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**A STATISTICAL ANALYSIS AND COMPARATIVE STUDY OF
MODERN TECHNOLOGY WITH IMPACTS ON HUMAN RESOURCE
DEVELOPMENT**

IN PUBLIC SECTOR BANK

(With Reference To Gujarat State)

A Thesis

Submitted To The Saurashtra University

For

Ph.D. Degree In Management

Under The Faculty of Management

Saurashtra University,

Rajkot – 360 005.

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CERTIFICATE

It is certified that the thesis entitled “a statistical analysis and comparative study of modern technology with ipacts on human resource development in public sector bank”- is research study done by Mr. Piyush N. Goswami under our guidance hence the present thesis represents independent study on the part of candidate.

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PREFACE TO THE RESEARCH STUDY

It used to be that human resource professionals relied on technology just for administrative tasks such as time and attendance and payroll.

Today, core HR responsibilities as diverse as recruitment, oversight of legal and regulatory compliance, benefits administration, and the safeguarding of confidential employee information cannot be carried out effectively without high-tech tools.

In this world, matters gets measured, many HR executives are turning to sophisticated analytics to gauge their department's strategic contributions. In addition, many HR managers are borrowing from other business disciplines and integrating collaborative and social networking tools such as listservs, Facebook applications and video.

For these HR professionals, the growth of electronic communication and Internet use requires developing policies governing the safekeeping and appropriate flow of information which includes e-mail and blogs also. Indeed, HR professionals, working in tandem with information technologists, now rely on policy and software to monitor data flow, block inappropriate data which prevent the leaking of trade secrets.

HR professionals also rely on automated systems to direct employee benefit contributions. Such systems automatically direct a portion of workers' pay toward their retirement savings plans unless employees opt out, for instance.

And while total rewards statements that alert employees to the total value of their compensation benefits packages have been around for years, many companies now are making that information available to workers electronically through HR information systems or self-service sites.

Initiatives for workplace diversity gets a boost from technology. Remarkable developments in assistive technology, for example, have increased job opportunities for people with physical disabilities. Some employers say that investing in such technologies is simply the right thing to do while others argue that such initiatives are good for the bottom line since they allow companies to recruit from a broader pool.

Employers are also turning to technology to assist in evaluating their workers and vice versa. Electronic systems can automate performance-management processes, ensure an accurate "grading curve" and guarantee feedback to employees.

Meanwhile, many companies are relying on technology to streamline traditionally cumbersome employee surveys.

Technology has significant impact on organization and employee development in such areas as e-learning, computer-based testing and workplace collaboration. Organizations are increasingly using technology in training.

Human resources professionals are upping their reliance on technology to manage safety and security information and functions. Workplace safety and security can benefit from technology by facilitating acquisition and analysis of injury and illness data, injury costs per employee, training documentation and management, performance management, electronic communications, digital access key log-in information, security camera data management and identity theft protection.

Biometrics devices which use fingerprints or other physical traits for identification can help to solve some employee discipline problems and protect sensitive data. Time clocks are one of a growing number of workplace applications of biometrics.

During the last decade, the Internet has played a growing role in external recruiting. All-purpose online job boards quickly found a place in recruitment.

Meanwhile, niche sites catering to specific industries and demographic niches such as women and Asians won favor. Online corporate job sites and intranets have become key recruiting tools, allowing employers to get the word out about job openings quickly and inexpensively.

Employers also are using technology to market job openings more strategically. Many capitalize on emerging technology like real simple syndication (RSS) allowing online postings to reach job seekers via e-mail or text message as soon as a new job is posted. Others are enhancing traditional online listings with videos and podcasts.

Meanwhile, employers have had to adapt to tech-savvy candidates and multimedia which resumes that include text, photos, video and sound.

Technology is also playing a pivotal role in the controversy regarding illegal immigration. Tens of thousands of employers are voluntarily using e-Verify, an Internet-powered tool offered free by the Social Security Administration and the U.S. Department of Homeland Security, to verify a match between employees' names, Social Security numbers and immigration information.

Once an application comes in, many HR professionals tap desktop search engines such as Google to check backgrounds. A few employers check out workers' private blogs and entries they may have placed on social networking sites such as Facebook and MySpace. Others sign up for help from computerized background screening services.

Once a new hire comes on board, many HR professionals are relying on electronic onboarding systems to handle tasks including assigning parking passes, computers, uniforms, e-mail addresses and security badges. Some employers particularly those with a scattered workforce are capitalizing on computerized learning

systems for orientation and to deliver coaching on topics from sexual harassment avoidance to conflict resolution.

'New Human Resources (HR) consulting industry is on the rise. Management decisions about HR functions can affect the way a business is conducted. The inverse is also true. The way a business is done can affect HR decisions. The paper explores changes in the way HR functions are performed in the advent of high technology advances in conducting business processes over high-speed communications channels, termed e-business in today's market.

Today we live in a world increasingly dependent upon technology. To meet the changing demands of a technological age, business and industries are seeking to fill leadership and training positions with technologically literate men and women who are adaptable, flexible problem solvers. Industrial technology education teachers, vocational-technical teachers and human resource developers are needed to provide the personnel sought for these positions.

Technology and Human Resource Development is helping to meet these growing needs. It has four areas of studies :

(a) Human Resource Development, (b) Industrial Technology Education, (c) Vocational-Technical Education (d) Customized Training & Development

The globalisation of economy completed with entry of Multinationals has made it necessary for companies in India to become globally competitive. One strategy is to Technologically upgrade companies and its resources, the Technology is divided in to following areas

- (a) Computer Network
- (b) SAP

- (c) Security
- (d) Internet
- (e) E-Commerce
- (f) E-HRM System

The HR module enables customers to effectively manage information about the people in their organization, and to integrate that information with other SAP modules and external systems. From the Organization Management perspective, companies can model a business hierarchy, the relationships of employees to various business units and the reporting structure among employees. The Personnel Administration (PA) submodule helps employers to track functionality focuses on employees skills, qualifications and career plans. Finally, the Time Evaluation and Payroll submodules process attendance and absences, gross salary and tax calculations, and payments to employees and third-party vendors.

More and more organizations are concerned about falling behind the technology curve. They are using the Internet or Intranets to provide and communicate information to their employees and to create more efficient workplaces. The human resources department is often at the center of this effort.

Electronic Human Resource Management System (E-HRM System) is a web-based solution that takes advantage of the latest web application technology to deliver an online real-time human resource management solution. It is comprehensive but easy to use.

To Maintain and growing up of business in this competitive enviourmental market, how technology be helpful to shape the most need of source of business, i.e. Human Resource Development.

We will be studying the difficulties of Human Resource Development by adopting the new technological implementation.

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CHAPTER-01

OVERVIEW OF TECHNOLOGY AND HRM

1.1 INTRODUCTION:

As December gets ready to give way to a new January, it is time for a look back to in the coming year. A little introspection can help things in perspective and help us to see the forest rather than just the trees. Hopefully, it will also help us distill key trends which we can apply at work or in entrepreneurial ventures. However our focus is on India. What are the key technology-related trends that we can distill from what we are seeing and happening around us? We start with looking at mobile phones.

Look here, look there? are they everywhere? And it has reached 45 million people India's base of cell phones now exceeds its landline base. The average monthly revenue per phone is about Rs 400. About 90% of the revenues for operators comes in from voice, and 7-8% from SMS. The rest comes in from value-added services: Like ringtones, games, etc. Operators in India have already launched 3G services. Even the BlackBerry is now available in India, although at a very steep investment. The growth in mobile phones is likely to continue, It has been assumed that 500 million figure to be crossed sometime in 2010. The focus will be on increasing subscriber's revenues through value added services. In the context, mobile gaming is emerging as one key area.

According to market analysts for Indian mobility you are more interested for mobile with cheaper rates and fashionable design. Survey reveals that India has a large population of under-25s, and many in urban areas are fast adopting mobiles as must-have gadgets. India's mobile gaming market will bring in about \$436m by 2010, according to the report.

Services other than just voice calls which are offered by mobile operators in India have, as a result of the huge rise in subscribers, grown significantly and rapidly. "The growth of this market sector has attracted publishers, developers, animators, musicians, content providers and so on. It is also stimulating the development of innovative business models, as per statement given by Clint Wheelock, director of In-Stat/MDR's wireless research group. Mobile gaming is not just about fun, it also represents one key element of a rich mobile entertainment experience for consumers, and a lucrative market opportunity for industry players.

One of the byproducts of the infrastructure set up by the wireless operators for data services is the wireless mobile technology. Of special note is the network set up by Reliance Infocomm covering more than 1,000 cities and towns. From lottery terminals to ATMs and credit card authorization terminals, the data network is helping bypass the last-mile problem for low-bandwidth applications. At a rate of 10 - 49 paisa (less than a penny) a minute and covering a large part of urban and semi-urban, this has to be on the cheapest and most widespread wireless data services globally. The challenge ahead lies in creating services which can leverage these kinds of networks.

1.2 INDIA TRENDS: OUT SOURCED SERVICES

As per technical talk for Indian trends in respect of outsourced services following points to be noted. The other big development of the year has been in off shoring and outsourcing. One look at the financial results and recruitment plans of the Indian companies in this space is enough to give an indication of the solidity of the growth that is happening. What's interesting is that the bigger software companies seem to be growing faster (in percentage terms) than the mid-tier ones. Also, the global IT majors are stepping up their hiring in India. In IT-enabled services (business process outsourcing), companies are also starting to look beyond just call centre services. The BPO outfits are increasingly becoming more focused on building out expertise and

scale in a few business processes. A refrain heard often is to be the ADP (Automatic Data Processing, Inc.) of the process, implying that just like ADP has standardized and dominated the outsourced payroll business in the US, they want to do the same for the specific process. This is where labour arbitrage combined with on-demand computing platforms which can bring significant benefits in future.

As per economist expertise observation it is found that, India's IT industry is growing at a vertiginous rate. Last year the industry notched up sales of \$16 billion, three-quarters of which went abroad, according to NASSCOM. As per NASSCOM, annual sales are likely to surpass \$100 billion by 2010. The big firms are hiring about 1,000 graduates a month straight from Indian technical colleges and from related institutes.

India's BPO industry is younger and smaller, but growing even faster. Last year its sales were \$3.6 billion; by 2011 they are expected to reach \$35 billion-40 billion, says NASSCOM. About 70% of the BPO industry's revenue comes from call-centers; 20% from high-volume, low-value data work, such as transcribing health-insurance claims; and the remaining 10% from higher-value information work, such as dealing with insurance claims. But the BPO industry is more fragmented than the IT business, and could change shape rapidly.

The best Indian IT and BPO companies are aiming not only to lower the cost of western white-collar work, from software programming to insurance underwriting, but to improve its quality as well. Firms such as Wipro, Acer India, EXL Service and WNS are applying the same management disciplines to the way they provide services that GE applies to its industrial businesses. Tasks are broken into modules, examined and reworked to reduce errors, improve consistency and speed things up.

In the longer term, India's success at winning global white-collar work will depend on two things: the supply of high-quality technical and business graduates; and, more distantly, an improvement in India's awful infrastructure.

India is increasing part of not just the IT but also the services value chain of global organizations. Indian companies have demonstrated that they can not just start but also scale. India's share of the global pie is still miniscule leaving plenty of room for growth. This all can be possible if we change, improve our present educational system and infrastructure. India economist has the same argument for developing the Indian technology. That the development is possible provided educational system changes.

1.3 INDIA TRENDS: COMPUTING, INTERNET AND BROADBAND

Now let us look for internet & broadband friend in India. There are some disappointments in India, which are related with the growth of the computing base and broadband infrastructure in India, along with the Internet services. For many, a growth rate of 30-40% in computer sales would be very good. But considering the pathetically small installed base in India, this is not what India needs. Rapidly building up the computing and networking infrastructure in India is critical to address many of the challenges that we face in educating the masses, building real-time enterprises, and removing pain points from the government-citizen interactions.

Information technology researcher Gartner Inc. said that India's computer market grew 35 percent during the April - June 2010 quarter compared with the same period a year ago. One in every 10 computers sold in Asia-Pacific region, excluding Japan, is now in India, the report said, adding India is among the fastest growing markets for computers in Asia.

India, a country with more than a billion people, has been a laggard in adopting technology due to high levels of poverty and illiteracy, but faster economic growth in recent years has led to a surge in demand. As of March, India had 12 million computers and 4.5 million Internet connections.

Manufacturers and traders expect to sell about 11.2 million computers in the current fiscal year ending in March, 2010. The latest survey by Gartner shows that the growth in India comes from small businesses, banks and notebook buyers. "While the corporate market continued to look healthy, top vendors are now seen to be aggressively targeting the premium end of the consumer segment," said Vinod Nair, a Gartner analyst.

Much is made about the need for local languages support on computers. In fact, both Microsoft and Red Hat have made this a key aspect of their India policy, and the next year will see them have releases covering most of the Indian languages say Hindi, Gujarati, Bengali, Tamil, Telugu, Malyalam, Panjabi, Kanad, etc. But this is still only one dimension of the problem. The triad of access devices, networks and services go hand-in-hand. And that is where a disappointing broadband policy has taken the wind out of the sails of the domestic market. What we are starting to get is always-on narrowband connections camouflaged as broadband. The need is for innovative wireless broadband solutions in the last-mile which can connect up with the fibre back haul that exists across India. Recently Prof. Ashok Jhunjhunwala's presentation discusses how India can achieve 50 million broadband connections in the next 5-6 years. To solve this problem govt. of India under the ministry of telecommunication unvested change amount for such infrastructure and found the solution.

India also needs innovative Internet services. This is now starting to happen. On-line railway reservation air booking is one of the big e-commerce success stories. But much more has to be done to make the Internet a utility in our daily lives.

That India needs to move up and across the value chain is clear. The signs of that happening emerged in India. The number of companies setting up (or expanding) their development centers in India is growing. In year 2009 Yahoo India employs 250 people. Google has just opened their R&D centre. Microsoft and Oracle are growing theirs. IBM and the others already have a large presence. There is a small but non-zero possibility that Intel could set up a manufacturing facility in India. Nokia just announced that it will start making handsets in India next year. Even some of the leading American universities are exploring the possibility of setting up campuses in India to tap into the demand for highly qualified talent.

This is what the International Herald Tribune had to say about Nokia and Microsoft: Nokia and Microsoft both announced new ventures in India, underscoring the country's increasing allure for high-technology companies. Nokia, the world's biggest mobile phone maker, plans to spend as much as \$150 million on a new mobile phone manufacturing plant in India to reduce costs and to cash in on increasing demand in the country. Microsoft, the world's largest software maker, said that it would open a research lab in Bangalore, India, in January to increase its presence in the market and take advantage of the country's large and increasingly sophisticated population of engineers. While Microsoft is tapping into India's scientists and engineers, Nokia is targeting its rapidly growing phone market.

The state-of-the-art development centers and manufacturing facilities are also attracting Indians back from abroad and a growing interest in venture capitalists. Even though much of the VC investment continues to be in the services and BPO sectors, we are already starting to see US-based companies with freshly acquired capital make India a key part of their technology development strategies. As the talent pool grows, we will start seeing companies emerge out of India for the global marketplace.

One such example is Ittiam, an Indian DSP firm, which recently got \$6.5 million second round funding from Bank of America Equity Partners Asia. As per economic times, Ittiam has more than 50 customers for its intellectual property, some of which have been used in IP video phones and V.92 modems. Recently named the world's most preferred DSP IP supplier, Ittiam counts Sony and Texas Instruments among its customers.

What we are now starting to see is innovation from India. What we also need to see is innovation for India. Here is the difference: the first kind of innovation focuses on the needs of the top of the pyramid. Globally, while the second kind of innovation is for the middle of the pyramid in emerging markets. We are seeing some of the latter, but we have a long way to go. For this, we need entrepreneurs and venture capitalists willing to look inward rather than outward. Hopefully, the coming year will see a lot more of such innovation. This is what will get us the Rs 5,000 (\$110) per PC and at the Rs 1 lakh (\$2,200) per car. As present, Acer is selling its PC in the range of Rs. 8000/-. ANO by TATA at the rate of Rs. 1 lac. This is about a new innovation mindset, made in India, first for India, and then for the other emerging markets. This all are possible because of adoption of new emerging technology in India.

1.4 Insurance sector to drive Indian CRM market

After telecom and banking, it's the turn of insurance companies to deploy customer relationship management (CRM) solutions. As competition intensifies, insurers are trying every trick in the book to retain existing customers, with a wide range of services driving the market for CRM applications in the process, says Akhtar Pasha

Vikram G Shah says that CRM with BI tools can help insurance firms monitor the ebb and flow of customer behaviour, giving them a holistic 360-degree view of their customers

While the insurance sector is seeking to maintain a balance between acquiring customers and developing existing ones, customer acquisition is vital, as no retention strategy will entirely stem customer defection. It is said, insurance companies are experiencing unacceptable levels of customer churn, thanks to which they are focusing on keeping the customers they already have in a bid to ensure a net growth in their customer base. Today, the focus is on selling more products to existing customers to improve profitability. Customer-focused strategies require CRM (customer relationship management) to help acquire customers thorough various touch points and translate operational data into actionable insights for proactively serving customers. Vikram G Shah, managing director, Talisma Corporation says, “CRM with BI (Business Intelligence) tools can help insurance firms monitor the ebb and flow of customer behaviour, giving them a holistic 360-degree view of their customers.”

While the CRM market in India is still nascent, bigger players such as ICICI Prudential Life Insurance Company are adopting it in a big way. The company was earlier using GoldMines (a sales and marketing tool) and HEAT (an operational CRM solution) from FrontRange Solutions. Last year it took a decision to invest in CM3 from Teradata and SAS’s statistical tool for BI. Anil Tikoo, head-IT at ICICI Prudential Life Insurance Company says, “As a forward looking company, we see CRM playing a significant role in acquiring new customers. CRM lets us obtain granular details about our customers, helping us to design better products, improve service levels and reduce operational costs.” CRM has helped ICICI Prudential Life capture five lakh customers through effective event-based marketing and lead tracking to cross- and up-sell products.

Tarun Pandey, application manager at Aviva Life Insurance Company India adds, “CRM helps us categories and segment customers and align our products that best suit them.” Aviva says that CRM is helping them expand into rural areas. Aviva caters to close to 100,000 customers with its CRM solution.

That's not all. Players such as Birla Sun Life, Aviva, HDFC Life and MetLife are expected to adopt CRM tools as well in the near term.

According to Anil Tikoo, insurance companies with huge customer databases, servicing their customers through numerous branches and call centers will invest between 15 to 20 percent of their total IT budget on CRM applications

1.5 Current market scenario

Insurance firms are tactically rolling out an application here and there rather than strategically implementing a complete CRM suite. In this, they are on the right track. "They (insurance firms) are taking baby steps, starting with operational CRM to increase sales force automation. Once they have a sufficiently large customer database, they use BI tools to mine data from various sources (such as contact centers and from banks with which they align) pushing the need for analytical CRM solutions," says Pranav Kumar, research director for Enterprise Application Software at Gartner Asia/Pacific.

CRM technologies such as sales force automation, contact centre segmentation and campaign management tools are maturing and finding wider adoption with large insurance companies. Kumar adds, "The banking, financial services and insurance (BFSI) sector and telecom will continue to drive the CRM market, but the uptake of CRM in the insurance vertical will climb steeply in 2004 and growth will be rapid and higher [than in other verticals]." The insurance vertical has crossed the threshold of IT and process maturity beyond which an investment in CRM investments starts yielding good returns. The need to integrate customer data from multiple channels and to increase sales force productivity (including that of agents) and running productive marketing campaigns will continue to drive demand for CRM software.

1.6 Spending on CRM

Insurance firms spend close to 12 percent of their IT budgets on CRM software and services. The cost includes operational CRM and spending on BI tools. If a spokesperson of an upcoming insurance firm adds, "Of our total IT budget, we are spending 14 percent on CRM applications." Industry pundits believe that insurance firms are looking for CRM initiatives with budgets ranging from Rs 50 lakh going right up to Rs 3 crore. The sector is busy compiling data on individuals, including their purchasing patterns and buying preferences of policies, pension plans etc. In many cases, policy renewal marketing to existing customers remains an unsophisticated exercise, often amounting to little more than a request to renew, with no attempt at putting a value proposition before the customer. With a little help from CRM software, insurance firms can sell multiple insurance policies and pension plans to the same customer.

1.7 The opportunity

Within the financial services sector, IT investment in insurance is expected to grow the fastest with a CAGR of 55 percent in the five-year forecast period (2006-2011). [Source: IDC India] Other sub-verticals of the financial services sector are expected to grow at a CAGR ranging from 21 to 25 percent. Much of this spending will be on CRM applications and integrating multiple delivery channels. IDC says that new delivery channels are evolving as the insurance market expands.

According to a report from Indian Infoline (January 2010), India has the highest number of life insurance policies in force in the world. The industry is pegged at Rs 400 billion in India. Gross premium collections stand at 2 percent of the GDP and this has been growing by 15 to 20 percent per year from the Life Insurance Corporation of India (LIC) and other government-owned insurers. Privatization has led to new players entering this market and it is expected to grow at a rapid pace. George Varghese, head-Marketing, SAS says, "More than three-fourths of India's insurable population has

no life insurance, pension cover and post-retirement protection cover.” A substantial part of the insurance market—the portion dealing in pension plans and insurance as an investment option—is protected by a tariff and administered price regime. Competition in pricing is yet to emerge. Once that happens, as with all dynamic customer-oriented service industries such as banking and telecom, the race to gain and retain customer mind share will be on.

1.8 Business drivers for CRM

Margins are under pressure: A couple of years ago, LIC dominated the insurance market with the help of its sales force and channels and margins were reasonably high. Today, there are close to 20 companies offering both life and general insurance products. All of them have equally strong international and local partners; all are focusing upon similar geographies and target audiences. The new firms selling life insurance and non-life insurance [pensions, insurance as saving, etc] have failed to emulate the LIC model because margins are getting squeezed. There are several pain areas that new insurance firms face—acquiring new customers, retaining them, cross-selling products and controlling rising costs while providing comprehensive support.

Insurers have added a plethora of products and services to their kitty. These range from insurance as an investment option to pension plans. They target the younger generation in the 20 to 30 years age group. “The convergence of four factors—protection, saving (investment option), loans and pension—have compelled insurance companies to align with banks in reaching out to a larger audience,” says Tikoo. This trend has led to another—insurance companies are joining hands with banks by becoming channel partners for insurance. Tata AIG has a marketing alliance with HSBC, Birla Sun Life has one with Citibank and IDBI and LIC ally with Corporation Bank, while Kotak Life Insurance has an arrangement with Kotak Bank. This strategy helps insurance firms increase their footprint to cover a larger part of the customer

base in the 20-30 years demographic. CRM helps connect a bank's high net worth customers with insurance firms.

