfers its inputs into outputs.
- ***TQM:*** A way of creating an organisational culture committed to the continuous improvement of skills, teamwork, processes, product and service quality and customer satisfaction.
- ***Reengineering:*** Radical, quantum change in an organisation.
- ***Diversity:*** The situation that arises when employees differ from each other in terms of age, gender, ethnicity, education, etc.
- ***Flexitime:*** A work scheduling system that allows employees some discretion over when they arrive at work and leave.
- ***Culture:*** It is the organisation's personality revealing the shared values, beliefs and habits of its members.

- ***Benchmarking:*** Measuring the performance of processes within your organisation, comparing these performance levels with the best in class companies and where deficiencies exist, using the information on the best practices too improve your organisation's own business processes (Kehoe).

1.23 REVIEW QUESTIONS

1. Define "HRM". Outline is objectives.
2. What are the current misconceptions about HRM? What should be done to improve the situation?
3. Define HRM and outline its features clearly.
4. What do you mean by the "Systems approach to HRM"? What are the important subsystems of HRM?
5. Give examples of how HR concepts and techniques can be of use to all managers.
6. Why is it important for a company to make its human resources into a competitive advantage? How can HR professionals contribute to a doing so?
7. What are the important stages in the growth of personnel management in India?
8. Explain the factors inhibiting the growth of personnel management in India. Suggest measures to improve the situation.
9. Why should HR managers monitor demographic trends (such as composition, race, age, sex, education, etc.)?
10. How do economic cycles impact the HR function? Give an example of an HR policy that takes variations in the economy into account.
11. What is meant by diversity and what are the major reasons that have made it a challenge for today's organisations?
12. Outline the major characteristics of diversity.
13. How can diversity be managed? Offer suggestions at both the individual and organisational levels.
14. What factors influence personnel environment in India? Discuss their implications.
15. Discuss the present state of personnel function in organisational context with special reference to the strategy, structure and systems of HR.
16. Discuss the relationship between technology and HR strategies and actions. What can HR managers do to grapple with economic challenges and technological advancements?

Answers to Student Activity 1

1. a) False b) False c) True d) False
   e) False f) True g) True h) True
2. a) Sponsor; internal consultant b) Pyramidal
   c) Consistent; predictable d) System e) Employees

Answers to Student Activity 2

1. 1) d 2) a 3) e 4) b 5) c
2. 1) d 2) c 3) a 4) d
   5) d 6) a

Answers to Student Activity 3

2. a) Multicultural b) Internal environment
   c) Changes in employee roles; level of education d) Low volume; mass
   e) Social; local and governmental

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CASE STUDY

Does Sincerity Pay?

Rajdhani Tyres Ltd (RTL) was a medium-sized tyre company, manufacturing tyres of various types and grades. It had 6000 workers and 400 executives on its rolls.

The manufacturing division was headed by Ramlal. Shekhar who was the Chief Engineer reporting to Ramlal directly. The division had 400 workers, 20 executives and 40 supervisors.

Baluja joined the manufacturing division four years back as a skilled worker. He was technically sound, hardworking and performed his duties sincerely. He was promoted as a supervisor recently.

Contd...

On Monday, Baluja was taking rounds in the department. It was a routine inspection and he spotted Raghu doing nothing. Baluja advised Raghu to concentrate on the job given to him instead of wasting his time. Raghu shot back saying "you mind your business. I am the senior most in this department. Don't think you have become big after your recent promotion". Other workers witnessed the exchange of words with interest and finally burst into laughter when Baluja tried to retort. Encouraged by the favourable response from his team mates, Raghu retaliated by using unparliamentary words. In frustration, Baluja had to report the matter to the Chief Engineer Shekhar. Shekhar took a serious note of the situation and issued a stern warning to Raghu, ignoring the fact that Raghu was quite notorious for such incidents in the past as well.