More than three-fourths of India's insurable population has no life insurance, pension cover and post-retirement protection cover, says George Varghese, giving an indication of the insurance opportunity in India

Where to begin—operational CRM or analytical CRM?

The choice between operational and analytical CRM as a starting point depends upon the insurer's needs. Gartner says that insurance companies with multiple financial products and a big customer base, such as integrated insurance solution providers, will leverage their customer base to cross- and up-sell different financial products, including insurance. Such providers will benefit from adopting analytical CRM. Market segmentation, campaign management and data mining applications will benefit them in many ways.

- a. Call centre text mining: This tool can help improve the customer experience by resolving complaints rapidly. Insurers are using these tools to mine text from call centre transcripts to identify issues faced by customers. Text mining tools also help detect and capture other useful pieces of information around a customer's life stage, financial needs and product interests. These can be used to generate leads and trigger cross-selling. However, to be fully effective, customer service representatives must be trained to probe for information that will help in cross-selling during the text mining phase. Text mining tools are leading-edge today, but are predicted to take off quickly.
- b. Event-triggering and profiling: "Insurers can use event triggers to generate leads that can be acted upon quickly, usually within 24 hours," says Tikoo. Event-triggering tools monitor incoming transaction and contact data in near-real-time

to recognize changes in a customer's behaviour or profile to trigger actions or alerts.

- c. Lead management gets sophisticated: Often the ability of an insurer to generate leads by means of event-triggering, re-engineered touch points and cross line-of-business referral can outstrip their ability to manage said leads. In such a situation, though the number of leads generated rises, the conversion rate does not. It may even drop. CRM can help provide sales representatives with a mechanism to priorities and manage leads.

Pure insurance providers who do not have a large customer base will derive the maximum value from operational improvements, especially in integrating customer information from multiple channels and sales force automation.

Not all CRM deployments will involve packaged software. As per Kumar "Indian organizations in other verticals have used 'bespoke CRM' solutions and some insurance vendors will do likewise."

Most insurers will look to empower their agents by deploying partner-facing applications. Apart from making agents more productive, it will let insurers keep in touch with customers, otherwise difficult in a primarily channel-driven business.

Vendors and analysts agree that the need to acquire, retain and support customers will stimulate greater investment in CRM, covering customer life cycle management. Insurers who are in an IT catch-up mode have been relatively prosperous during the last 18 to 24 months. Now they are investing in CRM to lock in their gains.

1.9 Using analytical CRM, insurance companies can enhance

- a. Cross- and up-selling capability to provide market opportunities within an existing customer database.
- b. Predictive capability to determine customer behaviour.

- c. Information regarding customer retention or attrition helps determine the likelihood of policy lapses and helps identify customers worth targeting for retention campaigns.
- d. Customer segmentation that leverages data to create accurate categories for use in marketing strategies.
- e. Market automation that combines analytics with campaign management functionality to help drive a more effective and efficient marketing campaign.

Following are the Gartner's tips for insurance firms

- a. Take baby steps in implementing CRM.
- b. Invest in bespoke CRM (customized CRM) and not an entire CRM suite in one go.

Following are the Broad CRM prospective:

CRM module Areas where it can be applied Collaborative CRM Applying collaborative interfaces (such as e-mail, conferencing, chat, real-time) to facilitate interaction between customers and organisations, as well as between organisational entities dealing with customer information (customers to sales representatives, sales to marketing, agent to provider) Operational CRM Automating horizontal integrated business processes involving front-office customer touch points-sales, marketing, and customer service-via multiple, interconnected delivery channels and integration between front-office and back-office.

Analytical CRM Analysing data created on the operational side of the CRM equation for the purpose of business performance management. Analytical CRM is tied to a data warehouse architecture; it is most often evident in analytical applications that leverage data marts. (Source: META Group)

1.10 TECHNOLOGY IN BANKING (THE NEW FACE OF BANKING)

An industry that's tightly protected by regulations has finally opened up. But this has introduced many new challenges. Here's a look at how technology can help overcome these challenges and address the new set of issues associated with modern day banking. As pr Anil Patrick R

The Banking sector in India has experienced a rapid transformation. Just about a decade back this sector was limited to the sarkari (read nationalized) and co-operative banks. Then came the multi-national banks, but these were confined to serving an elite few.

One could regard the past as the 'medieval ages' in the banking industry, wherein every branch of the same bank acted as an independent information silo, and multi-channel banking (ATMs, Net banking, tele-banking, etc) was almost non-existent.

“Banks are increasingly facing sliding margins and fierce competition. It is imperative to increase volumes and reduce operational costs” - K. P. Padmakumar, Chairman, Federal Bank

1.10.1 The tipping point

The opening up of the Indian banking sector to private players acted as 'the tipping point' for this transformation. The deregulatory efforts prompted many financial institutions (like HDFC and ICICI) and non-financial institutions enter the banking arena.

With the entry of private players into retail banking and with multi-nationals focusing on the individual consumer in a big way, the banking system underwent a phenomenal change. Multi-channel banking gained prominence. For the first time consumers got the choice of conducting transactions either the

traditional way (through the bank branch), through ATMs, the telephone or through the Net. Technology played a key role in providing this multi-service platform.

The entry of private players combined with new RBI guidelines forced nationalized banks to redefine their core banking strategy. And technology was central to this change.

10.2 Pressing issues

Today banks have to look much beyond just providing a multi-channel service platform for its customers. There are other pressing issues that banks need to address in order to chalk-out a roadmap for the future. Here are the top three concerns in the mind of every bank's CEO.

Customer retention: Customer retention is one of the main priorities for banks today. With the entry of new players and multiple channels, customers have become more discerning and less 'loyal' to banks. Given the various options, it is now possible to open a new account within minutes. Or for that matter shift accounts within a couple of hours. This makes it imperative that banks provide best levels of service to ensure customer satisfaction.

Cost pressures: Cost pressures come into play when banks are not able to afford the cost of a certain service or initiative although they want to or need to have it in place. This is primarily because the cost structure at the backend is not efficient enough to offer that kind of service to the marketplace.

Increased competition: The entry of new players into the banking space is leading to increased competition. A recent example would be of Kotak Mahindra Finance Limited (KMFL)—a financial services company focused on investment

consulting, auto finance, insurance, etc—morphing into Kotak Bank. Many other such players are waiting on the sidelines.

Technology makes it easier for any company with the right channel infrastructure and money reserves to get into banking. This has been one of the major reasons behind this kind of competition from players who do not have a banking background. Kotak Bank overcame the initial costs of setting up its own ATM network by getting into a sharing agreement with UTI bank.

New entrants with strategies such as these make the banking game tougher.

1.10.3 Redefining objectives

To cope with cost pressures and increased competition as well as to retain existing customers, banks have started venturing into newer territories.

This is one of the main reasons why banks are focused on retail banking in a big way. The main advantage of getting into retail banking is that the risks involved are lesser in this segment. There are lower Non Performing Assets (NPAs) in retail banking. This is one of the reasons why loans such as those for housing, automotive, etc are being touted by banks like never before. Credit cards and debit cards is another focus area for banks.

With this, banks have redefined their business priorities. They are now focused on: Cost reduction, Product differentiation and Customer-centric services

1.10.4 Cost reductions

Reduced costs basically translate to higher profit margins. If banks can reduce costs, it can go a long way in increasing profits.

The focus is on increasing the profit margins by cutting costs where it matters—on the operations side. Banks have woken up to the fact that they need to get into shape fast in order to handle competition.

"Banks have been increasingly facing sliding margins and fierce competition. It is imperative for them to increase the volumes and reduce the cost of operations," says K.P. Padmakumar, Chairman, Federal Bank.

1.10.5 Differentiation

The customer is interested in how he/she can benefit from the bank and its products. That's why it becomes necessary for a bank to differentiate its products from the others. Some of the ways in which differentiation can be introduced are through specialization, new products, and increasing the added value.

Specialization basically means that the bank gets involved only in selected areas. For example, the bank might be getting involved only in housing finance. Or, it could be limiting its services just for corporate banking clients. Another way to specialize could be by handling just specific sets of portfolios.

Banks can differentiate themselves by adding new products to their range of services. This will provide the bank with better yields per contact. Increasing the added value of products is another way of differentiation for banks. Operational excellence is also a key factor in effective differentiation from the competition.

1.10.6 Customer-centric model

Indian banks have realized that it no longer pays to have a 'transaction-based' operating model. This has led to the development of a relationship oriented model of operations focusing on customer-centric services.

While banks have to ensure product superiority and operational excellence, the biggest challenge today is to establish customer intimacy without which the other two are meaningless.

"In the financial world, product superiority does not last long as it is relatively easy to copy products. So, the real strength comes from operational excellence and understanding the customer and developing rapport with him," says Gunit Chadha.

In this context, it is very important that banks identify and understand customer needs. This will help banks in tailoring their products according to customer needs. It also helps in new business opportunities like cross-selling and 'upselling,' which takes cues from customer aspirations and transaction patterns.

Customer relationships have to be managed in the best possible manner. This will ensure that the customer comes back to the bank. In addition to good customer retention rates, it will also provide better income generation capability. This is because a major chunk of income of most banks comes from existing customers, rather than from new customers.

"The cost of transactions over channels like ATMs and the Internet are lower than doing it through the branches" - Rangesh Nayar, Country Manager- Financial Services Sector, IBM

1.10.7 IT is pivotal

IT is central to banking. This is one of the major reasons why new private and multi-national banks have been able to survive, thrive, and adapt in an increasingly competitive space.

These banks were able to leverage on low-cost channels such as ATMs and Net banking to the optimum levels contributing to reduced operating costs.

Banks have realized that shifting customer access to lower cost channels can help bring down operating costs.

"These channels are used not only to improve customer service but also to divert traffic from the branches. It is a fact that the cost of transactions over these channels is lower than doing this through the branches," says Ranges Nayar, Country Manager-Financial Services Sector, IBM.

But this does not mean that branch banking is obsolete. Rather, banks are reinventing their business models to offer new financial services through its branches.

1.10.8 Evolving IT

Banks are looking at newer ways to make a customer's banking experience more convenient, efficient, and effective. They are using new technology tools and techniques to identify customer needs and are offering tailor-made products to match them.

Centralized operations and process automation using core banking applications and IP-based networks improve efficiency and productivity levels tremendously. Core banking applications help a bank to shift from 'branch banking' to 'bank banking.' This basically means that a customer will be treated as a bank's customer than just the customer of a particular branch which was the case earlier. Also, IP-based networks lets a bank offer multiple services over the same network, resulting in costs savings.

CRM solutions, if implemented and integrated correctly, can help significantly in improving customer satisfaction levels. Data warehousing can help in providing better transaction experiences for customers over different transaction channels. This is made possible because data warehousing helps bring all the transactions coming from different channels under a common roof.

Data mining helps banks analyze and measure customer transaction patterns and behavior. This can help a lot in improving service levels and finding new business opportunities.

Risk Assessment is another area where technology can play a major role. "Using technology, banks are able to better assess risks like interest risks, liquidity risks, FOREX risks, etc. The other driver for using IT is that banks can reduce costs and reduce the time to market," says Rangesh Nair, Country Manager-Financial Services Sector, IBM.

1.10.9 Is traditional branch banking dead?

The extent to which new regulatory policies and technology has transformed the banking industry brings us to one moot question: Is traditional branch banking dead?

With the emergence of various channels for (retail) banking, pundits all over have been predicting the end of traditional branch banking, at least in the metros and other upwardly urban areas.

But despite the benefits offered by other technologies in terms of lower costs or better reach, it looks like branch banking is very much here to stay.

The reason: Branch banking itself is undergoing a transformation. Traditionally, banks used their retail outlets to provide services to the individual customer. Now with ATMs, Net banking, and Tele-banking replacing traditional service channels, banks are more focused on enhancing customer value through branches. They are using their existing network of branches to advice on and sell new financial instruments like consumer loans, mutual funds, etc.

They are also using branches to inform and educate customers about other, more efficient channels to conduct common transactions like cash withdrawal or balance checks.

As Naresh Wadhwa, Vice President-West, Cisco Systems (India) says, "It is very interesting to observe that no channel has replaced any of the others. Rather, they are complementing each other. The customer remains one, but over the years, there are multiple channels being developed like ATMs, call centers, online banking, mail/fax, WAP, etc. The interesting trend is that customers are using all the available channels instead of settling for just one."

1.10.10 What are the main issues besides increased competition or lowering of costs that banks need to deal with?

These issues have always been there and all banks have to cope with these. In today's world of narrowing margins, a serious look at costs definitely is an imperative. One obviously has to ensure product superiority and operational excellence. However, to my mind, the biggest challenge today is to establish a customer intimacy without which the other two are meaningless. In the financial world, product superiority does not last for long as it is relatively easy to copy products. So, the real strength comes from operational excellence and understanding the customer and developing rapport with him.

1.10.11 What are the techniques used to ensure that consumer satisfaction and lower costs are achieved?

Notwithstanding what banks may feel about their products, customers utilize these products only for a few minutes. The key lies in making those few minutes convenient, efficient and effective. There are multiple ways to achieve these objectives. For instance, we introduced welcome kits wherein, a customer who comes in to open an account with our bank walks out with a fully enabled

account, debit card, cheque book, Net Banking account, and phone banking account—in a matter of minutes.

Another key area that I can immediately think of is integration of services. Why should a customer receive multiple mailers from the bank when he can instead receive integrated financial statements? Why should a customer have multiple login IDs for different electronic channels?

These measures not only lead to customer convenience, they also help the banks save on cost. Identifying customer needs and tailoring products to match these needs is another area where a lot can be done. For example, we recently launched a 110 percent Housing Loan to address other needs of a customer when he goes for a housing loan.

1.10.12 To what extent are the CEO and CFO involved in the decision for purchasing/upgrading a bank's infrastructure? What's the process flow?

We have a well-established Discretion Policy wherein for budgeted items executives have discretion available to commit expenditure. However, for key and large expenses, the respective business head and CFO get involved in the decision process.

For larger expenditure amounts the CEO also participates in the decision process. Expenditure requests invariably originate from the respective businesses.

1.10.13 What factors are taken into account when planning IT infrastructure budgets every year ?

IT infrastructure budgets take a medium term (18 to 24 months) view of the requirements. While cost optimization plays an important role, the key

considerations are on high-availability, scalability and optimal level redundancy of the infrastructure. The key lies in making this infrastructure transparent to the end user.

1.10.14 What are the mistakes that banks have made in the past in terms of over investment in IT, underutilization of resources and so on?

I do not think Indian Banks have at any stage done over investment in technology. Expenditure has been right or perhaps less than what has been the need of the hour. However, expecting tangible and time-bound returns is today's minimum expectation from the investments in technology.

Mistakes can be that there was a lot of emphasis on doing things in-house and an improper alignment of technology with business requirements. Another issue is that of proper synchronization of tech innovations with businesses processes and rollouts. Without this, however good a product or service may be, sales do not result. At the end of the day, anything that does not result in sales is not meaningful.

10.15 What are the main points to keep in mind when investing in IT ?

The main points to be kept in mind while investing in IT are:

A well defined Return on Technology investment, A visible addition to customer value and Improvement of operational efficiencies leading to customer convenience and cost savings

Chapter-2

Concept of Technology and its Effect on Human Resources

2.1 Introduction :

It used to be that human resource professionals relied on technology just for administrative tasks such as time and attendance and payroll.

HR professionals also rely on automated systems to direct employee benefit contributions. Such systems automatically direct a portion of workers' pay toward their retirement savings plans unless employees opt out, for instance.

And while total rewards statements that alert employees to the total value of their compensation benefits packages have been around for years, many companies now are making that information available to workers electronically through HR information systems or self-service sites.

Workplace diversity initiatives are getting a boost from technology. Remarkable developments in assistive technology, for example, have increased job opportunities for people with physical disabilities. Some employers say that investing in such technologies is simply the right thing to do; others argue that such initiatives are good for the bottom line since they allow companies to recruit from a broader pool.

Biometrics devices that use fingerprints or other physical traits for identification can help solve some employee discipline problems and protect sensitive data. Time clocks are one of a growing number of workplace applications of biometrics.

During the last decade, the Internet has played a growing role in external recruiting. Large, all-purpose online job boards quickly found a place in recruitment. Meanwhile, niche sites catering to specific industries and demographic niches such as women and Asians won favor. Online corporate job sites and intranets have become key recruiting tools, allowing employers to get the word out about job openings quickly and inexpensively.

From the executive summary: 'New Human Resources (HR) consulting industry is on the rise. Management decisions about HR functions can affect the way a business is conducted. The inverse is also true; the way a business is done can affect HR decisions. The paper explores changes in the way HR functions are performed in the advent of high technology advances in conducting business processes over high-speed communications channels, termed e-business in today's market.'

2.2 Human Resource Information Systems (HRIS)

Computers have simplified the task of analyzing vast amounts of data, and they can be invaluable aids in HR management, from payroll processing to record retention. With computer hardware, software, and databases, organizations can keep records and information better, as well as retrieve them with greater ease. A **human resource information system (HRIS)** is an integrated system designed to provide information used in HR decision making. Although an HRIS does not have to be computerized, most are.

2.2.1 Purposes of an HRIS

An HRIS serves two major purposes in organizations. One relates to administrative and operational efficiency, the other to effectiveness. The first purpose of an HRIS is to improve the efficiency with which data on employees

and HR activities is compiled. Many HR activities can be performed more efficiently and with less paperwork if automated. When on-line data input is used, fewer forms must be stored, and less manual record keeping is necessary. Much of the reengineering of HR activities has focused on identifying the flow of HR data and how the data can be retrieved more efficiently for authorized users. Workflow, automation of some HR activities, and automation of HR record keeping are key to improving HR operations by making workflow more efficient.

The second purpose of an HRIS is more strategic and related to HR planning. Having accessible data enables HR planning and managerial decision making to be based to a greater degree on information rather than relying on managerial perception and intuition. For example, instead of manually doing a turnover analysis by department, length of service, and educational background, a specialist can quickly compile such a report by using an HRIS and various sorting and analysis functions. HR management has grown in strategic value in many organizations; accordingly, there has been an increased emphasis on obtaining and using HRIS data for strategic planning and human resource forecasting, which focus on broader HR effectiveness over time.

2.2.2 Uses of an HRIS

An HRIS has many uses in an organization. The most basic is the automation of payroll and benefit activities. With an HRIS, employees' time records are entered

Human resource information system (HRIS)

An integrated system designed to provide information used in HR decision making into the system, and the appropriate deductions and other individual adjustments are reflected in the final paychecks. As a result of HRIS development and implementation in many organizations, several payroll

functions are being transferred from accounting departments to HR departments. Another common use of HRIS is EEO/affirmative action tracking. Beyond these basic activities, many other HR activities can be affected by the use of an HRIS.

2.2.3 Establishing an HRIS

The explosion of information technology has changed the nature of HR information usage. Just a few years ago, most HR information had to be compiled and maintained on mainframe computers. Today, many different types of information technology are being integrated and used so that HR professionals can access HR-related data and communicate it to other managers and executives.

2.3 Job Satisfaction and Organizational Commitment

In its most basic sense, **job satisfaction** is a positive emotional state resulting from evaluating one's job experiences.

Job *dissatisfaction* occurs when these expectations are not met. For example, if an employee expects clean and safe

Working conditions on the job, then the employee is likely to be dissatisfied if the workplace is dirty and dangerous.

Job satisfaction has many dimensions. Commonly noted facets are satisfaction with the work itself, wages, and recognition, rapport with supervisors and co-workers and chance for advancement. Each dimension contributes to an individual's.

Overall feeling of satisfaction with the job itself, but the "job" is defined differently by different people.

An organizational team composed of a core of members, resource experts who join the team as appropriate, and part-time temporary members as needed.

Resource Experts Core Members Part-time Temporary Members.

Job satisfaction: A positive emotional state resulting from evaluating one's job experiences. The number of people who are dissatisfied with their jobs nationally varies with the unemployment rate. Higher unemployment rates usually mean more dissatisfied workers because it is more difficult to change jobs, and people stay longer on jobs they do not like. Those workers who are mostly satisfied with their jobs vary from 60 to 85 percent of the total. These numbers are similar to those found in Europe when employees are asked about satisfaction with their jobs. Individual managers seem to have a greater impact on employee satisfaction than the company itself. There is no simple formula for predicting a worker's satisfaction. Furthermore, the relationship between productivity and job satisfaction is not entirely clear. The critical factor is what employees expect from their jobs and what they are receiving as rewards from their jobs. Although job satisfaction itself is interesting and important, perhaps the "bottom line" is the impact that job satisfaction has on organizational commitment, which affects the goals of productivity, quality, and service.

2.4 Seven Emerging Technology Trends that will Impact Banking

That the banks in India have taken to adoption of core banking system is by now the old story. Brick and mortar banking has been given a quiet burial and emerged the new, sophisticated but snazzy, technology platform changing the face of banking drastically. With technology, bank branches becomes only one of the many channels that are now available to customers for performing routine banking transactions. Transition from single channel banking to multi-channel banking has brought about tremendous customer convenience. Having achieved tremendous growth in implementing technology driven transaction banking system, banks in India have upgraded their capability to handle business volume. But the quality improvement of business, the key criteria for sustainable growth, is yet to emerge. Besides transactional convenience, banks are hardly in position to leverage on their humongous technology capability in identifying potential business, mitigating operational and business risks and improving the standards of governance.

Increasing customer expectations and regulatory pressure that has marked the post sub-prime financial world are, in fact, posing too many questions to the business leaders to answer. This trend has made the business leaders and technology providers sit up look deep into the future and come with solutions that are definitely going to change the way banking services are delivered today. Significant shifts in the business environment, economic volatility, and changing customer expectations make it increasingly challenging for banks to prioritize technology investments challenging for banks to prioritize technology investment. Following trends are likely to occupy the

mindspace of business leaders and technology solution providers in the days to come. Many of trends are already reasonably visible.

Intergration and Emergence of Real-Time Organisations : Most of banking solutions are now operating in silos. Even if one takes the Core Banking, the solution is not fully integrated with all other business lines, say, treasuring operations, card business, investment advisory business etc. Integration, in its ideal sense, would mean both system level and logical integration. For example, if we talk of 360 degree view of customer, a necessary condition for determining risk profile of the customer, it would imply a customer profile across products, relationships and units. Merely system level loose coupling will not meet the requirements unless all the systems can become intelligently interactive.

Data and Decisions: Traditionally, banks have spent heavily on large databases and even larger data warehouses, producing reams of output of often dubious or questionable value. Data and decision tools will greatly enhance decision making, both within the bank and among its customers and prospects. Employees will be able to make instant decisions and customers will have the right information about products, services and billing, when they need it, delivered in the way they want it. To support these functionalities, more and more emphasis will be on a variety of sophisticated data visualization tools, which has recently entered the market, integrated into popular business intelligence software. During the next three to five years, banks will have significantly better data and greater intelligence about customers. It will be available at the “fingertips” of all customer-facing functions, enabling more efficient and effective sales and service.’

Mobility : Mobility is the new 'e' The speed of innovation, world-wide penetration and rate of growth, support predictions that mobile devices will augment and in many cases supplant personal computers as the new e-business channel for employees and customers going forward. Innovation in mobile devices continues at breakneck speed. They are becoming full-fledged "Platforms" in their own right, capable of running a wide range of third-party applications.

Convergence of collaboration, communication, community and content : The nature of human interaction is changing, both between a bank and its customers and between employees. Face-to-face discussions are increasingly being replaced by a wide range of technologies: social networks, wikis, blogs, telepresence, etc.

Internet Computing & Cloud Computing : Internet computing is what we use, as a label, to pull together a flood of seemingly unrelated technologies as under. Virtualization _ enables the decoupling of hardware and software to enable economies of scale and ease of management and systems, Multi-tenancy architectures and software-as-a service allow banks to outsource the development and support for noncore applications.

IT Security : Cyber-crime is an ever increasing threat, becoming more organized and profit driven. We are moving away from the era of the lone hacker trying to get into a government NASA system into something far more sinister and potentially far more costly to banks. Banks need to look deep into the IT governance structure and organizations to prevent any type of potential unholy collaboration to beat the system. In an integrated world, the risk of loss could be enormous even if the reason may be too insignificant.

2.5. Summary :

HR planning is tied to the broader process of strategic planning, beginning with identifying the philosophy and mission of the organization. ! Human resources can provide a core competency for the organization, which may represent unique capabilities of the organization. Human resources can be part of resource-based organizational strategies if they have value, rareness, difficult limitability, and organization. ! HR strategies are affected by the culture of the organization and the life-cycle stages of the industry and the organization. ! Different organizational strategies require different approaches to HR planning. HR planning involves analyzing and identifying the future needs for and availability of human resources for the organization. The HR unit has major responsibilities in HR planning, but managers must provide supportive information and input. ! The HR planning process must be linked to organizational objectives and strategies. When developing HR plans, it is important for managers to scan the external environment to identify the effects of governmental influences, economic conditions, geographic and competitive concerns, and workforce composition and patterns. ! Assessment of internal strengths and weaknesses as a part of HR planning requires that current jobs and employee capabilities are audited and organizational capabilities be inventoried. ! An HRIS is an integrated system designed to improve the efficiency with which HR data is compiled and to make HR records more useful to management as a source of information ! An HRIS offers a wide range of HR uses, with payroll, benefits administration, and EEO/affirmative action tracking being the most prevalent. ! The growth of web-based HRIS options means that training and security issues must be addressed. ! Information on past and present conditions is used to identify expected future conditions and forecast the supply and demand for human resources. This process can be carried out with a

variety of methods and for differing periods of time ! Management of HR surpluses may require downsizing and outplacement. Attrition and early retirement are commonly used.

Chapter-3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

Research in common parlance refers to a search for knowledge. One can also define research as a scientific and systematic search for pertinent information on a specific topic. In fact, research is an art of scientific investigation. The advanced learner's dictionary of current english lays down the meaning of research as a careful investigation or inquiry specially through search for new facts in any branch of knowledge .

“All progress is born of inquiry. Doubt is often better than overconfidence, which leads to inquiry, and inquiry leads to invention.” which is quoted by famous Hudson Maxim in context of significance of research Research inculcates scientific and inductive thinking and it promotes the development of logical habits of thinking and organization.

The role of research in several fields of applied economics, whether related to business or to the economy as a whole, has greatly increased in modern times. The increasingly complex nature of business and government has focused attention on the use of research in solving

operational problems. Research, as an aid to economic policy, has gained added importance, both for government and business.

Research has its special significance in solving various operational and planning problems of business and industry. Operations research and market research, along with motivational research, are considered crucial and their result assists, in more than one way, in taking business decision. The purpose of research is to discover answers to questions through the application of scientific procedures. Though each research study has its own scientific purpose, we may think of research objectives as falling into a number of following groups:

- To gain familiarity with a phenomenon or to achieve new insights.
- To portray accurately the characteristics of a particular individual, situation or a group.
- To determine the frequency with which something occurs or with which it is associated with something else.
- To test a hypothesis of a casual relationship between variables.

The prime objective of any research can be summarized as to

- (1) Discover new facts
- (2) Verify and test important facts
- (3) Analyze an event or process or phenomenon to identify the cause and effect relationship
- (4) Develop new scientific tools, concepts and theories to solve and understand Scientific and nonscientific problems
- (5) Find solutions to scientific, nonscientific and social problems and
- (6) Overcome or solve the problems occurring in our everyday life

Research is important both in scientific and nonscientific fields. In our life new problems, events, phenomena and processes occur every day. Practically implementable solutions and suggestions are required for tackling new problems that arise. Scientists have to under-take research on demand find their causes, solutions, explanations and applications. Precisely, research assists us to understand nature and natural phenomena.

Some important avenues for research are:

- (1) A research problem refers to a difficulty which a re-searcher or a scientific community or an industry or a government organization or a society experiences. It may be a theoretical or a practical situation. It calls for a thorough understanding and possible solution.
- (2) Research on existing theories and concepts help us identify the range and applications of them.
- (3) It is the fountain of knowledge and provides guide-lines for solving problems.
- (4) Research provides basis for many government policies. For example, research on the needs and desires of the people and on the availability of revenues to meet the needs helps a government to prepare budget.
- (5) It is important in industry and business for higher gain and productivity and to improve the quality of products.
- (6) Mathematical and logical research on business and industry optimizes the problem in them.
- (7) It leads to the identification and characterization of new materials, new living things, new stars, etc.

- (8) Only through research, inventions can be made; for example, new and novel phenomena and processes such as superconductivity and cloning have been discovered only through research.
- (9) Social research helps in finding answers to social problems. They explain social phenomena and seek solution to social problems.
- (10) Research leads to a new style of life and makes it delightful and glorious.

Emphasizing the importance of research, Louis Pasteur said “I beseech you to take interest in these sacred do-mains called laboratories. Ask that there be more and that they be adorned for these are the temples of the future, wealth and well-being. It is here that humanity will learn to read progress and individual harmony in the works of nature, while humanity’s own works are all too often those of barbarism, fanaticism and destruction.” (Louis Paster – article by S. Mahanti Dream 2047, p. 29–34 (May 2003)).

In order to know what it means to do research one may read scientific autobiographies like Richard Feynman’s “Surely you are joking, Mr.Feynman!”, Jim Watson’s “The double helix”, “Science as a way of life – A biography of C.N.R. Rao” by Mohan Sundararajan, etc.

RESEARCH METHODS AND RESEARCH METHODOLOGY

Is there any difference between research methods and research methodology ? Yes.

Research methods are the various procedures, schemes, algorithms, etc. used in research. All the methods used by a researcher during a research study are termed as research methods. They are essentially planned, scientific and

value-neutral. They include theoretical procedures, experimental studies, numerical schemes, statistical approaches, etc. Research methods help us to collect samples, data and find a solution to a problem. Particularly, scientific research methods call for explanations based on collected facts, measurements and observations and not on reasoning alone. They accept only those explanations which can be verified by experiments. Research methodology is a systematic way to solve a problem. It is a science of studying how research is to be carried out. Essentially, the procedures by which researchers go about their work of describing, explaining and predicting phenomena are called research methodology. It is also defined as the study of methods by which knowledge is gained. Its aim is to give the work plan of research.

3.2 SUBJECT OF THE STUDY

The world has become a small village with extraordinary development of information technology. Every human being in the modern environment has to think globally and act locally. Top executives as human being has to face a lots of problem in the day to day working life of him. In absence of B.O.D. he is the key person to take managerial decision and also to manage the entire organization – resulting stress and affect on HR-components.

I want to test the effect of technology adoption on human culture, the motivation, the quality Of work life ,stress and efficiency/effectivness of employee. That is why I have selected the topics:

“ A STATISTICAL ANALYSIS AND COMPARATIVE STUDY OF MODERN TECHNOLOGY WITH IMPACTS ON HUMAN RESOURCE DEVELOPMENT IN PUBLIC SECTOR BANK ”

3.3 OBJECTIVES OF STUDY :

In this investigation I have consider the following

1. To examine the trend of technology in the country.
2. To study the implication of technology on the HR Practices in The public sector bank who had adopted the new technology in their organization.
3. To study the changes in the HR practices in relation to job satisfaction, motivation, quality of work life, organizational culture, in past and future.
4. To examine the effect of technology on overall employee efficiency before and after adoption of technology.
5. To offer suggestions for improvement in the HR practices for successful technological adoption.

3. 4 HYPOTHESIS FOR THE STUDY

1. There is no significant difference in HR Practices of public sector bank before and after the technological adoption.
2. There is no significant difference in culturure of the organization before and after the technological adoption.
3. There is no significant difference in motivation of employees before and after the technological adoption.
4. There is no significant difference in quality of work life before and after the technological adoption.
5. There is no significant difference in stress level of employees before and after the technological adoption.

3.5 VARIABLES USED IN THE STDUDY

For the present study the researcher has taken into account five types of variables, as observed from the specific objectives and corresponding null hypotheses mentioned above. These variables are furnished below:

1. Age and other variables
2. Experience and other variables
3. Educational Qualification and other variables
4. Organizational Environment and other variables
5. Job Satisfaction and other variable

3.6 UNIVERSE OF THE STUDY:

The universe of the study consists of all kind of employees who have been working with public sector bank in Gujarat State.

3.7 SAMPLING PLAN

Total population	: 1200
Geographical/sample area	: Public sector Bank
Sample size	: 132
Sampling Procedure	: Random Sample

SAMPLING DESIGN

The sample would be selected considering the following factors.

1. The data will be collected for five years beginning from 2004 to 2009 which will be considered on secondary data.
2. The public sector bank who adopted the new technology in their organization are consider for data collection through questionnaire method.

DATA COLLECTION

- A. **Method of data collection** – The necessary data would be obtained through questionnaires consisting of rating scale and by interviews.
- B. **Source of data** – The study would be based on both primary and secondary data.

The Primary data would be collected from the selected employees among the The public sector bank who adopted the new technology in their organization.

Secondary data would be obtained from business newspapers, magazines, journals and through the internet as relevant to the research study.

3.8 PERIOD OF STUDY, DATA COLLECTION AND DATA ANALYSIS:

The present study is made on the basis of data collected from all category of staff in the public sector bank from 2 years to 25 years. The data collected were duly edited, classified, and analyzed using all type of relevant statistical techniques and employing the most appropriate parametric and non-parametric tests. The data were presented through simple classification and with the help of percentage, average, correlation and association. The data were analyzed and the hypothesis were tested at 5 percent level of significance by employing appropriate test. The normal technique used by the researcher is observation, questionnaire, interview, analysis of records, case study, etc.

Methods are more general than techniques. Methods and Techniques are used in performing research operations, i.e.,

Collection of data, Statistical processing & analysis (tests) and to evaluate the accuracy of the results obtained.

3.9 Research design

After the formulation of research objectives, the next step was to identify the tools and procedures to collect and analyze data relevant to the research problem.

Our research purpose is experimentation to prove the relationship. It is the blue print of procedure to test hypotheses by reaching valid conclusions about relationships between independent and dependent variables.

Research design shall consist of:

The sample design, Observation design, Statistical design and Operational design

3.10 LIMITATION OF STUDY

1. The study is limited to the state of Gujarat.
2. The authenticity of secondary data used depends entirely on the accuracy of such data
3. During the course of personal interviews, the prejudices or bias on part of interviews may have influence on the response received.
4. The study would take into account for limited number of companies and their employees which have the accuracy of the results.

5. Time is the biggest constraint.
6. Primary data is used which is not always give correct result.
7. Sample is randomly selected so it may not help to give overall information about particular program category.
8. Non-probability method is used which may not be best for the research work.
9. Judgment sampling is not scientific, as the sample is affected by the bias, of the investigator.
10. Success of this method depends on the knowledge about the population then the sample will be representative not.
11. There is no method for determining the sample error in this method.
12. Questionnaire tool is used for data collection in which bias, manipulated replies and incomplete replies can be possible.

3.11 CONCLUSION :

1. Examine the trend of technology in the country.
2. Study the implication of technology on the HR practices in The public sector bank who adopted the new technology in their organization.
3. Study the changes in the HR practices in relation to job satisfaction, motivation, quality of work life, organizational culture, in past and future.

4. Examine the effect of technology on overall employee efficiency after the modernisation.
5. Offer suggestions for improvement in the HR Practices for successful technological adoption.

Chapter- 4

The Analysis Of Effect Of Technology On HRM And Hypothesis Testing

4.1. INTRODUCTION

Very often in practice we are called upon to make decisions about populations on the basis of sample information. For example, we may wish to decide on the basis of sample data whether a new drug is really effective in curing a disease, whether one educational procedure is better than another etc. Such decisions are called *statistical inferences* or *statistical decisions*. Two major areas of statistical inference are (1) estimation and (2) testing of hypothesis. By “estimate” we mean “judgment or opinion of the approximate size or amount.” In estimation we use a statistic (a function of sample observations only) to make a close guess about the unknown value of a population parameter. The main aim of hypothesis testing is to provide rules that lead to decision resulting in acceptance or rejection of statements about the population parameters.

In this chapter we shall discuss the problem of testing of hypothesis.

4.2 TESTS OF HYPOTHESIS

The principal objective of statistical inference is to draw inferences (or generalize) about the population on the basis of data collected by sampling from population.

On the basis of sample data drawn from the population a sample statistic is obtained. If the statistic differs from the assumptions made about a population parameter, a decision must be made as to whether or not this difference is significant. If it is, the assumption called hypothesis is rejected otherwise it can be accepted. This

procedure of taking decisions is called 'Tests of hypothesis or tests of significance ' or rules of decision.

Before developing the necessary rules, let's explain few related terms and concepts.

4.3. SOME RELATED TERMS AND CONCEPTS

(I) Parameters

Statistical measures or constants of population such as mean (μ), Standard deviation (σ) , correlation coefficient (ρ), population proportion (P) etc. are called the parameters.

(II) Statistic

Statistic is a real valued function of the random sample. So statistic is a function of one or more random variables not involving any unknown parameter.

Thus, statistic is a function of samples observations only and is itself a random variable. Therefore a statistic must have a probability distribution.

A value obtained for the sample drawn from the given population is called a *statistic*. Statistics are generally denoted by small (latin) letters. E.g. \bar{x} = sample mean, s = sample standard deviation, r = sample correlation coefficient, p = sample proportion etc.

(III) Hypothesis

In order to arrive at a decision regarding the population through a sample of the population we have to make certain assumption referred as **hypothesis** *which may or may not be true*.

(IV) Statistical Hypothesis

It is an assumption or conjecture or guess about the parameter(s) or population distribution(s). Such assumptions may or may not be true, are called *statistical hypothesis* and in general these are statements about probability distributions of the population.

(V) Sampling Distribution

Suppose random samples of size 'n' are drawn from a population of size N. These samples will give different values of a statistic. For example, we calculate mean \bar{x} . The means of the samples will not be identical. If we arrange different values of these means according to their frequencies, the frequency distribution so formed is called **sampling distribution of the mean**. Similarly we can have *sampling distribution of the standard deviation* etc.

(VI) Standard Error (S.E.) of a Statistic

The standard deviation of the sampling distribution of a statistic is called the *standard error* of that statistic. It gives an index of the precision of the estimate of the parameters. For example, the standard error (S.E.) of the sample mean is

$\frac{\sigma}{\sqrt{n}}$, where σ is the standard deviation of the population from which the sample is drawn and n is the sample size. As the sample size n increases, S.E. decreases. Standard error plays an important role in large sample theory and forms the basis in tests of hypothesis. The standard error enables us to determine the probable limits within which the population parameter may be expected to lie. For example, the probable limits for the population mean μ are

given by $\bar{x} \pm 3 \frac{s}{\sqrt{n}}$, where s is the sample standard deviation.

(VII) Null Hypothesis (N.H.)

A statistical hypothesis is a statement about a population parameter or the nature of the population. Statistical hypothesis which is formulated with a view of testing or verifying its validity is called *null hypothesis* and is denoted by H_0 . The null hypothesis is always tested on the basis of sample information which may or

may not be consistent with it. If the sample information is found to be consistent with H_0 , the null hypothesis is rejected and we conclude that it is false. On the other hand, if the sample information is found to be consistent with H_0 , it is accepted even though, we do not conclude that it is true. The reason is that, the sample information is not sufficient to conclude that it is true. We can say at best that H_0 is not false. Thus, H_0 asserts that there is *no true difference in the sample statistic and population parameter* in the particular matter under consideration and that the difference found is random arising out of fluctuations.

(VIII) Alternative Hypothesis (A.H.)

The rejection of null hypothesis i.e. H_0 implies that it is rejected in favour of some other hypothesis which is accepted. A hypothesis which is accepted in the event of H_0 being rejected, in otherwise a complimentary hypothesis to null hypothesis is called the *alternative hypothesis* and is generally denoted by H_1 or H_A .

(IX) Testing of Hypothesis

Test of hypothesis or test of significance or rules of decision are a procedure to decide whether to accept or reject the (null) hypothesis. This test determines whether observed sample differ significantly from expected results. Acceptance of hypothesis merely indicates that the data do not give sufficient evidence to refute the hypothesis. Whereas, rejection is a firm conclusion where the sample evidence refutes it.

When N.H. is accepted, result is said to be non-significant i.e. observed differences are due to 'chance' caused by process of sampling. When N.H. is rejected (i.e. A.H. is accepted) the result is said to be significant. Thus test of hypothesis decides whether a statement concerning a parameter is true or false instead of estimating the value of the parameter. Since the test is based on

sample observations, the decision of acceptance or rejection of the null hypothesis is always subjected to some error, i.e., some amount of risk.

(X) Types of Errors in Test of Hypothesis

When a statistical hypothesis H_0 is tested, we have following four possible results:

- (i) H_0 is true and it is accepted by the test.
- (ii) H_0 is false and it is rejected by the test.
- (iii) H_0 is true but it is rejected by the test.
- (iv) H_0 is false but it is accepted by the test.

The first two are correct decisions but the later two lead to errors.

Type I error involves rejection of null hypothesis when it should be accepted (as true).

Type II error involves acceptance of null hypothesis when it is false and should be rejected.

These errors can be represented in a table as follows:

Decision →	Accept H_0	Reject H_0
H_0 is true	Correct decision	Type I error
H_0 is false	Type II error	Correct decision

(XI) Level of Significance (L.O.S)

The probability level below which leads to the rejection of the hypothesis is known as the *significance level*.

The level of significance (L.O.S.) usually denoted by ' α ' is the probability of committing type I error. Thus L.O.S. measures the amount of risk or error associated in taking decisions. It is customary to fix α before sample information is collected and to choose (take) generally α as 0.05 or 0.01 i.e. 5% or 1%. These are called *significance levels*. L.O.S. $\alpha=0.01$ is used for higher precision and $\alpha=0.05$ for moderate precision. We feel confident in rejecting a hypothesis at 1% L.O.S. than at 5% L.O.S. For example, when a decision is taken at 5% L.O.S., then there are 5 chances out of 100 that we would reject the hypothesis when it should be accepted i.e. we are about 95% confident that we have made the right decision. When we test a hypothesis at 1% L.O.S., there is only 1 chance out of 100 that we would reject the hypothesis when it should be accepted i.e. we are about 99% confident that we have made the right decision. L.O.S. is also known as the *size of the test*. Thus,

α = Probability of committing type I error

$$= P(\text{reject } H_0/H_1) = \alpha$$

and β = Probability of committing type II error

$$= P(\text{accept } H_0/H_1) = \beta$$

Power of the test is computed as $1 - \beta$.

Note 1: When the size of the sample is increased, the probability of committing both types of errors I and II i.e. α and β can be reduced simultaneously.

Note 2 : α and β are known as producer's risk and consumer's risk respectively.

Note 3: When both α and β are small, the test procedure is good one giving good chance of making the correct decision.

(XII) Critical Region (C.R.)

It is important to specify, before the sample is taken, which value of a test statistic S^* will lead to a rejection of H_0 , and which will lead to acceptance of H_0 . *The area of rejection is called the critical region.*

Consider the area under the probability curve of the sampling distribution of the test statistic S^* which follows some known (given) distribution. This area under probability curve is divided into dichotomous regions namely (1) the region of rejection (significant region or critical region) where H_0 is rejected and (2) the region of acceptance (non-significant region or non-critical region) where H_0 is accepted. Thus **Critical region** is the region of rejection of H_0 . The area of critical region = The level of significance α . Note that C.R. always lies on the tail(s) of the distribution. Depending on the nature of the H_1 (alternative hypothesis), C.R. may lie on one side or both sides of the tail(s).

(XIII) One Tailed Test(O.T.T.) and Two Tailed Test (T.T.T.)

The probability curve of the sampling distribution of the test statistic is generally a normal curve. In any test, the critical region is represented by a portion of the area under the probability curve of the sampling distribution of the test statistic.

Right One Tailed Test (R.O.T.T.)

When the alternative hypothesis (A.H.): H_1 is of the greater than type (mean etc), i.e. $H_1: \mu > \mu_0$ or $H_1: \sigma_1^2 > \sigma_2^2$ etc. then the entire critical region of area α lies on the right side tail of the probability density curve as shown in the Fig. 4.1. In such case, the test of hypothesis is known as **right one tailed test**.

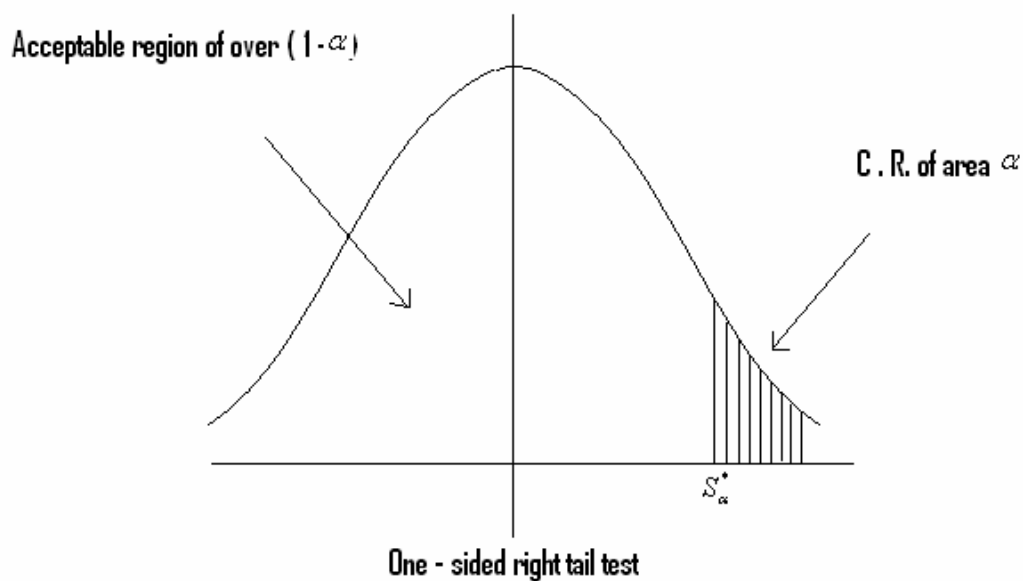


FIGURE. 4.1

Left One Tailed Test (L.O.T.T.)