Baluja was able to get along with others in the departments, despite occasional flare-ups over matters relating to discipline and production targets. After a two-year stint, Baluja was in the midst of a crisis again.

A worker named Roberts came to duty in a drunken state and was celebrating his birthday with other colleagues, disrupting work. Even after half an hour the noise did not subside and Baluja had to intervene and check Roberts to go back to work and allow others to resume normal duties. Roberts got wild when he was physically forced to go to his workspot. In a fit of anger, Roberts resorted to physical abuse and slapped Baluja in front of others. Not content with this, Roberts reported the matter to the union, alleging verbal as well as physical abuse from the supervisor, Baluja.

Three days afterwards Baluja got the shock of his life when he came to know about this from another supervisor. After the ugly incident Baluja had to rush back to his house for admitting his son in the local hospital for viral fever. Since Roberts was drunk and it was his birthday, Baluja never thought of reporting the matter to his boss.

The union presented a highly fabricated case to the chief of manufacturing, Ramlal and demanded immediate disciplinary action against Baluja. Ramlal instructed Shekhar to demote Baluja immediately so that he would mend his violent ways of dealing with workers. Shekhar advised restraint since this would send wrong signals to other supervisors and would demoralise them thoroughly. Shekhar however, fearing a revolt from the union, had to demote Baluja.

Unable to swallow the insult to his ego, Baluja resigned immediately thereafter, citing personal reasons. Shekhar was quite unhappy with the turn of events and sought advice from the personnel manager, Khurana.

Khurana was quick to respond "incidents of this nature should help us realise the importance of picking up people with good interpersonal skills as supervisors rather than technical skills. After all, they need to extract work from others, without losing their cool even under provocative situations. You see, we can't put unions in a spot even when they are on the wrong side".

Shekhar: "I know people were after Baluja, since he is sincere and hard-working. He was a race horse. Others were not. With a little bit of tact, Baluja could have managed the situation well".

Ramlal: "It's sad to lose people like him. But Shekhar, workers are illiterates and respond negatively when you talk tough language. A supervisor should use his brains rather than hands while dealing with people. This fellow rubbed shoulders with union people on the wrong side previously too. Other supervisors seem to be OK. Be careful in your selections from now on".

Questions

1. What is the main problem in the case?
2. What would you do, if you were in place of Shekhar?
3. Do you think Baluja was wrong on both occasions? Why? Why not?
4. What ways do you suggest for dealing with tough employees in an organisation?

(Adapted, IGNOU).

CASE STUDY

Government Regulation

Since the 1940s the Indian Government has increased its regulation of the way employers treat employees. The Trade Union Act, 1926, permits workers to join unions, the Minimum Wages Act, 1948, guarantees a minimum wage, the Factories Act, 1948, ensures a safe and healthy environment, the Workmen's Compensation Act, 1923, offers compensation to injured workers, the Payment of Wages Act, 1936, checks fraudulent practices in the payment of wages to workers. The regulatory framework covering factories, union-management relations, compensation issues, dispute settlement, etc., is quite rigorous and elaborate. There are laws that prohibit discrimination and restrict the freedom of employers to make HR decisions in other areas as well.

As the guardian of the economy and as a regulator of employment relations, the Central government does not seem to loosen its grip in the near future. Experts believe that the trend toward increased governmental intervention will continue. They base their arguments on the current trends in developed countries in this area in the form of employer-sponsored health insurance schemes, greater job security, improved treatment, etc.

Others, however, are not very optimistic about governments trying to regulate the employer-employee relations closely. Competitive pressures, deregulation of industry, rising wage bills, increasing number of older employees needing social security protection, inflationary pressures, heavy taxes and a host of other factors having a significant bearing on the profitability of a firm do not seem to support government's active intervention in industry. These experts contend that if Indian firms have to remain competitive in international markets, they should be freed from all types of control, especially those imposed by the government.

Questions

1. Which trend do you think will occur and why?
2. If government regulation continues to increase, how will HR departments be affected?