When the alternative hypothesis (A.H.): H_1 is of less than type (mean etc) i.e. $H_1: \mu_1 < \mu_0$ or $H_1: \sigma_1^2 < \sigma_2^2$ etc. then the entire critical region of area α lies on the

left side tail of the probability density curve as shown in the Fig. 4.2. In such case, the test of hypothesis is known as **left one tailed test**.

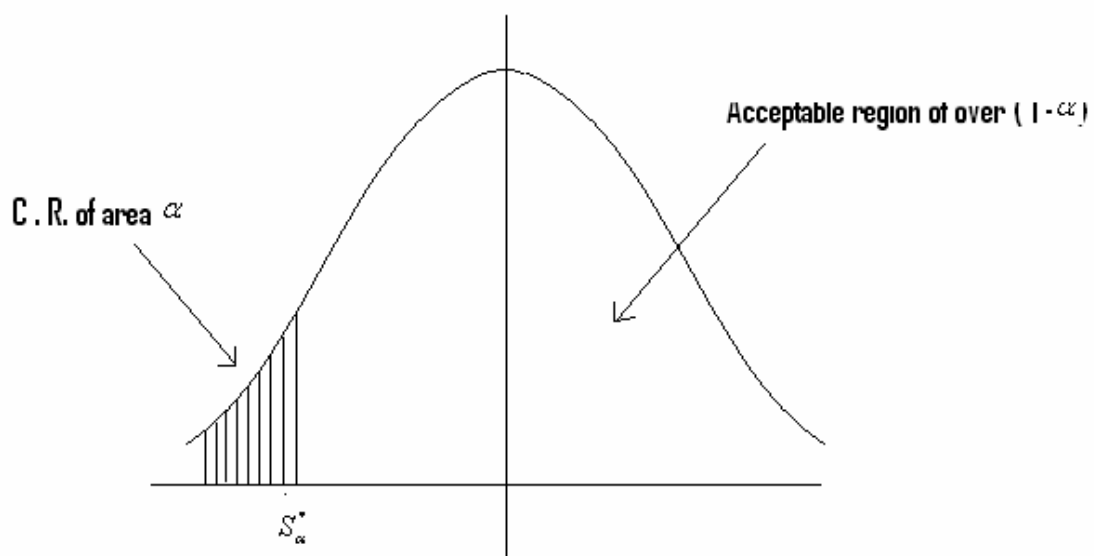


FIGURE. 4.2

Two Tailed Test (T.T.T.)

If A.H. is of the not equal type i.e., $H_1: \mu_1 \neq \mu_2$ or $H_1: \sigma_1 \neq \sigma_2$ etc. then the C.R. lies on both sides of the right and left tails of the curve such that C.R. of area $\frac{\alpha}{2}$ lies on the right tail and C.R. of area $\frac{\alpha}{2}$ lies on the left tail, as shown in Fig. 4.3.

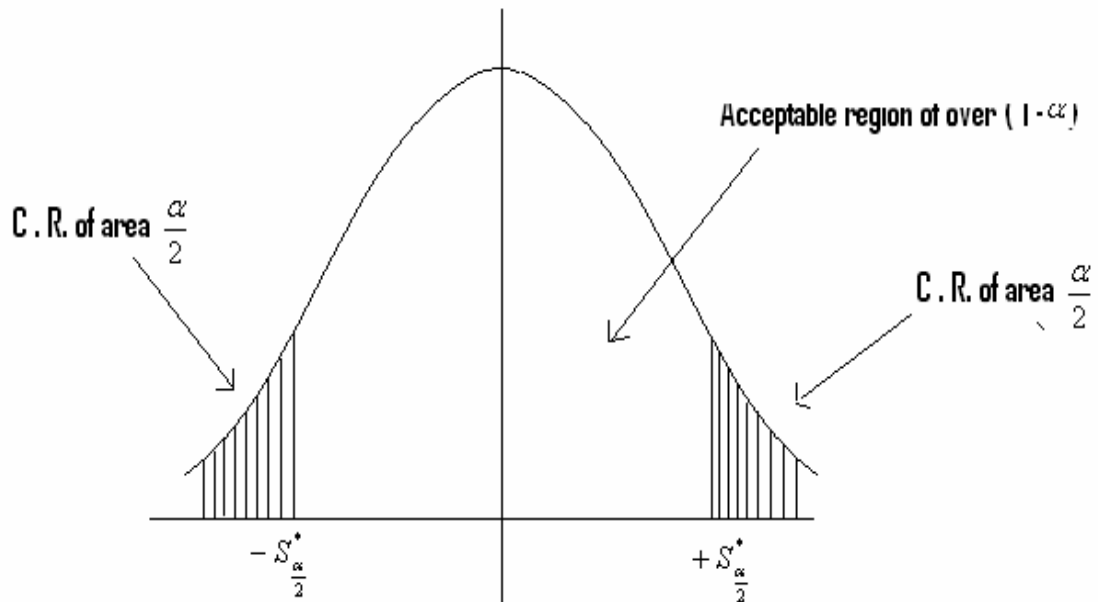


FIGURE 4.3

Thus the test of hypothesis or test of significances or rule of decision consists of the following six steps.

Step 1: Formulate N.H : H_0

Step 2: Formulate A.H. : H_1

Step 3: Choose L.O.S. : α

Step 4: C.R. : is determined by the critical value $S_{\frac{\alpha}{2}}^*$ and the kind of A.H.

(based on which the test is R.O.T.T. or L.O.T.T. or T.T.T.)

Step 5: Compute the test statistic S^* using the sample data.

Step 6: Decision : Accept or reject N.H. depending on the relation between S^* and $S_{\frac{\alpha}{2}}^*$.

(XIV) Degrees of Freedom (d.f.)

The number of degrees of freedom can be interpreted as the number of useful items of information generated by a sample of given size with respect to the

estimation of a given population parameter. Thus, it is defined as '**the total number of observations minus the number of independent constraints imposed on the observations**'. It is based on a concept that one could not have exercised his/her freedom to select all the samples.

The concept can be explained by an analogy:

$$X + Y = 10 \quad \text{..... (4.1)}$$

In the above equation you have freedom to choose a value for X or Y but not both because when you choose one, the other is fixed. If you choose 8 for X, then Y has to be 2. So the degree of freedom here is 1.

$$X + Y + Z = 15 \quad \text{..... (4.2)}$$

In the equation (2), one can choose values for two variables but not all. You have freedom to choose 8 for X and 2 for Y. If so, then Z is fixed. So the d.f. is 2. d.f. is calculated by subtracting 1 from the size of each group. Thus, the d.f. for selecting 'n' observations with one restriction is given as n-1, it is n-2 if two restrictions are given. If n is the number of observations and k is the number of independent constraints then n-k is the number of degrees of freedom. Generally, the degrees of freedom is denoted by Greek symbol ν (read as nu). Thus d.f. $\nu = n - k$.

Chi-Square Test

The Chi-square test is a non-parametric test of proportions. It is used to test a hypothesis. If the association between two variables is to be tested this test is commonly used.

The test involves the calculation of quantity, called chi-square from the Greek letter 'chi' (χ) and pronounced as 'kya'. It was developed by Karl Pearson.

In many of the statistical tests we had to assume that the samples came from normal populations. When this assumption cannot be justified it is necessary to use the test procedure that do not require that these condition to be met. χ^2 -test belongs to such test procedure. χ^2 -test makes no assumption about the population being sampled. The quantity χ^2 describes the magnitude of discrepancy between theory and observation and hence with the help of χ^2 -test we can know whether such discrepancy can be attributed to chance or not. If χ^2 is zero, it indicates that the observed values and theoretical values completely coincide.

Definition of Statistic χ^2

Chi-square statistics is defined as square of a standard normal variate. If O_i ($i=1,2,\dots,n$) are the observed values (or frequencies) and E_i ($i= 1,2,\dots,n$) are the theoretical values (or frequencies) of a random variable X from a normal population, then the statistic χ^2 is computed as

$$\chi^2 = \sum_{i=1}^n \frac{(O_i - E_i)^2}{E_i} \quad (i= 1,2,\dots,n)$$

Here χ^2 follows, Chi-square distribution with $(n-1)$ degrees of freedom.

We find $\chi^2 \leq \chi^2_{n-1,0.05}$ from the χ^2 - table.

If $\chi^2 \leq \chi^2_{n-1,0.05}$, we accept H_0 : the given theoretical values fits the observed (Empirical) values, otherwise we reject H_0 .

Note: If we have estimated k parameters in fitting the given theoretical distributions, the d.f. for χ^2 are $n-k-1$.

Conditions for the Application of χ^2 - test

- (1) Sample observations must be independent of each other.
- (2) The sample data must be drawn at random from the target population.
- (3) The sample should contain at least 50 observations.
- (4) There should be no less than 5 observations in any one cell.

Application of χ^2 - test

- (1) To test the discrepancy between observed values and theoretical values.
- (2) To test goodness of fit.

In this we test whether the frequencies are according to certain assumption or not ?

The formula is

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

- (3) To test whether the two attributes are independent or not?

The formula is

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

Where O = Observed frequency

E = Expected frequency

We use χ^2 test with $(r-1)(c-1)$ d.f. where r is number of rows and c is number of columns.

EXAMPLE-1: Ratio male to female births in universe is expected to be 1 : 1. In one village it was found that male children born were 52 and females 48. Is this difference due to chance?

SOLUTION:

	Observed frequencies (O)	Expected Frequencies (E)
Male	52	50
Female	48	50

$$\chi_c^2 = \sum \frac{(O - E)^2}{E} = \frac{(52 - 50)^2}{50} + \frac{(48 - 50)^2}{50} = \frac{8}{50} = 0.16$$

The degrees of freedom = $n - 1 = 2 - 1 = 1$

At 5% level of significance for 1 d.f. $\chi_T^2 = 3.841$. $\chi_c^2 < \chi_T^2$, and calculated value of χ_c^2 i.e. 0.16 is much lower, hence significant. Therefore the observed difference in births of two sexes is due to chance.

EXAMPLE-2: In an experiment of pea breeding, the following frequencies were obtained.

Round and Yellow	Wrinkled and Yellow	Round and Green	Wrinkled and Green
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315	101	108	32
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Theory predicts that the frequencies be in proportions 9:3:3:1. Examine the correspondence between the theory and the experiment.

SOLUTION:

Let H_0 : There is no significant difference between observed (experimental) frequencies and theoretical frequencies

Total frequency = $315 + 101 + 108 + 32 = 556$.

On the basis of proportions 9 : 3 : 3 : 1, the expected frequencies are

$$556 \times \frac{9}{16} = 312.75, 556 \times \frac{3}{16} = 104.25$$

$$556 \times \frac{3}{16} = 104.25, 556 \times \frac{1}{16} = 34.75$$

$$\begin{aligned} \therefore \chi^2 &= \sum \frac{(O - E)^2}{E} = \frac{(315 - 312.75)^2}{312.75} + \frac{(101 - 104.25)^2}{104.25} + \frac{(108 - 104.25)^2}{104.25} + \frac{(32 - 34.75)^2}{34.75} \\ &= 0.016 + 0.101 + 0.136 + 0.135 \end{aligned}$$

$$\chi^2 = 0.606$$

$$\text{d.f.} = 4 - 1 = 3$$

From the χ^2 -table we find that $\chi^2_{3,0.05} = 7.82$

$$\therefore \chi^2_c < \chi^2_r$$

\therefore We accept H_0 at 5% level of significance and conclude that the theory and experiment are in agreement.

EXAMPLE-3: The demand for a particular spare part in a factory was found to vary from day to day. In a sample study the following information was obtained:

Day	Mon.	Tue.	Wed.	Thur.	Fri.	Sat.
No. of parts demanded	1124	1125	1110	1120	1120	1115

Test the hypothesis that the number of parts demanded has no association with the days of the week.

SOLUTION:

Let H_0 : The number of spare parts during the six days.

$$\begin{aligned}\therefore \chi^2 &= \sum \frac{(O - E)^2}{E} = \frac{(1124 - 1120)^2}{1120} + \frac{(1125 - 1120)^2}{1120} + \frac{(1110 - 1120)^2}{1120} \\ &+ \frac{(1120 - 1120)^2}{1120} + \frac{(1126 - 1120)^2}{1120} + \frac{(1115 - 1120)^2}{1120} \\ &= \frac{16 + 25 + 100 + 0 + 36 + 25}{1120}\end{aligned}$$

$$\chi^2 = \frac{202}{1120} = 0.1804,$$

$$\text{d.f.} = n - 1 = 6 - 1 = 5$$

From the χ^2 -table, we find $\chi^2_{5,0.05} = 11.07$.

Here $\chi^2_c < \chi^2_r$

\therefore We accept H_0 and conclude that the number of spare parts demanded does not depend on the day of the week.

EXAMPLE-4: A die is thrown 150 times and the following results are obtained.

Number turned up	1	2	3	4	5	6
Frequency	19	23	28	17	32	31

Test the hypothesis that the die is unbiased at 5% level of significance.

SOLUTION: H_0 : The die is unbiased

If the die is unbiased all the numbers 1, 2, 3, 4, 5, 6 are equiprobable to turn up. The

probability is $\frac{1}{6}$. Hence out of 150 each number will turn up for $150 \times \frac{1}{6} = 25$ times, which is theoretical frequency of each number.

Number Turned up	Observed Frequency (O)	Expected Frequency (E)	O-E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
1	19	25	-6	36	1.44
2	23	25	-2	4	0.16
3	28	25	3	9	0.36
4	17	25	-8	64	2.56
5	32	25	7	49	1.96
6	31	25	6	36	1.44
Total	150	150	-		7.92

Calculated Value of Lambda square at 5 d.f at 5% level of significance is 7.92

The degrees of freedom = $n-1=6-1=5$

At 5% level of significance for 5 d.f. $X_{T^2}=11.07$

$X_C^2 < X_T^2$

therefore H_0 is accepted and it can be said that the dice is unbiased

Contingency Table

If the observed frequencies occupy a single row, the table is called a classification table. Extending the same idea we can arrive at a two way classification table of R-rows and C-columns figuring observed frequencies and such a table is called a *contingency table*. Corresponding to each observed frequency in R x C contingency table we can obtain the corresponding expected (theoretical) frequency by the concept

of proportion. The total frequency in each row or column is called *marginal frequency*. The associated degree of freedom = (R-1)(C-1).

How to make a 2 x 2 Contingency Table?

In a contingency table first enter raw data, that is the exact number of subject / animals etc.-not percentage, means or fractions. The group (treatment / control, exposure / no exposure) are entered on the left side as rows, with the treatment group in the top row and the control group in the second row. The outcome is entered as columns on the right side with the positive outcome as the first column and the negative or no change outcome as the second column. The columns and rows are also mutually exclusive. A particular subject or patient can be only in one column not in both.

The following is a form of a 2 x 2 table.

Exposure	Outcome	
	Yes	No
Yes		
No		

For example, Patients with symptoms of viral upper respiratory tract infection were divided into two groups and given placebo or Antihistaminic (AH). The result was recorded as improvement or no improvement after 48 hours.

	<i>Improvement</i>	<i>No improvement</i>	Total
Antihistaminic	58	442	500
Placebo	67	423	490
Total	125	865	990

We state the following formula for obtaining the value of χ^2 for 2 x 2 contingency table.

a	b
c	d

$$\chi^2 = \frac{(a+b+c+d)(ad-bc)^2}{(a+b)(c+d)(a+c)(b+d)}$$

The 2 x 2 contingency table along with the marginal frequencies is as follows:

	I	II	Totals
A	A	b	a+b
B	C	d	c+d
Totals	a+c	b+d	N = a+b+c+d

Let E(a), E(b), E(c), E(d) respectively denote the expected frequencies corresponding to the observed frequencies a, b, c, d. In respect of the null hypothesis that the classifications are independent we have

$$E(a) = \frac{(a+c)(a+b)}{N} ; \quad E(b) = \frac{(b+d)(a+b)}{N}$$

$$E(c) = \frac{(a+c)(c+d)}{N} ; \quad E(d) = \frac{(b+d)(c+d)}{N}$$

EXAMPLE-1: The following table shows the results of an experiment to investigate the effect of vaccination induced on the animals against a particular disease. Use the Chi-square test to test the hypothesis that there is no difference between the vaccinated and unvaccinated groups i.e. vaccination and this disease are independent.

	Got disease	Did not get disease
Vaccinated	9	42
Not vaccinated	17	28

(Value of χ^2 for 1 d.f. at 5% level is equal to 3.84)

SOLUTION:

H_0 : Vaccination and Medicine are independent.

	Got disease	Did not get disease	Total
Vaccinated	9(a)	42(b)	51(a+b)
Not vaccinated	17(c)	28(d)	45(c+d)
	26(a+c)	70(b+d)	96(a+b+c+d = N)

From the given table $a = 9$, $b = 42$, $c = 17$, $d = 28$, $N = a + b + c + d = 96$

We know that,
$$\chi^2 = \frac{(a+b+c+d)(ad-bc)^2}{(a+b)(c+d)(a+c)(b+d)}$$

$$= \frac{(96)(-462)^2}{(51)(26)(70)(45)} = 4.906$$

$$\chi_{cal}^2 = 4.906 > \chi_{0.05}^2 = 3.84$$

The hypothesis that the vaccination and disease are independent rejected at 5% level of significance.

EXAMPLE-2: The following data relate to the sales, in a time of trade depression of a certain article in a wide demand. Do the data suggest that the sales are significantly affected by depression?

Sales	Trade depreciation	
	Not hit by	Hit by
Satisfactory	140	60
Not satisfactory	40	60

SOLUTION:

H₀: Sales and depression are independent

Sales	Trade depreciation		Total
	Not hit by	Hit by	
Satisfactory	140 (120)	60 (30)	200
Not satisfactory	40 (60)	60 (40)	100
Total	180	120	300

Expected frequency is obtained as follows:

$$E_{ij} = \frac{R_i \times C_j}{N}, \text{ where } R_i = \text{Total of } i^{\text{th}} \text{ row, } C_j = \text{Total of } j^{\text{th}} \text{ column, } N = \text{Total frequency}$$

$$E_{11} = E(140) = \frac{R_1 \times C_1}{N} = \frac{200 \times 180}{300} = 120$$

The expected frequencies of different sales are indicated in bracket in the respective cells.

$$\chi_c^2 = \sum \frac{(O - E)^2}{E}$$

$$= \frac{(140 - 120)^2}{120} + \frac{(60 - 30)^2}{30} + \frac{(40 - 60)^2}{60} + \frac{(60 - 40)^2}{40}$$

$$\begin{aligned}
&= \frac{400}{120} + \frac{400}{80} + \frac{400}{60} + \frac{400}{40} \\
&= 3.33 + 5.00 + 6.67 + 10 \\
&= 25
\end{aligned}$$

$$\begin{aligned}
\text{Degrees of freedom} &= (R - 1)(C - 1) \\
&= (2 - 1)(2 - 1) \\
&= 1
\end{aligned}$$

R = No. of rows

C = No. of columns

At 5% level of significance for 1 d.f. $\chi^2_T = 3.841$.

$\chi^2_c > \chi^2_T$, therefore H_0 is rejected and we conclude that the sales and trade depreciation are not independent and sales are significantly affected by depression.

EXAMPLE-3: In an experiment to study the dependence of hypertension on smoking habits, the following data were taken on 180 individuals:

	Non Smoker	Moderate Smoker	Heavy Smoker
Hypertension	21	36	30
No Hypertension	48	26	19

Test the hypothesis that the presence (or absence) of hypertension is independent of smoking habits.

SOLUTION:

H_0 : Hypertension is independent of smoking habit.

Observed Frequencies(O):

	Non Smoker	Moderate Smoker	Heavy Smoker	Total
Hypertension	21	36	30	87
No Hypertension	48	26	19	93

Total	69	62	49	180
--------------	----	----	----	-----

Expected Frequencies(O):

From the above table we have row total and column total,

	Non Smoker	Moderate Smoker	Heavy Smoker
Hypertension	$\frac{87 \times 69}{180} = 33$	$\frac{62 \times 87}{180} = 30$	$\frac{49 \times 87}{180} = 14$
No Hypertension	$\frac{93 \times 69}{180} = 36$	$\frac{62 \times 93}{180} = 32$	$\frac{49 \times 93}{180} = 25$

χ^2 – calculation :

	Obs. Freq (O)	Exp. Freq (E)	(O-E)²	$\frac{(O-E)^2}{E}$
Hypertension:				
Non Smoker	21	33	144	4.36
Moderate Smoker	36	30	36	1.2
Heavy Smoker	30	24	36	1.5
No Hypertension:				
Non Smoker	48	36	144	4

Moderate Smoker	26	32	36	1.125
Heavey Smoker	19	25	36	1.44
		Total	452	$\chi^2 = 13.625$

Degrees of freedom = (R-1) (C-1)

$$= (2-1) \times (3-1) = 2 \text{ d.f}$$

Value of χ^2 at 95% at 2 d.f. = 5.991

$$\therefore \chi_c^2 = 13.625 \quad \text{and} \quad \chi_T^2 = 5.991$$

$$\therefore \chi_c^2 > \chi_T^2$$

So computed value of χ^2 is greater than critical value of χ^2 . Therefore Null hypothesis is rejected. Hence it may be concluded that hypertension is not independent of smoking.

4.7 GRAPHS :

Shows the Effect of an improvement in relevant HR-Component
(Before adoption of technology and after adoption of technology.)

TABLE – 4.7.1

Quality of Worklife(QWL)

	Before	After		Before	After
	G	G		PG	PG
Nutral	10	12		9	12
Not Agree	335	293		315	279
Agree	675	714		640	688

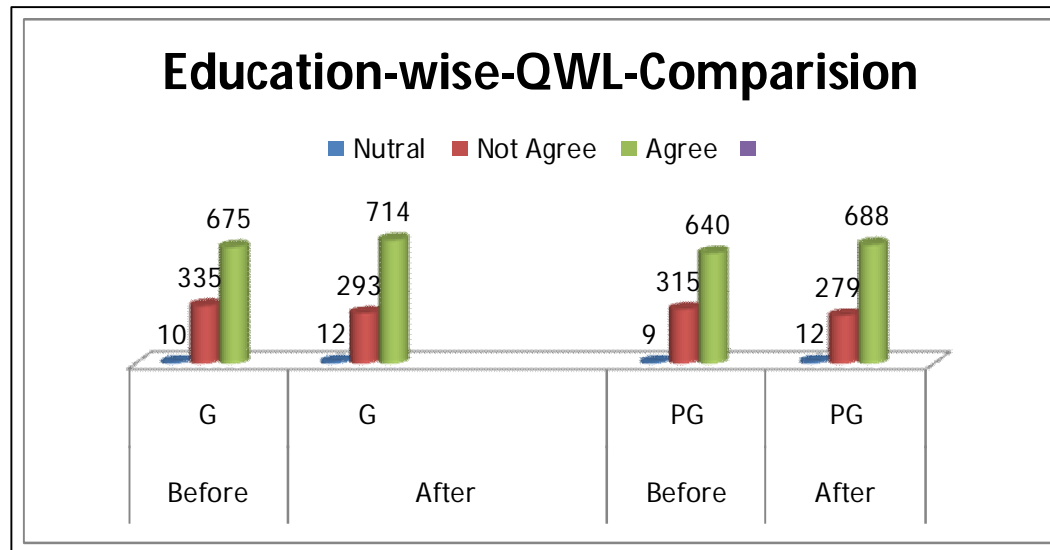


TABLE – 4.7.2
Stress

	G	G	PG	PG
	before	after	before	after
Nutral	10	12	9	12
Not Agree	335	293	315	279
Agree	675	714	640	688

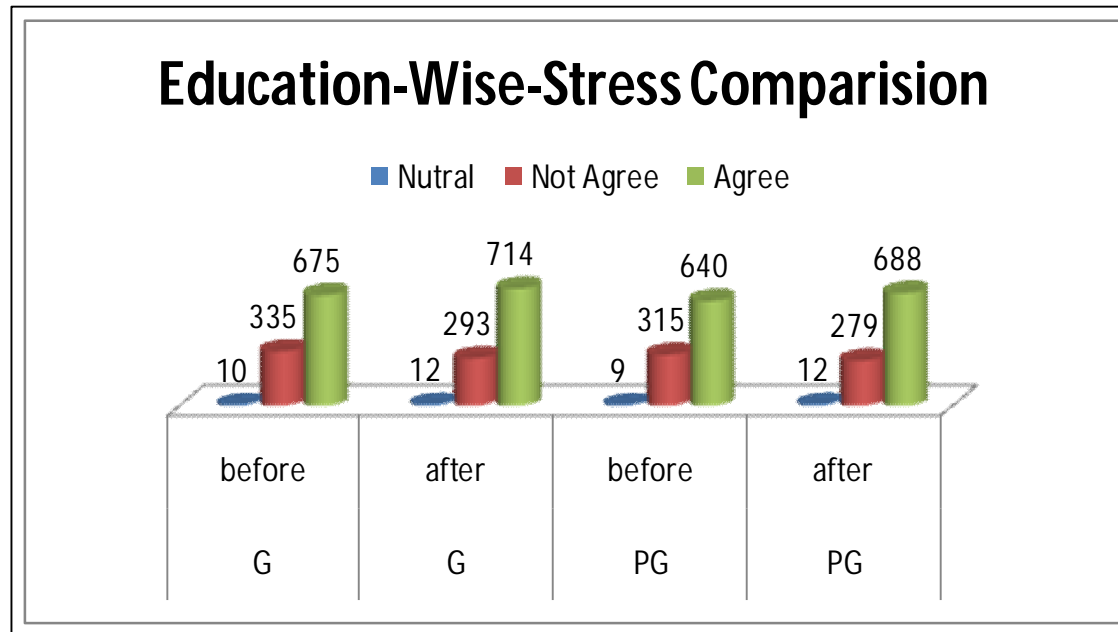


TABLE – 4.7.3
Post wise Qwality of Work Life (QWL) comparision

	Casier		Clerk		DyManager		Manager		Operator		Supervisor	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Nutral	35	52	36	47	34	50	36	50	35	55	36	46
Not Agree	394	367	379	356	389	363	395	370	390	361	382	360
Agree	650	656	634	643	656	662	678	686	624	630	641	650

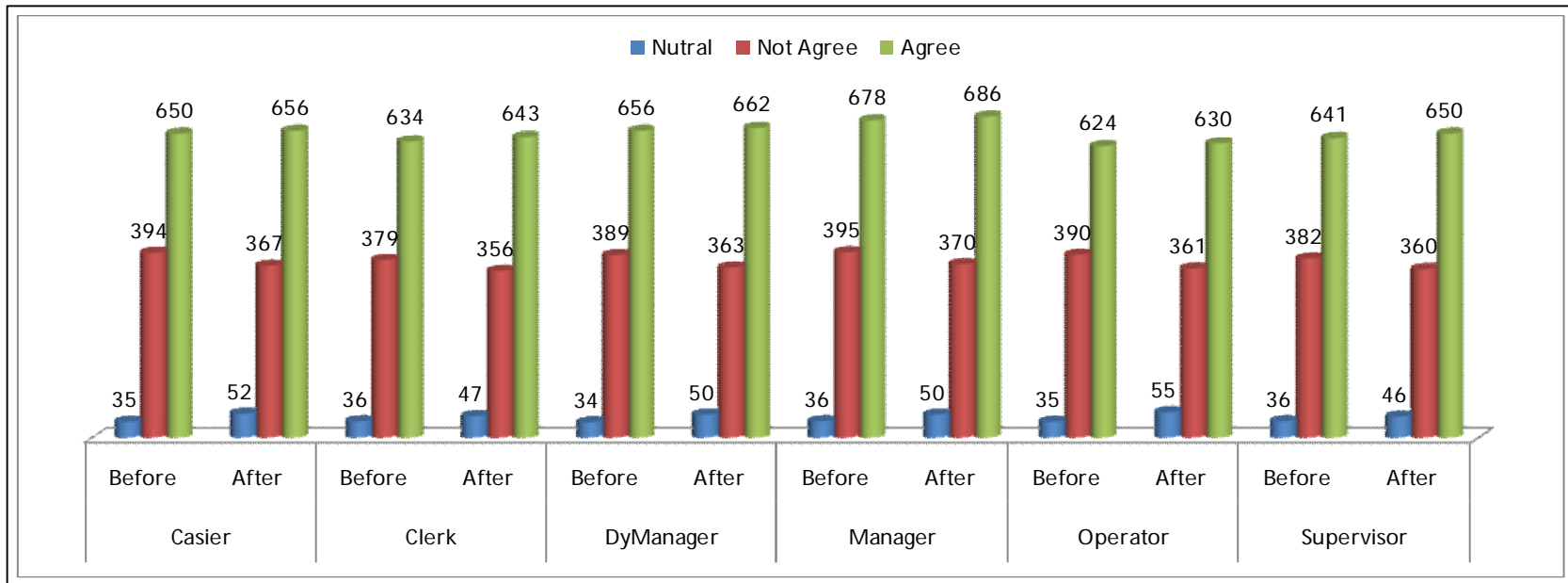


TABLE – 4.7.4
Post-wise Stress

	Casier		Clerk		DyManager		Manager		Operator		Supervisor	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Nutral	9	10	8	10	9	10	9	11	10	11	8	10
Not Agree	283	246	280	239	281	242	286	245	276	239	284	242
Agree	568	603	549	587	570	607	589	627	551	586	553	592

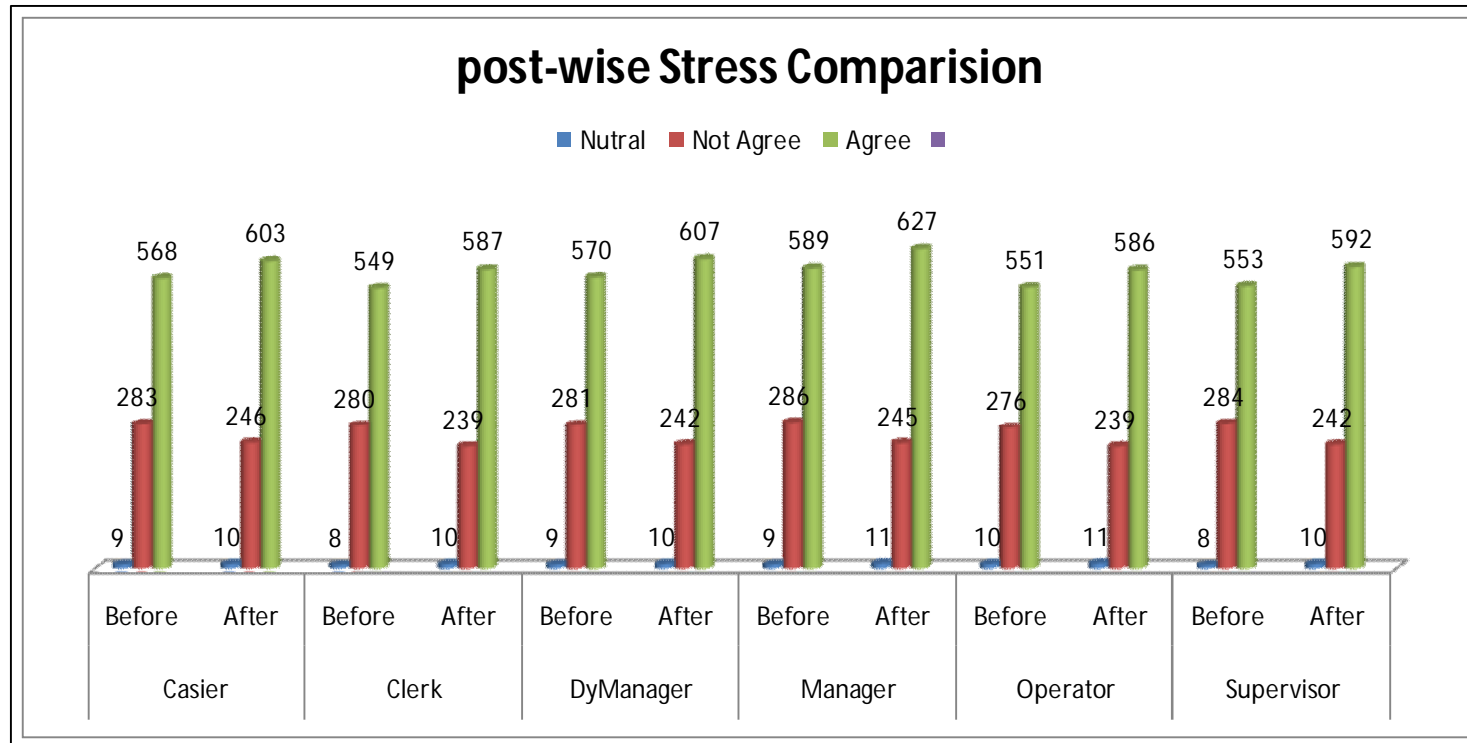


TABLE – 4.7.5
Post-Wise HR-Practice Comparision

	Casier		Clerk		DyManager		Manager		Operator		Supervisor	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Nutral	48	48	44	50	44	45	45	51	47	48	44	51
Not Agree	541	481	544	470	541	473	567	481	530	468	556	481
Agree	1139	1199	1092	1160	1143	1210	1164	1244	1103	1164	1096	1164

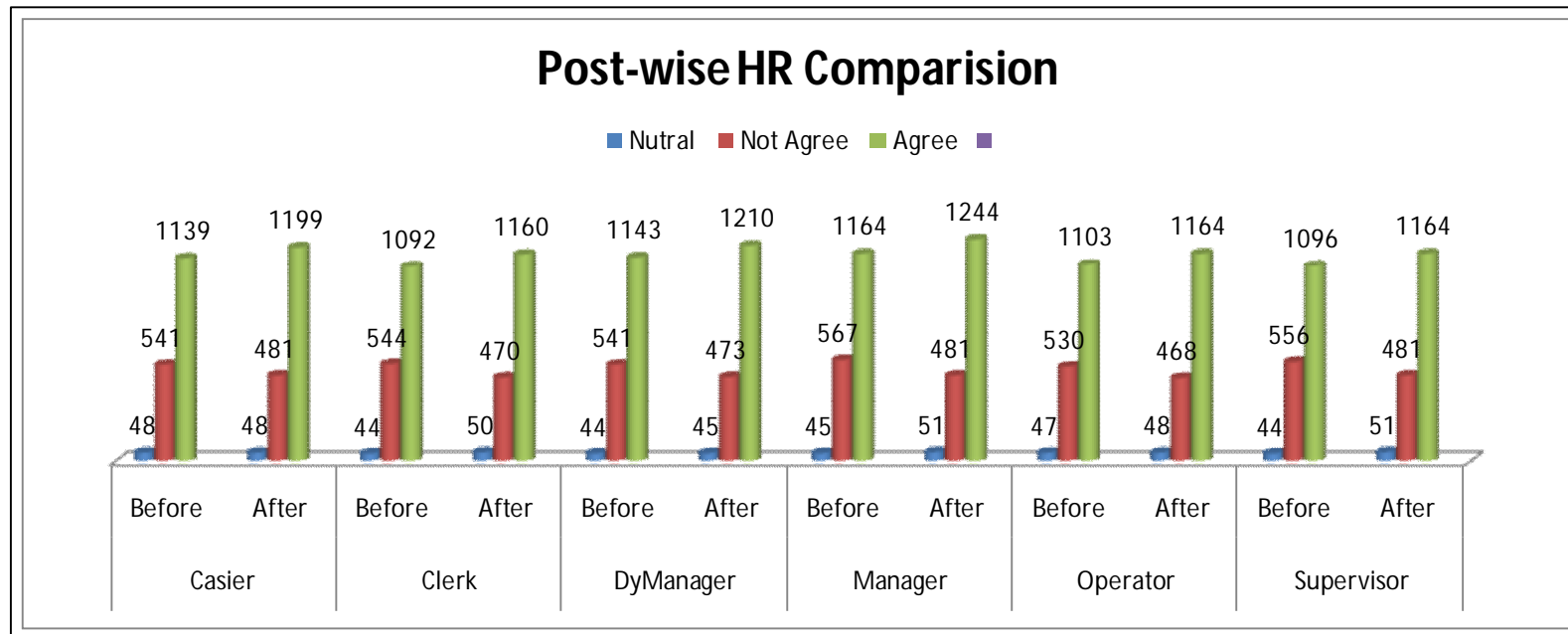


TABLE – 4.7.6
CITY-WISE CULTURE COMPARISION

	RAJKOT		AHEMDABAD		BARODA		BHAVNAGAR		SURAT	
	Before	After	Before	After	Before	After	Before	After	Before	After
Nutral	0	18	0	17	0	17	0	12	0	21
Not Agree	175	76	172	80	181	84	186	85	178	87
Agree	100	180	103	177	94	173	111	196	108	177

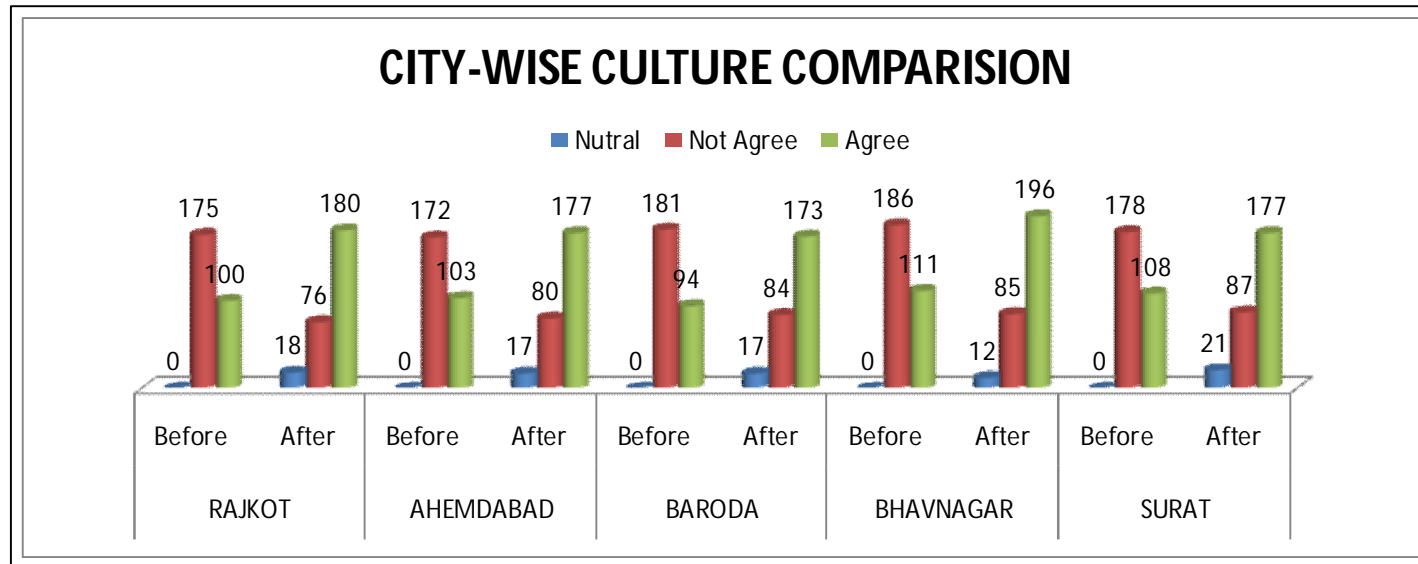


TABLE – 4.7.7
CITY-WISE MOTIVATION COMPARISION

	RAJKOT		AHEMDABAD		BARODA		BHAVNAGAR		SURAT	
	Before	After	Before	After	Before	After	Before	After	Before	After
Nutral	20	26	12	17	12	18	8	14	17	21
Not Agree	170	123	177	115	177	121	176	120	194	87
Agree	183	224	185	242	184	234	219	269	177	177

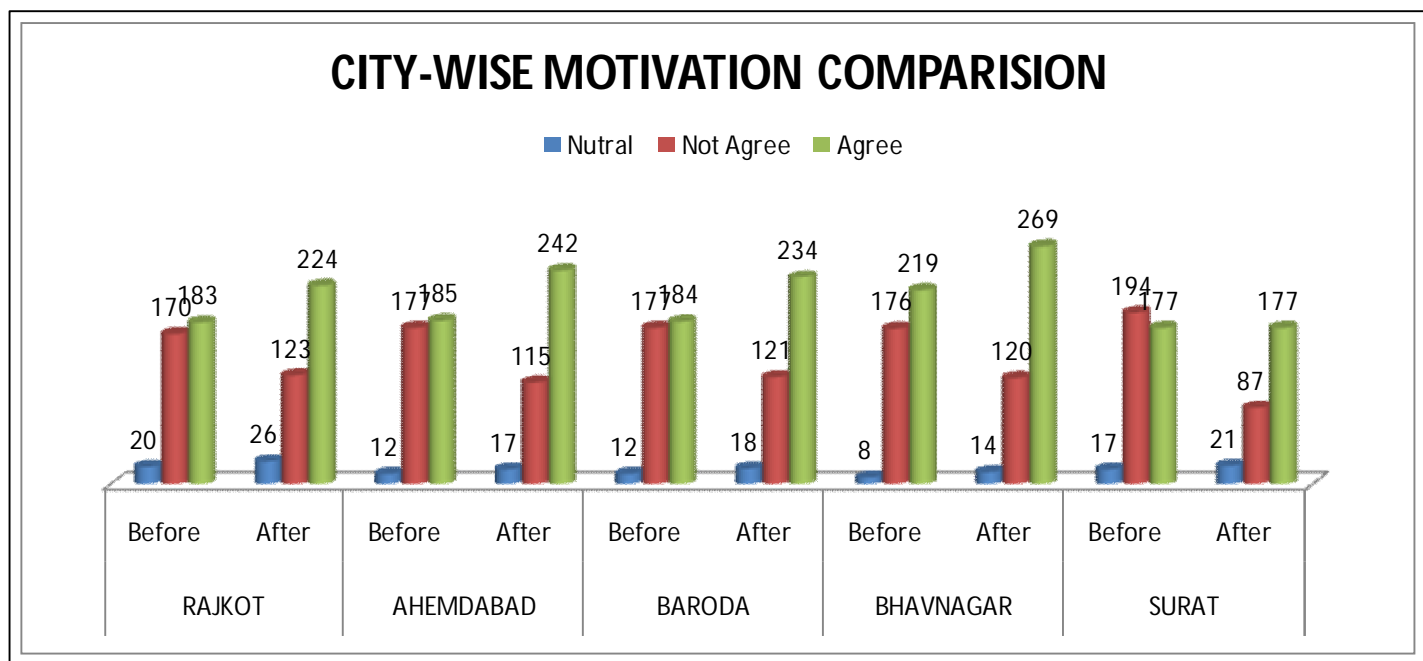


TABLE – 4.7.8

CITY-WISE QUALITY OF WORK-LIFE COMPARISION

	RAJKOT		AHEMDABAD		BARODA		BHAVNAGAR		SURAT	
	Before	After	Before	After	Before	After	Before	After	Before	After
Nutral	5	5	9	11	3	16	12	12	10	15
Not Agree	83	83	98	90	97	87	90	82	99	96
Agree	162	162	143	148	150	146	167	175	151	148

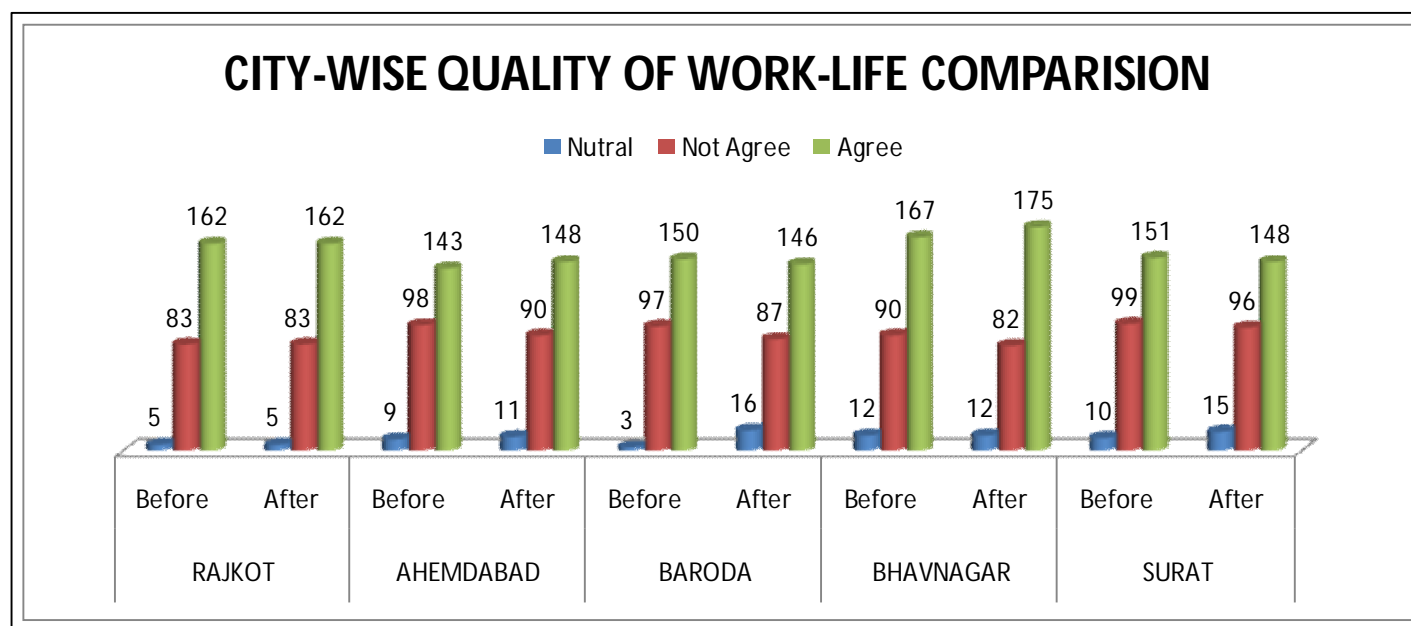


TABLE – 4.7.9

CITY-WISE STRESS COMPARISION

	RAJKOT		AHEMDABAD		BARODA		BHAVNAGAR		SURAT	
	Before	After	Before	After	Before	After	Before	After	Before	After
Nutral	0	2	3	3	3	17	2	2	2	2
Not Agree	64	56	91	57	56	84	62	62	62	62
Agree	135	141	106	139	140	173	151	151	143	143

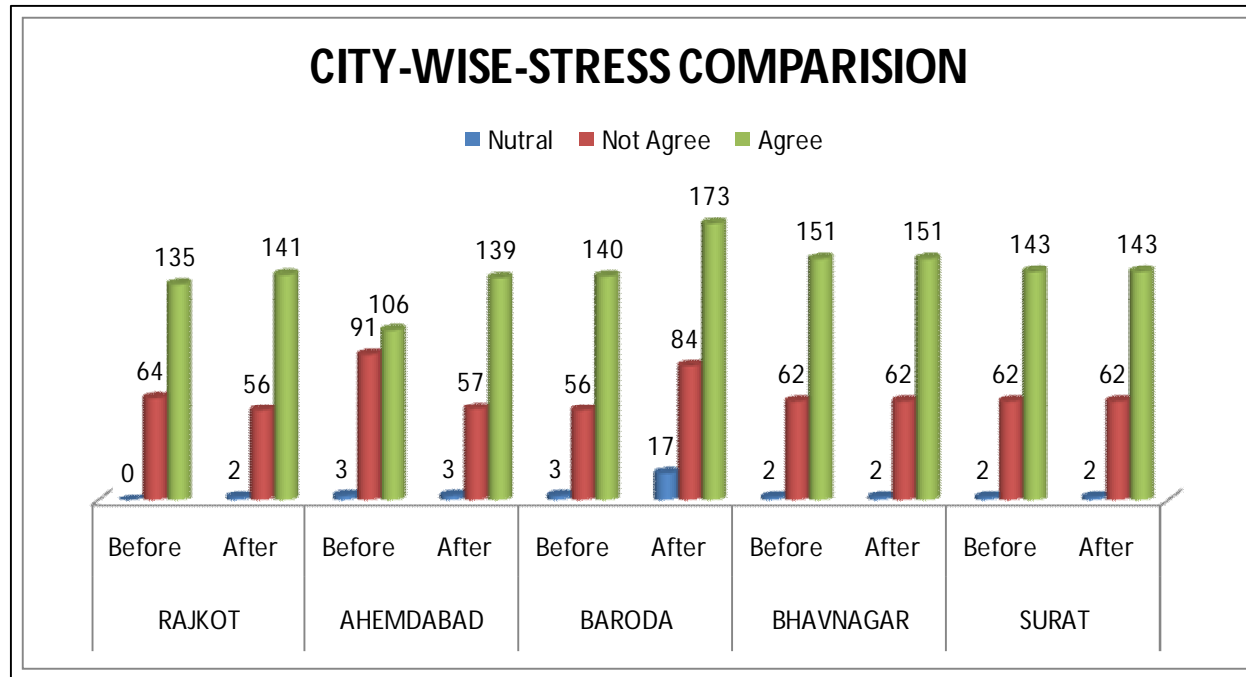


TABLE – 4.7.10
CITY-WISE HR-PRACTICES COMPARISION

	RAJKOT		AHEMDABAD		BARODA		BHAVNAGAR		SURAT	
	Before	After	Before	After	Before	After	Before	After	Before	After
Nutral	6	13	13	13	10	11	11	11	12	12
Not Agree	160	114	130	117	141	107	128	123	126	117
Agree	234	273	257	270	249	282	293	298	278	287

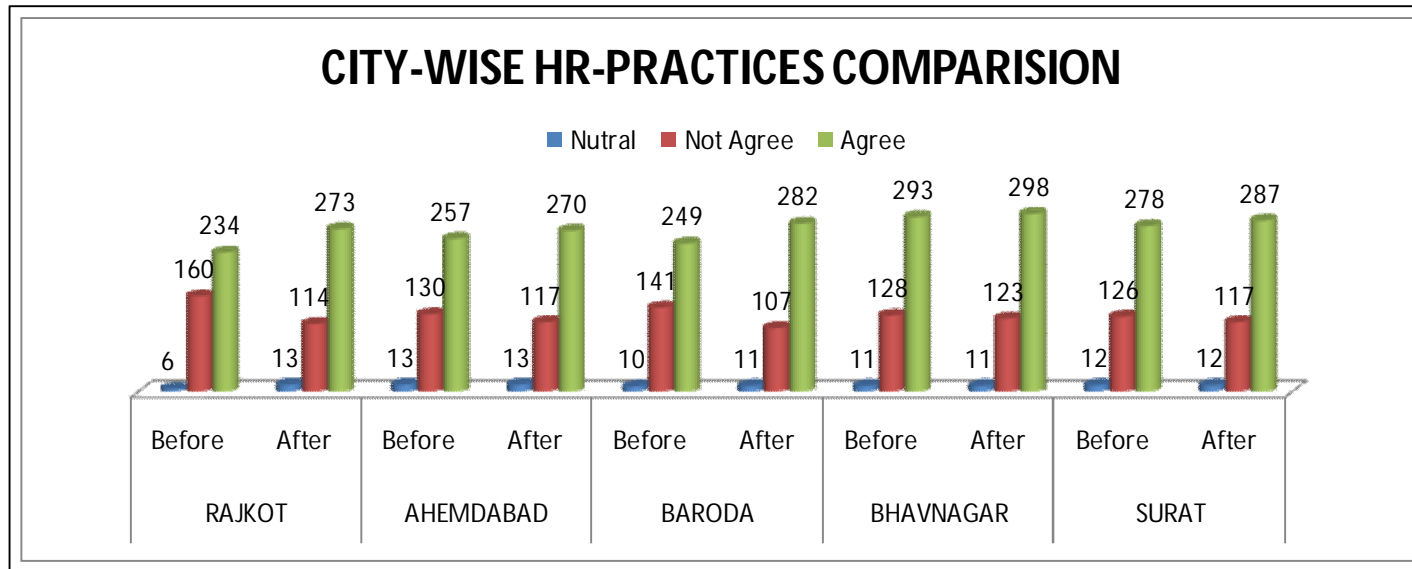


TABLE – 4.7.11
AGE-WISE-CULTURE COMPARISION

	35-40Yrs		40-45Yrs.		45-50Yrs.		50-55Yrs.	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
Nutral	53	69	0	83	0	83	0	83
Not Agree	779	364	885	410	874	398	870	404
Agree	855	802	512	896	501	886	505	880

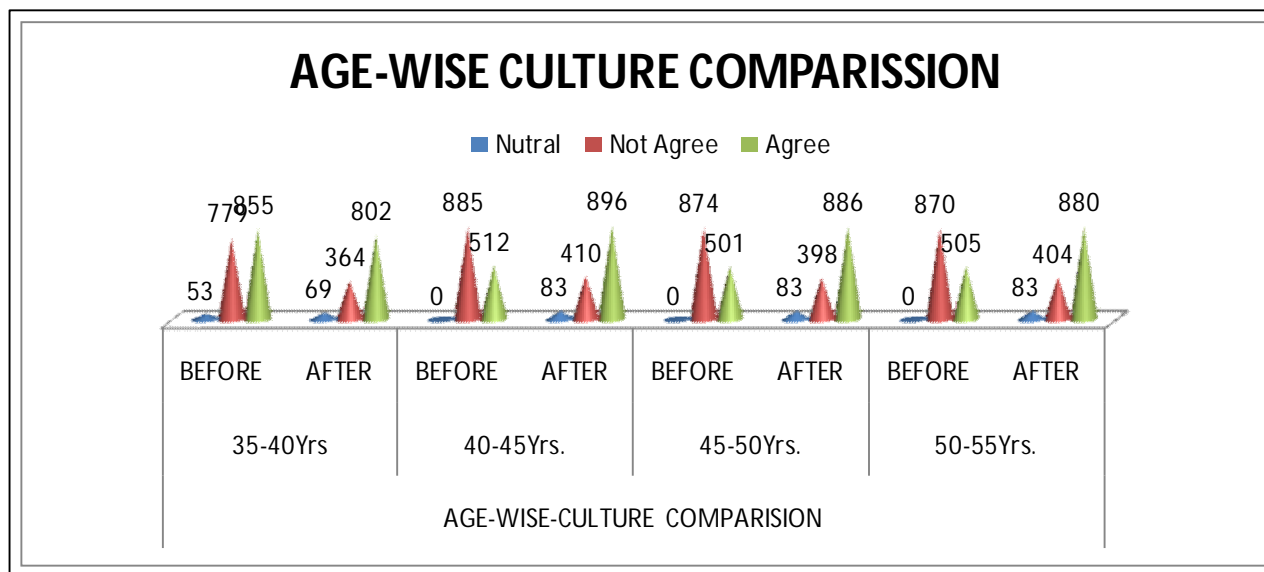


TABLE – 4.7.12

AGE-WISE-MOTIVATION COMPARISION

	35-40Yrs		40-45Yrs.		45-50Yrs.		50-55Yrs.	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
Nutral	53	80	68	97	67	95	67	152
Not Agree	779	526	887	597	868	582	872	1009
Agree	855	1081	941	1202	931	1189	927	950

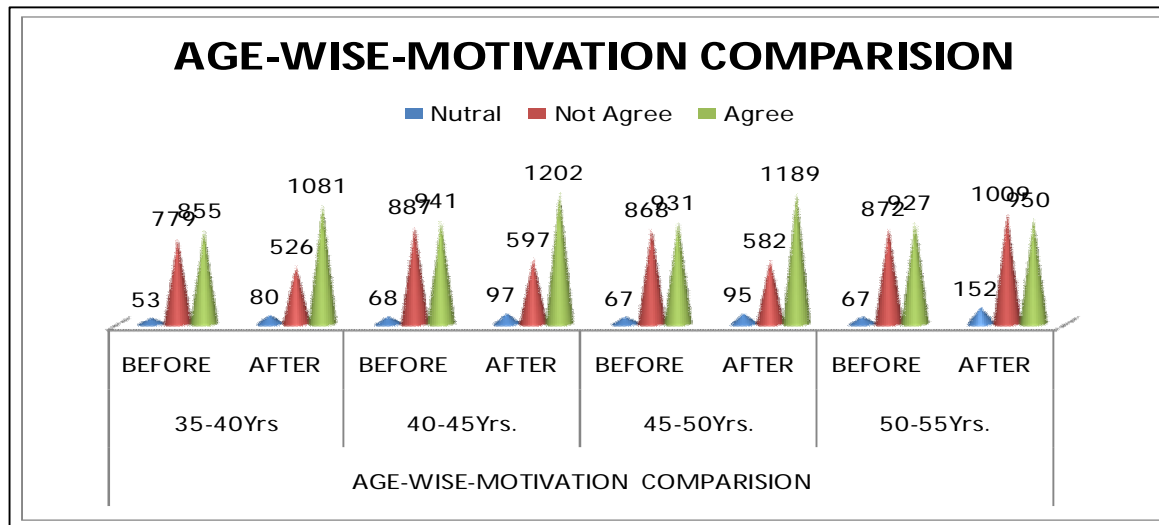


TABLE – 4.7.13
AGE-WISE-QUALITY OF WORK LIFE COMPARISION

	35-40Yrs		40-45Yrs.		45-50Yrs.		50-55Yrs.	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
Nutral	36	50	39	59	38	55	39	56
Not Agree	404	379	463	434	453	426	452	425
Agree	689	697	767	772	758	764	758	764

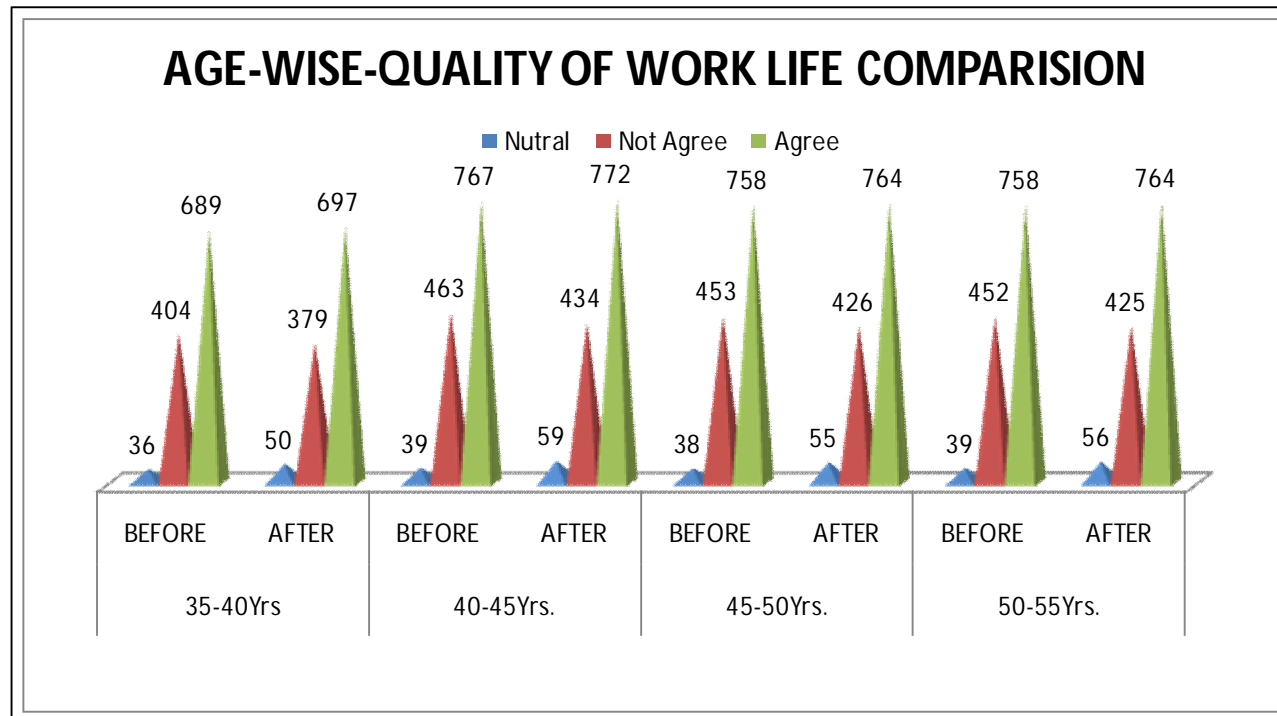


TABLE – 4.7.14
AGE-WISE-STRESS COMPARISION

	35-40Yrs		40-45Yrs.		45-50Yrs.		50-55Yrs.	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
Nutral	9	11	10	12	9	11	9	11
Not Agree	295	253	330	289	329	287	326	286
Agree	596	635	672	710	658	697	661	698

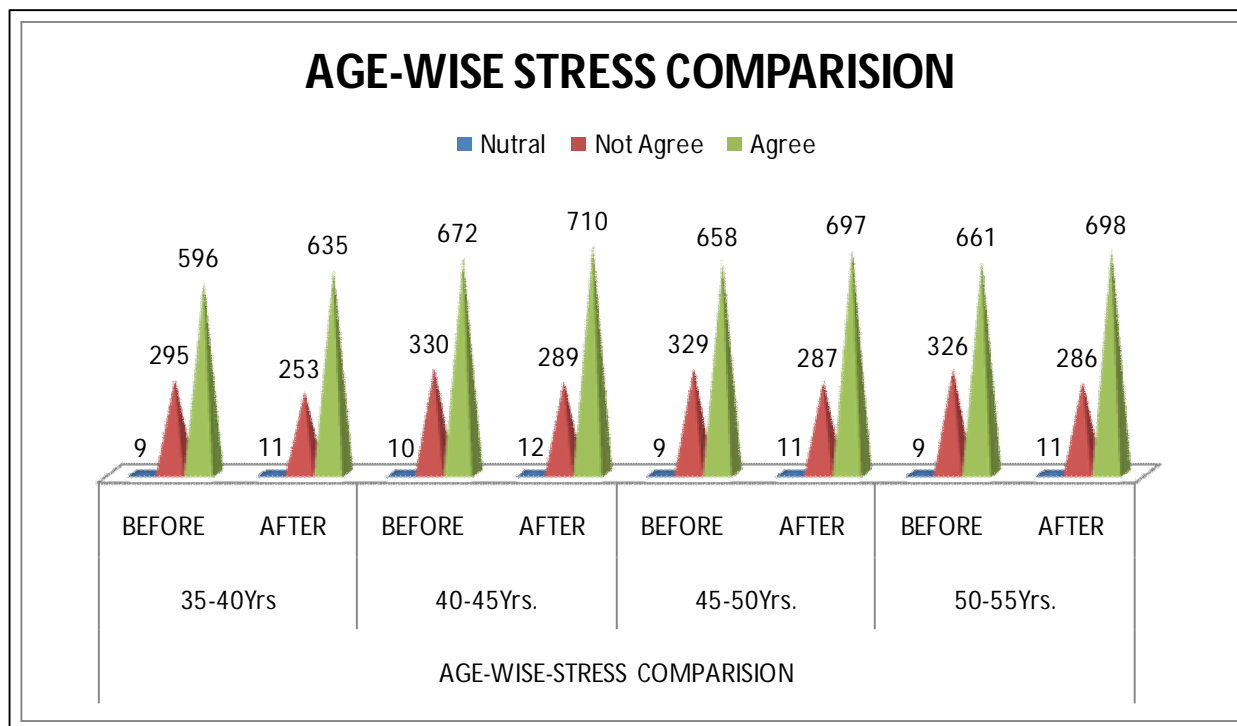


TABLE – 4.7.15
AGE-WISE-HR-PRACTICES COMPARISION

	35-40Yrs		40-45Yrs.		45-50Yrs.		50-55Yrs.	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
Nutral	45	51	51	58	50	57	49	56
Not Agree	585	497	675	569	667	566	663	561
Agree	1178	1260	1306	1405	1283	1377	1288	1383

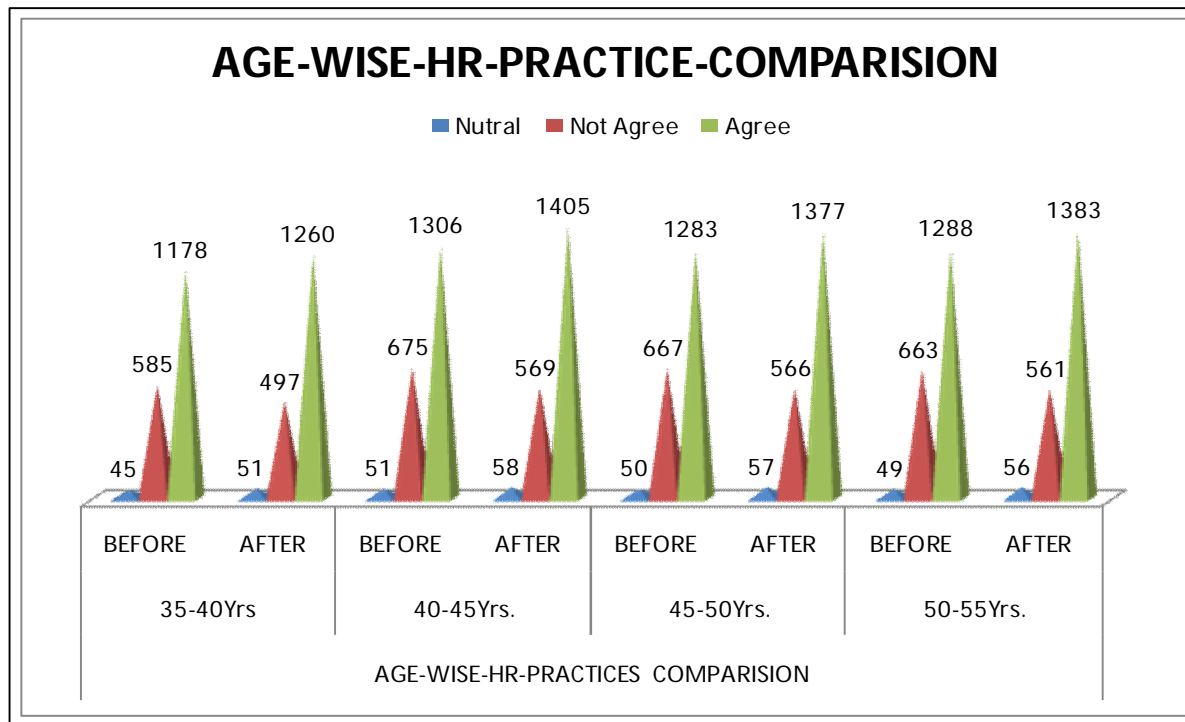


TABLE – 4.7.16
EXPERINCE-WISE CULTURE COMPARISION

	10-15Yrs		15-20Yrs.		20-25Yrs.		25-30Yrs.	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
Nutral	0	69	0	77	0	83	0	85
Not Agree	784	364	828	381	885	410	886	407
Agree	459	802	481	843	512	896	511	897

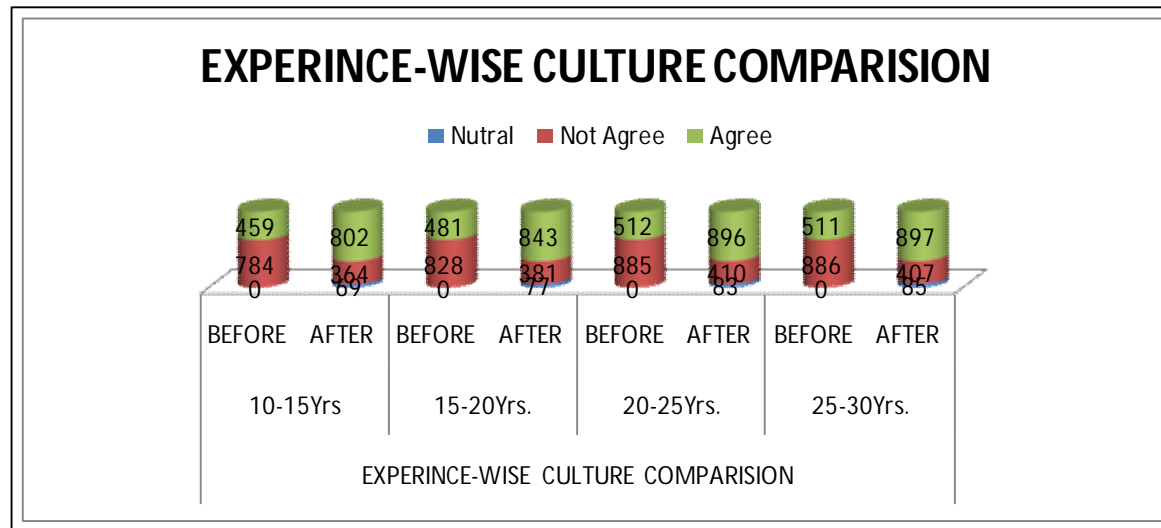


TABLE – 4.7.17
EXPERINCE-WISE MOTIVATION COMPARISION

	10-15Yrs		15-20Yrs.		20-25Yrs.		25-30Yrs.	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
Nutral	53	80	58	86	68	97	69	83
Not Agree	779	526	828	552	887	597	886	556
Agree	855	1081	890	1138	941	1202	941	1130

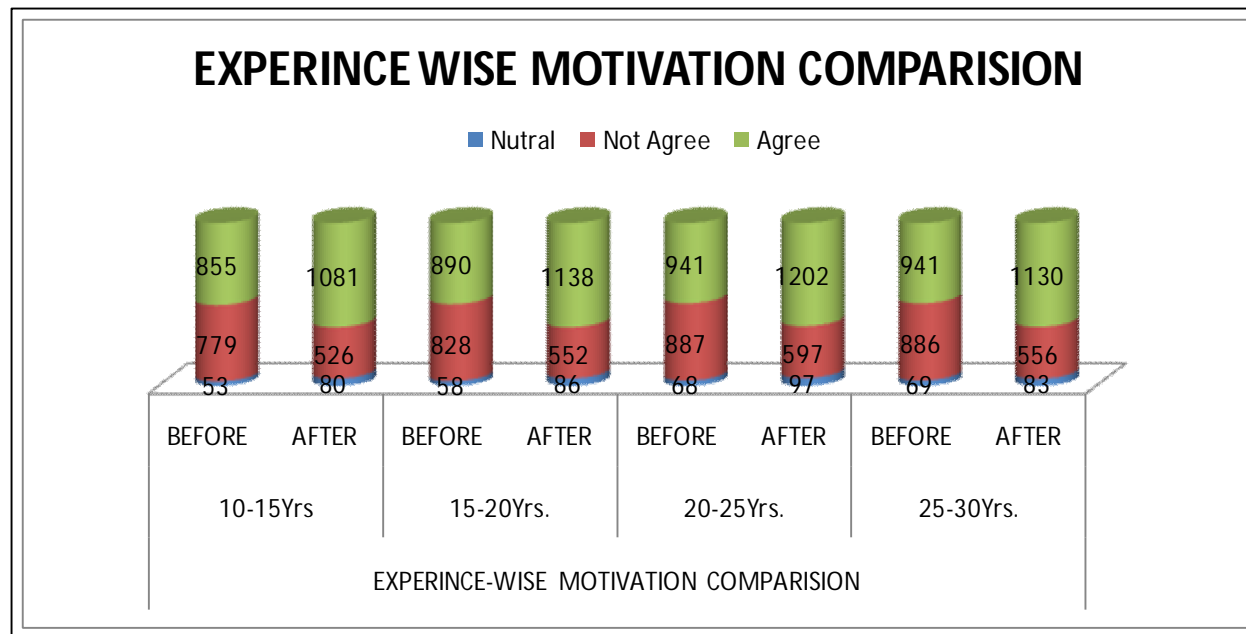


TABLE – 4.7.18

EXPERINCE-WISE QUALITY OF WORK LIFE COMPARISION

	10-15Yrs		15-20Yrs.		20-25Yrs.		25-30Yrs.	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
Nutral	36	50	37	54	39	59	39	56
Not Agree	404	379	429	402	463	434	462	435
Agree	689	697	723	729	767	772	768	774

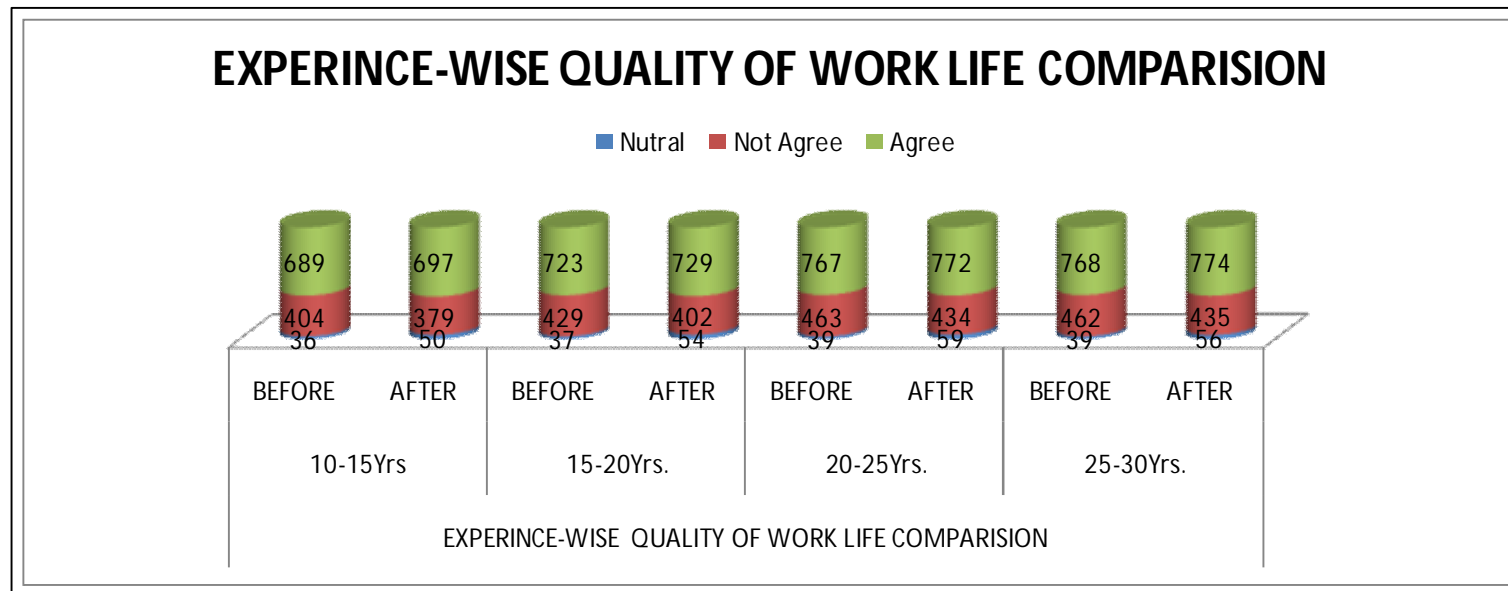


TABLE – 4.7.19

EXPERINCE-WISE STRESS COMPARISION

	10-15Yrs		15-20Yrs.		20-25Yrs.		25-30Yrs.	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
Nutral	9	11	9	11	10	12	9	11
Not Agree	295	253	312	272	330	289	333	291
Agree	596	635	627	664	672	710	670	709

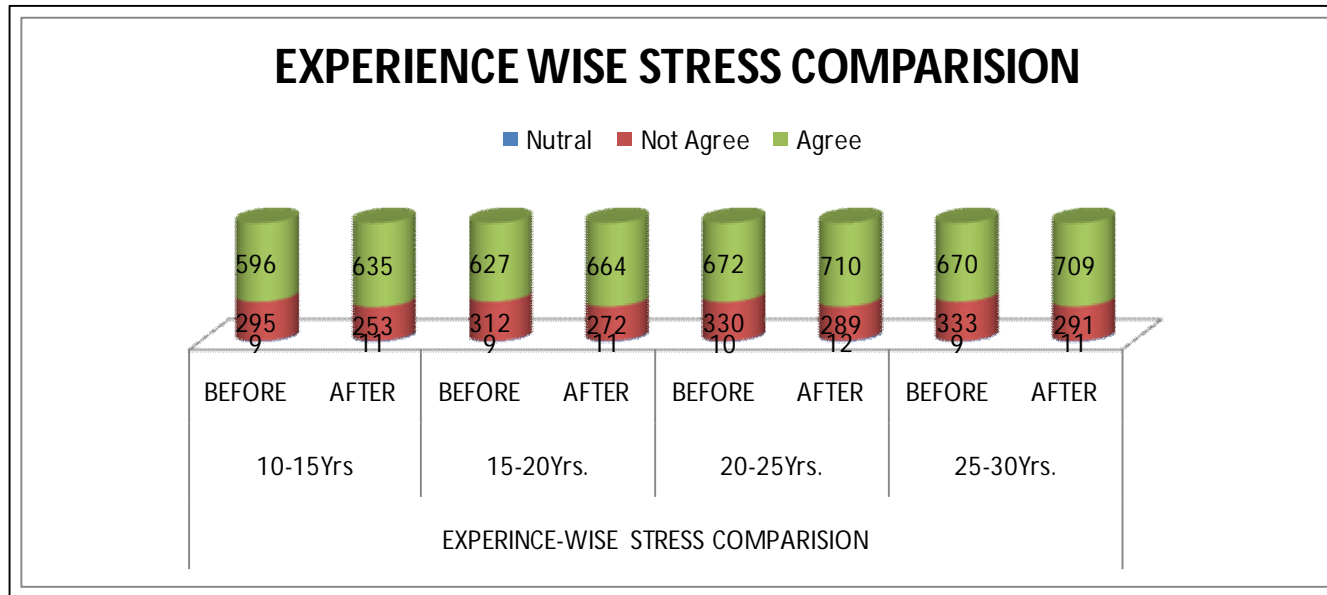
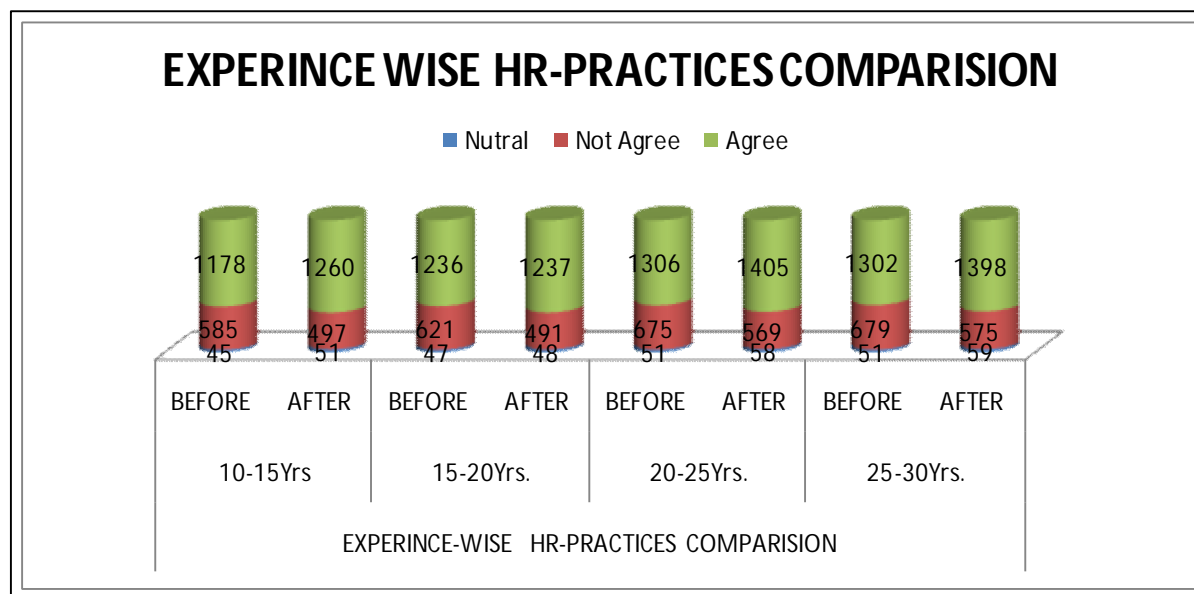


TABLE – 4.7.20
EXPERINCE-WISE HR-PRACTICES COMPARISION

	10-15Yrs		15-20Yrs.		20-25Yrs.		25-30Yrs.	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
Nutral	45	51	47	48	51	58	51	59
Not Agree	585	497	621	491	675	569	679	575
Agree	1178	1260	1236	1237	1306	1405	1302	1398



4.8 CONCLUSION FROM CHI-SQAURE TABLE 4.4 :

1. On the basis of Chi-Square test value comes out as 0.994 which is grater than .05 (Level of Significance at 95%), which shows that test is Insignificant and hence accepte the null Hypothesis, that is

There is no significant difference between gender in respect of Culture before adoption of technology .

2. On the basis of Chi-Square test value comes out as $0.959 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accepte the null Hypothesis, that is

There is no significant difference between gender in respect of Motivation before adoption of technology .

3. On the basis of Chi-Square test value comes out as $0.974 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accepte the null Hypothesis, that is

There is no significant difference between gender in respect of Quality of work life before adoption of technology .

4. On the basis of Chi-Square test value comes out as $0.989 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accepted the null Hypothesis, that is,

There is no significant difference between gender in respect of Stress before adoption of technology .

5. On the basis of Chi-Square test value comes out as $0.95 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between gender in respect of HR. Practice before adoption of technology .

6. On the basis of Chi-Square test value comes out as $0.985 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between gender in respect of Culture after adoption of technology .

7. On the basis of Chi-Square test value comes out as $0.945 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between gender in respect of Motivation after adoption of technology .

8. On the basis of Chi-Square test value comes out as $0.971 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between gender in respect of Quality of work life after adoption of technology.

9. On the basis of Chi-Square test value comes out as $0.962 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between gender in respect of Stress after adoption of technology .

10. On the basis of Chi-Square test value comes out as $0.942 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between gender in respect of HR. Practice after adoption of technology .

11. On the basis of Chi-Square test value comes out as $0.975 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Education in respect of Culture before adoption of technology .

12. On the basis of Chi-Square test value comes out as $0.915 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Education in respect of Motivation before adoption of technology .

13. On the basis of Chi-Square test value comes out as $0.968 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between Education in respect of Quality of work life before adoption of technology .

14. On the basis of Chi-Square test value comes out as $0.991 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accepted the null Hypothesis, that is,

There is no significant difference between Education in respect of Stress before adoption of technology .

15. On the basis of Chi-Square test value comes out as $0.894 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between Education in respect of HR. Practice before adoption of technology .

16. On the basis of Chi-Square test value comes out as $0.975 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between Education in respect of Culture after adoption of technology .

17. On the basis of Chi-Square test value comes out as $0.911 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between Education in Motivation after adoption of technology .

18. On the basis of Chi-Square test value comes out as $0.971 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Education in respect of Quality of work life after adoption of technology .

19. On the basis of Chi-Square test value comes out as $0.988 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Education in respect of Stress after adoption of technology .

20. On the basis of Chi-Square test value comes out as $0.914 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Education in respect of HR. Practice after adoption of technology .

21. On the basis of Chi-Square test value comes out as $0.998 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of Culture before adoption of technology .

22. On the basis of Chi-Square test value comes out as $0.0 < 0.05$ (Level of Significance at 95%), which shows that test is significant and hence reject the null Hypothesis, that is

There is significant difference between Cader in respect of Motivation before adoption of technology .

23. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of Quality of work life before adoption of technology .

24. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of Stress before adoption of technology .

25. On the basis of Chi-Square test value comes out as $0.997 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of HR. Practice before adoption of technology .

26. On the basis of Chi-Square test value comes out as $0.629 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of Culture after adoption of technology .

27. On the basis of Chi-Square test value comes out as $0.988 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of Motivation after adoption of technology .

28. On the basis of Chi-Square test value comes out as $0.998 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader Quality of work life after adoption of technology .

29. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of Stress after adoption of technology .

30. On the basis of Chi-Square test value comes out as $0.998 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of HR. Practice after adoption of technology .

31. On the basis of Chi-Square test value comes out as $0.906 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between City in respect of Culture before adoption of technology .

32. On the basis of Chi-Square test value comes out as $0.149 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between City in respect of Motivation before adoption of technology .

33. On the basis of Chi-Square test value comes out as $0.244 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between City in respect of Quality of work life before adoption of technology .

34. On the basis of Chi-Square test value comes out as $0.004 < 0.05$ (Level of Significance at 95%), which shows that test is significant and hence the null hypothesis is rejected, that is,

There is significant difference between City in respect of Stress before adoption of technology .

35. On the basis of Chi-Square test value comes out as $0.058 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between City in respect of HR. Practice before adoption of technology .

36. On the basis of Chi-Square test value comes out as $0.857 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between City in respect of Culture after adoption of technology .

37. On the basis of Chi-Square test value comes out as $0.279 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between City in respect of Motivation after adoption of technology .

38. On the basis of Chi-Square test value comes out as $0.23 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between City respect of Quality of work life after adoption of technology .

39. On the basis of Chi-Square test value comes out as $0.002 < 0.05$ (Level of Significance at 95%), which shows that test is significant and hence the null Hypothesis is rejected, that is,

There is significant difference between City respect of Stress after adoption of technology .

40. On the basis of Chi-Square test value comes out as $0.995 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between City in respect of HR. Practice after adoption of technology .

41. On the basis of Chi-Square test value comes out as $0. < 0.05$ (Level of Significance at 95%), which shows that test is significant and hence reject the null Hypothesis, that is,

There is no significant difference between Age in respect of Culture before adoption of technology .

42. On the basis of Chi-Square test value comes out as $0.982 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Age in respect of Motivation before adoption of technology .

43. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Age in respect of Quality of work life before adoption of technology .

44. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Age in respect of Stress before adoption of technology .

45. On the basis of Chi-Square test value comes out as $0.997 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Age in respect of HR. Practice before adoption of technology .

46. On the basis of Chi-Square test value comes out as $0.998 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Age in respect of Culture after adoption of technology .

47. On the basis of Chi-Square test value comes out as $0.952 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference Age wise in respect of Motivation after adoption of technology .

48. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Age in respect of Quality of work life after adoption of technology .

49. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Age in respect of Stress after adoption of technology .

50. On the basis of Chi-Square test value comes out as $0.999 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Age in respect of HR. Practice after adoption of technology .

51. On the basis of Chi-Square test value comes out as $0.998 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Culture before adoption of technology .

52. On the basis of Chi-Square test value comes out as $0.973 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Motivation before adoption of technology .

53. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Quality of work life before adoption of technology .

54. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Stress before adoption of technology .

55. On the basis of Chi-Square test value comes out as $0.995 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of HR. Practice before adoption of technology .

56. On the basis of Chi-Square test value comes out as $0.999 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Culture after adoption of technology .

57. On the basis of Chi-Square test value comes out as $0.997 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Motivation after adoption of technology .

58. On the basis of Chi-Square test value comes out as $0.999 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Quality of work life after adoption of technology.

59. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Stress after adoption of technology .

60. On the basis of Chi-Square test value comes out as $0.997 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of HR. Practice after adoption of technology .

CHAPTER - 5

ANALYSIS OF HRM COMPONENTS BEFORE AND AFTER ADOPTION OF TECHNOLOGY (Non-Parametric test)

5.0 INTRODUCTION:

In human Resource Management, I have tested following five components by applying various statistical test on collected data.

- 5.1. Culture
- 5.2. Quality of work life
- 5.3. Motivation
- 5.4. Stress
- 5.5. HRM (i.e Efficiency / Effectiveness of employee)

5.1 culture and organizational culture:

Culture is defined as

The way of life of a people, including their attitudes, values, beliefs, arts, sciences, modes of perception, and habits of thought and activity. Cultural features of forms of life are learned but are often too pervasive to be readily noticed from within.

5.1.1 Organisational Culture:

Basically, organizational culture is the personality of the organization. Culture is comprised of the assumptions, values, norms and tangible signs (artifacts) of organization members and their behaviors. Members of an organization soon come to

sense the particular culture of an organization. Culture is one of those terms that's difficult to express distinctly, but everyone knows it when they sense it. For example, the culture of a large, for-profit corporation is quite different than that of a hospital which is quite different than that of a university. You can tell the culture of an organization by looking at the arrangement of furniture, what they brag about, what members wear, etc. -- similar to what you can use to get a feeling about someone's personality.

Corporate culture can be looked at as a system. Inputs include feedback from society, professions, laws, stories, heroes, values on competition or service, etc. The process is based on our assumptions, values and norms, e.g., our values on money, time, facilities, space and people. Outputs or effects of our culture are, e.g., organizational behaviors, technologies, strategies, image, products, services, appearance, etc.

The concept of culture is particularly important when attempting to manage organization-wide change. Practitioners are coming to realize that, despite the best-laid plans, organizational change must include not only changing structures and processes, but also changing the corporate culture as well.

There's been a great deal of literature generated over the past decade about the concept of organizational culture -- particularly in regard to learning how to change organizational culture. Organizational change efforts are rumored to fail the vast majority of the time. Usually, this failure is credited to lack of understanding about the strong role of culture and the role it plays in organizations. That's one of the reasons that many strategic planners now place as much emphasis on identifying strategic values as they do mission and vision.

5.1.2 Types of Culture :

There are different types of culture just like there are different types of personality. Researcher Jeffrey Sonnenfeld identified the following four types of cultures.

1. Academy Culture

Employees are highly skilled and tend to stay in the organization, while working their way up the ranks. The organization provides a stable environment in which employees can development and exercise their skills. Examples are universities, hospitals, large corporations, etc.

2. Baseball Team Culture

Employees are "free agents" who have highly prized skills. They are in high demand and can rather easily get jobs elsewhere. This type of culture exists in fast-paced, high-risk organizations, such as investment banking, advertising, etc.

3. Club Culture

The most important requirement for employees in this culture is to fit into the group. Usually employees start at the bottom and stay with the organization. The organization promotes from within and highly values seniority. Examples are the military, some law firms, etc.

4. Fortress Culture

Employees don't know if they'll be laid off or not. These organizations often undergo massive reorganization. There are many opportunities for those with timely, specialized skills. Examples are savings and loans, large car companies, etc.

5.1.3 Corporate Culture

For many years, scholars in organizational behavior have attempted to demonstrate the link between an organization's culture and its performance. It has been argued that the success of an organization's strategy depends, to a significant extent, on the culture of the organization (Yip 1995).

One common thread that greatly affects many of the organizational aspects that enhance performance and increase productivity is the widely shared and strongly held values that underlie and define an organization's culture. Desphandé and Webster (1989) reviewed several studies and defined organizational (or corporate) culture as "the pattern of shared values and beliefs that help individuals understand organizational functioning and thus provide them with the norms for behavior in the organization". Schneider and Rentsch (1988) describe culture as "why things happen the way they do", and organizational climate as "what happens around here". Cultures can be determined by the values, assumptions and interpretations of organization members (Hales 1998). These factors can be organized by a common set of dimensions on both psychological and organizational levels to derive a model of culture types to describe organizations (Cameron and Freeman 1991). Corporate culture is an important predictor of organizational capabilities and outcomes such as customer orientation (Desphandé et al. 1993) and new product development (Moorman 1995).

Harrison (1975) reported four types of cultural orientations of employees as derived from organizational ideologies. These include power orientation where there is the intention of complete dominance of the environment, elementary competition and, in most cases, with ruthless disregard for employee welfare. Others are role orientation, which tends to have a preoccupation with legitimacy, legality and responsibility. Task oriented culture places the highest priority on task achievement whereas Person (self) oriented culture serves the needs of employees through organizational learning as a result of individual influence on one another.

According to Jaworski and Kohli (1993), depending on the theoretical approach taken, organizational culture could be viewed as a property of the group or the organization itself, or as something that resides within each individual as a function of the cognitive and learning process (Krefting and Frost 1985), or as both a process and outcome because it shapes human interactions and is also an outcome of the interactions (Jelinek et al. 1983). In considering culture in the light of a strategic management paradigm, Barney (1986) argued that, “for an organization’s culture to provide sustained competitive advantages, it must add value. It must be rare or unique and be difficult to imitate by competitors”. This could be sustained through the formulation of strategies that encourage a non-passive employee socialization in the form of formal indoctrination into organizational activities and processes, remedial training in areas related to enhancing personal productivity within a group context, and formally sanctioned encouragement to interact with socially oriented as well as production oriented work groups (Hopkins and Hopkins 1991).

5.2 Quality of work life :

Quality of work life (QWL) is viewed as an alternative to the control approach of managing people. The QWL approach considers people as an 'asset' to the organization rather than as 'costs'. It believes that people perform better when they are allowed to participate in managing their work and make decisions. This approach motivates people by satisfying not only their economic needs but also their social and psychological ones. To satisfy the new generation workforce, organizations need to concentrate on job designs and organization of work. Further, today's workforce is realizing the importance of relationships and is trying to strike a balance between career and personal lives. Successful organizations support and provide facilities to their people to help them to balance the scales. In this process, organizations are coming up with new and innovative ideas to improve the quality of work and quality of work life of every individual in the organization. Various programs like flex time, alternative work schedules, compressed work weeks, telecommuting etc., are being adopted by these organizations.

Technological advances further help organizations to implement these programs successfully. Organizations are enjoying the fruits of implementing QWL programs in the form of increased productivity, and an efficient, satisfied, and committed workforce which aims to achieve organizational objectives. The future work world will also have more women entrepreneurs and they will encourage and adopt QWL programs.

The success of any organization is highly dependant on how it attracts, recruits, motivates, and retains its workforce. Today's organizations need to be more flexible so that they are equipped to develop their workforce and enjoy their commitment. Therefore, organizations are required to adopt a strategy to improve the employees' 'quality of work life' (QWL) to satisfy both the organizational objectives and employee needs. These caselets discuss the importance of having effective quality of

work life practices in organizations and their impact on employee performance and the overall organizational performance.

5.3. Motivation:

Rensis likert has called motivation as the core of management. Motivation is an important function, which every manager has to performs for actuating people to work for the accomplishment of objectives of organization. Motivation is an effective instrument in the hands of a manager for inspiring the work force and creating a confidence in it. By motivating the work force, management creates will to work which is necessary for the achievement of organizational goals. The role of motivation is to develop and intensify the desire in every member of organization to work effectively and efficiently in his position.

Motivation is a term which applies to the entire class of urges, drives, desires, needs and similar forces. This chapter deals with the analysis of motivational aspects. It broadly covers views of the employees about their dominating nature and its influence, control, power, Goal setting and work, decision – making, ability to direct people, social interaction, support, interpersonal relationships, responsibility, authority, accountability, risk taking ability, performance appraisal, efforts for goal achievement, rewards and challenges, rewards and expectations, comparison with each other, skill, independent working habits, pay and performance.

5.4 STRESS :

Stress at work is a relatively new phenomenon of modern lifestyles. The nature of work has gone through drastic changes over the last century and it is

still changing at whirlwind speed. They have touched almost all professions, starting from an artist to a surgeon, or a commercial pilot to a sales executive. With change comes stress, inevitably. Professional stress or job stress poses a threat to physical health. Work related stress in the life of organized workers, consequently, affects the health of organizations.

Job stress is a chronic disease caused by conditions in the workplace that negatively affect an individual's performance and/or overall well-being of his body and mind. One or more of a host of physical and mental illnesses manifests job stress. In some cases, job stress can be disabling. In chronic cases a psychiatric consultation is usually required to validate the reason and degree of work related stress.

In the early stages job stress can `rev up` the body and enhance performance in the workplace, thus the term `I perform better under pressure`. However, if this condition is allowed to go unchecked and the body is revved up further, the performance ultimately declines and the person's health degenerates.

5.4.1 Symptoms

The signs of job stress vary from person to person, depending on the particular situation, how long the individual has been subjected to the stressors, and the intensity of the stress itself. Typical symptoms of job stress can be:

Insomnia, Loss of mental concentration, Anxiety, stress, Absenteeism, Depression, Substance abuse, Extreme anger and frustration, Family conflict and Physical illnesses such as heart disease, migraine, headaches, stomach problems, and back problems.

5.4.2 Causes of Workplace Stress

Job stress may be caused by a complex set of reasons. Some of the most visible causes of workplace stress are the following.

- **Job Insecurity**

Organized workplaces are going through metamorphic changes under intense economic transformations and consequent pressures. Reorganizations, takeovers, mergers, downsizing and other changes have become major stressors for employees, as companies try to live up to the competition to survive. These reorganizations have put demand on everyone, from a CEO to a mere executive.

- **High Demand for Performance**

Unrealistic expectations, especially in the time of corporate reorganizations, which, sometimes, puts unhealthy and unreasonable pressures on the employee, can be a tremendous source of stress and suffering. Increased workload, extremely long work hours and intense pressure to perform at peak levels all the time for the same pay, can actually leave an employees physically and emotionally drained. Excessive travel and too much time away from family also contribute to an employee`s stressors.

- **Technology**

The expansion of technology—computers, pagers, cell phones, fax machines and the Internet—has resulted in heightened expectations for productivity, speed and efficiency, increasing pressure on the individual worker to constantly operate at peak performance levels. Workers working with heavy machinery are under constant stress to remain alert. In this case both the worker and their

family members live under constant mental stress. There is also the constant pressure to keep up with technological breakthroughs and improvisations, forcing employees to learn new software all the times.

Workplace culture adjusting to the workplace culture, whether in a new company or not, can be intensely stressful. Making oneself adapt to the various aspects of workplace culture such as communication patterns, hierarchy, dress code if any, workspace and most importantly working and behavioral patterns of the boss as well as the co-workers, can be a lesson of life. Maladjustment to workplace cultures may lead to subtle conflicts with colleagues or even with superiors. In many cases office politics or gossips can be major stress inducers.

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Personal or Family Problems

Employees going through personal or family problems tend to carry their worries and anxieties to the workplace. When one is in a depressed mood, his unfocused attention or lack of motivation affects his ability to carry out job responsibilities.

- **Job Stress and Women**

Women may suffer from mental and physical harassment at workplaces, apart from the common job stress. Sexual harassment in workplace has been a major source of worry for women, since long. Women may suffer from tremendous stress such as `hostile work environment harassment`, which is defined in legal terms as `offensive or intimidating behavior in the workplace`. This can consist of unwelcome verbal or physical conduct. These can be a constant source of tension for women in job sectors. Also, subtle discriminations at workplaces, family pressure and societal demands add to these stress factors

5.4.3 The Survival Sutras

Because change is constant in life, stress is an integral part of it. Since we don't want to perish under it, we have to adhere to the bottom line for survival—adapt.

Following are some of the long-term tips to survive stress:

- Even if we feel secured in a habituated life, the truth remains that changing with the times makes one's position more secure. In today's business climate, you must continually be prepared for changes to avoid stress and survive in the competitive world
- Find and protect whatever time you get to refresh, re-energize and re-motivate yourself. Spend quality time with your family. This can be an excellent source of emotional and moral support.
- Avoid using alcohol, smoking and other substance abuses while under constant stress.
- Develop positive attitudes towards stressful situations in life. Give up negative mental traits such as fear, anger and revengeful attitudes, which actually germinate stress. Try to revert to holistic relaxation and personal growth techniques such as meditation, breathing and exercises, to remodel your lifestyles. • In case of chronic stress consult a health professional
- Reduce workplace stress by celebrating your's or your colleagues' accomplishments.
- Adapting to demands of stress also means changing your personality. Improve your line of communication, efficiency and learn from other's experiences.
- Don't be complacent. Be prepared for any change physically, emotionally and financially.

But, when you are under stress at work some simple practices can help which are following

- Sit straight and comfortably on your seat, and try breathing exercises. It will relax your nerves and muscles
- Relax and count backwards (20, 19, 18, 17, 16, 15....)
- Try creative visualization

5.4.4 Burnout

When under severe stress, an individual fails to take clear-cut decisions, reevaluate and reassess the priorities and lifestyles, and ultimately, tend to fall into unproductive distractions. This can be described as a classic case of `burnout`. The `burnouts` often engage in reckless or risk-taking behaviors. Starting from glamor and sport celebrities to common men, `burnouts` are found everywhere.

Chronic Responsibility Syndrome is a kind of burnout where people get mentally and physically exhausted from their workload. The symptom is often described as "there`s simply too much work to do, and no one else can do it but me". Typically it will occur in hard working, hard driven people, who become emotionally, psychologically or physically exhausted. You are at risk of burnout where:

- you find it difficult to say `no` to additional commitments or responsibilities
- you have been under intense and sustained pressure for some time
- your high standards make it difficult to delegate to assistants

- you have been trying to achieve too much for too long
- you have been giving too much emotional support for too long

Often burnout will manifest itself in a reduction in motivation, volume and quality of performance, or in dissatisfaction with or departure from the activity altogether.

If you feel that you are in danger of burning out, the suggestions below can help.

- Re-evaluate your goals and prioritize them
- Evaluate the demands placed on you and see how they fit in with your goals
- Identify your ability to comfortably meet these demands.
- If people demand too much, emotional energy, become more unapproachable and less sympathetic. Involve other people in a supportive role. Acknowledge your own humanity by remembering that you have a right to pleasure and a right to relaxation
- Learn stress management skills
- Identify stressors in your life, such as work, or family. Get the support of your friends, family and even counseling in reducing stress
- Ensure that you have the following healthy lifestyle:
 1. Get adequate sleep and rest to maintain your energy levels
 2. Ensure that you are eating a healthy, balanced diet—bad diet can make you ill or feel bad. Limit your caffeine and alcohol intake
 3. Try to recognize your spiritual needs that may have been buried under the mires of worldly pursuits

4. Develop alternative activities such as a relaxing hobby to take your mind off problems

If we have burned out then do the following

- If you are so de-motivated that for a time you do not want to continue with what you do, then take some time off
- Alternatively, try to switch to another area of activity within your organization. If you come back later, you may find that you have started to enjoy the work again, and can take on only those commitments that you want. You may, however, find that you have absolutely no interest in continuing with what you are doing. In this case it may be best to drop it altogether
- Take support and counseling of near and dear ones to bring change to the current situation
- Enroll yourself with some meditation or yoga classes (to ensure group spiritual practice), gyms, aerobics or sports clubs to switch your focus, and to reorganize your priorities
- If you are in late stages of burnout, feeling deeply de-motivated and disenchanted with your job or life, get help from a good psychologist.

5.4.5 More on stress

The word `stress` is defined by the Oxford Dictionary as "a state of affair involving demand on physical or mental energy". A condition or circumstance (not always adverse).

- **Stress Management**

Stress management is the need of the hour. However hard we try to go beyond a stress situation, life seems to find new ways of stressing us out and plaguing us with anxiety attacks.

- **Self Help**

5.4.6 Handling Stress From Criticism

Benjamin Franklin once said: "The sting of any criticism comes from the truth it contains." Most of us are most sensitive to stress in the areas.

- **Causes of Stress**

Listing the causes of stress is tricky. There can be innumerable stress factors since different individuals react differently to the same stress conditions.

- **Effects of Stress**

Medically, it has been established that chronic symptoms of anxiety and stress can crumble our body's immune system.

- **Spiritual and Psychological Stress**

Most causes of psychological stress are perennially related to emotional and psychological disorders. Stressful situations, whether long-term or short-term, can set forth a series of emotional More....

- **Anxiety In Children**

Stress and anxiety in children and teenagers are just as prevalent as in adults. Stressed out and negligent parents, high expectations in academic or other performances.

- **Gender Stress**

Causes of female and male depression and anxiety might be quite different from each other. It is not known for sure if stress affects men and women differently. Generally as the two genders.

- **Stress And Health**

Stress and health are closely linked. It is well known that stress, either quick or constant, can induce risky body-mind disorders. Immediate disorders such as dizzy spells, anxiety, tension.

- **Symptoms Of Depression**

When the negative reactions to life's situations become repetitively intense and frequent we develop symptoms of depression. Life throws up innumerable situations.

- **Social Anxiety And Stress**

Almost all stressed out people state social anxiety and relationship difficulties as their primary causes of stress. Broadly, social anxiety comes from three major relationship.

- **Spiritual and Mental Health**

Stress not only affects our body and corrupts its natural functioning; it also affects our mind and spirit as well. Everyday, each of us goes through stress a number of times—mild or severe.

- **Naturopathy**

Since long there has been a continuous search for newer and harmless methods cure for stress and stress-induced diseases.

- **Medication And Drugs**

Ideally, standard pharmaceutical therapy is not indicated for the management of daily stress such as those caused by work or family-related issues.

- **LifeStyle and Time Management Skills**

Perhaps it is time to put emphasis on the `life after birth`. And make it as enjoyable and stress free as it can be. Streamlining one`s living pattern and priorities of life is perhaps the most More....

5.4.7. Relaxation Techniques

Following are the relaxation techniques

Pranic Healing For Stress Pranic healing is an ancient science of healing through prana (Qi or `life energy`). Prana is that life energy, which keeps the body alive and maintains.

Massage Massage is an ancient healing art, which works on the basis that when the body is calmed and relaxed, mental anxiety is lessened.

Stress Reduction This therapy employs sound in an organized or rhythmic form to disentangle the stressed out nerves and brain, relaxing the mind-body as a whole. Certain sounds have telling effect upon the state.

Alternative Stress Management It is well known that either a quick or constant stress can induce risky mind-body disorders. Immediate disorders like dizzy spells, anxiety, tension, sleeplessness, nervousness, muscle cramps.

Transcend your stress "Nothing gives one person so much advantage over another as to remain always cool and unruffled under all circumstances."- Thomas Jefferson More...

A Call To Greatness The terror attacks in Mumbai have left the country shaken, coming as they have on the heels of a series of attacks across the country. How can spirituality help us to accept and transcend the perils.

Cool It Stress and anxiety can overtake the best of us. here is a checklist of what you can do to heal yourself and get back to peace and ease.

Healthy Mind Healthy Body Overwhelming evidence proves that the state of the mind is a key factor in wellness. a happy, balanced mind leads to a healthy body.

No Sweat Handle your stress with these easy-to-practice measures.

Compete Within Competition can often be an excessive drive to an illusionary goal. We need to compete, instead, with our own selves, challenging and realizing our innate and unique potential.

Upward Mobility We continue our serialization of the book, office yoga, with a few shoulder and neck exercises to limber up the most abused areas of your body at work.

Stress Busters at Work This introduction to a new column on yoga in the office tackles the basics: your chair, work surface and the right sitting position. More...

Dress your stress Life would be simple if our physiological and psychological needs were automatically fulfilled. The course of life does not always run smoothly. Things happen and our needs and goals are frustrated..

Stress Management through Sahaja Yoga Man today finds himself in a very unique situation of having to respond and tackle a variety of complex situations day in and day out for which he finds even his multi-dimensional personality.

Stress Management : Interestingly, it is possible to convert stress-building thoughts into stress-busting ones. Here are ten sure ways for managing stress in our life. More...

My way to cope with stress.. Interviews of celebrities taken by Suma Varughese and Swati Chopra on the best stress reliever.

Time-tested stress busters Stress is a handmaiden of modern life. But it is possible to convert stress-building thoughts into stress-busting ones.

5.4.7 Easy does it

Find the stressors in your life, learn to cope with them. Imagine a stress-free life, create it; think positive thoughts, be happy-that is the art of managing stress

The Institute of Heart Math Research Center is a recognized global leader in emotional physiology and stress-management research. HeartMath is

engaged in basic psychophysiology, neurocardiology and biophysics research, as well as clinical, workplace and organizational intervention and treatment outcome studies in collaboration with numerous universities, research centers and healthcare-system partners. This research has significantly advanced the understanding of heart-brain interactions, heart-rhythm-pattern and heart-rate-variability analyses, emotional physiology and the physiology of optimal learning and performance.

HeartMath's research forms the foundation for the development of practical, scientifically validated emotional refocusing and repatterning technologies that enable people to significantly improve their health and vitality, performance and quality of life.

Expanding areas of interest include furthering scientific understanding of the human biofield, global coherence, intuition and the emotional energetic system. There are numerous studies in progress, a sampling of which is available in the Featured Research section. The Research Center's latest project is the development of the Global Coherence Monitoring System (GCMS), a major undertaking that is an important part of IHM's Global Coherence Initiative.

The Research Center has teamed with internationally renowned astrophysicist and nuclear scientist Elizabeth Rauscher to design and build the GCMS to measure and explore fluctuations in the magnetic fields generated by the earth and ionosphere. Previous research has shown that specific measures of the earth's field can signal pending earthquakes, volcanic eruptions and other major planetary events long before they occur. Among the project's goals are determining how the earth's field influences human activity and conversely if collective human emotionality modulates the earth's fields

The IHM Research Center is committed to increasing the world's body of scientific knowledge and promoting heart-based living and global coherence – the mental, physical, emotional and spiritual well-being of the greater community of human beings.

"Somewhere, something incredible is waiting to be known." —Dr. Carl Sagan, Astronomer, Writer, Scientist, 1934-1996

The following is a small sampling of the continuing impact of HeartMath research and development:

- Students in more than 1,000 schools around the world have benefited from IHM research by using HeartMath learning programs to increase their confidence at school, raise test scores and overall academic performance and even improve their relationships and social lives among peers, friends and family. With HeartMath's help a great many educators are again finding their profession rewarding as they watch students show more interest in school and improved academic performance and behavior.
- Some of the world's most well-known corporations – Hewlett-Packard, Cisco Systems, BP and Unilever among them – have enlisted the aid of HeartMath to help them achieve increased organizational coherence and workforce satisfaction.
- U.S. governmental entities such as NASA, the four branches of the military and the Veterans Administration have used or continue to rely on HeartMath programs to reduce anxiety and stress levels and boost energy among their employees.

- Personnel with many large and small medical and healthcare operations – Kaiser Permanente, Veterans Administration, Duke, the University of North Carolina and others have expressed high praise for the impact of HeartMath programs, tools, techniques and technology to support and bring about measurable improvement in patients, but also to lower the stress levels and improve the overall health of their staffs, raise employee satisfaction levels and even reduce employee turnover.

See the Science of the Heart section for brief summaries of basic, clinical and organizational educational research studies.

5.4.8 Areas of HeartMath Research/Studies

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Emotional Physiology:

A key area of focus at the HeartMath Research Center is exploring our emotions and how they affect our physiology, with an emphasis on the physiological effects of positive emotions, especially intentionally experienced positive emotions. Studies already have revealed there are pronounced beneficial changes in the patterns of activity in the autonomic nervous, immune and hormonal systems and the brain and heart when we experience emotions such as appreciation, love, care and compassion. There are indications these physiological changes may help explain the connection between positive emotions, improved health and increased longevity. IHM researchers have shown that the heart plays an important role in the generation and perception of emotion. For related Research Publications, go to Basic Research.

- **Heart–Brain Interactions:**

The heart and brain maintain a continuous two-way dialogue, each influencing the other's functioning. Although it is not well known, the heart sends

far more information to brain than the brain sends to the heart and the signals the heart sends to the brain can influence perception, emotional processing and higher cognitive functions. This system and circuitry is viewed by neurocardiology researchers as a "heart brain." The heart also generates the strongest rhythmic electromagnetic field in the body and this actually can be measured in the brain waves of people around us. For related Research Publications, go to Basic Research.

Development and Testing of Positive Emotion-Focused Tools, Techniques, Technology and Programs:

Our research into emotional physiology, heart-brain interactions and much more has guided the development of practical, heart-based tools, techniques and technologies that enable people to sustain positive emotions and physiological coherence with greater consistency. They have been tested for effectiveness in laboratory studies as well as intervention studies conducted in educational, organizational and clinical settings. For related Research Publications, go to Basic Research.

- **Educational Intervention Studies:**

HeartMath's educational intervention studies examine the effects of HeartMath programs in educational settings. HeartMath tools, techniques, technology and learning programs levels have reduced general psychological distress, test anxiety and risky behaviors and improved test scores, classroom behavior, stress resiliency, learning and overall academic performance at the elementary, middle school, high school and college levels. Studies have been conducted and are under way to further investigate the impact of HeartMath programs in those settings and for special-needs children, including those with

attention-deficit hyperactivity disorder (ADHD). For related Research Publications, go to Educational Research.

- **Workplace Intervention Studies:**

Intervention studies investigating the impact of HeartMath programs in the workplace have documented a wide range of organizationally relevant outcomes, including increases in productivity, goal clarity, job satisfaction, communication effectiveness, improvement in employee health and reductions in turnover. Studies also have examined the programs' effect in helping organizations meet the demands of challenges such as downsizing and restructuring. For related Research Publications, go to Organizational Research.

- **Treatment Outcome studies in Clinical Populations:**

Treatment outcome studies assess how HeartMath's positive emotion-focused tools and techniques help people with various health problems and they have demonstrated significant improvements in health, psychological well-being and quality of life in people with hypertension, diabetes, congestive heart failure, AIDS and more. Substantial improvements also have been noted in case history data from patients and healthcare professionals who've utilized HeartMath interventions for chronic conditions such as cardiac arrhythmia, chronic fatigue, anxiety, depression, panic disorder, post-traumatic stress disorder, environmental sensitivity, chronic pain and fibromyalgia. For related Research Publications, go to Clinical and Health Research.

- **Heart-Rate Variability and Autonomic Function:**

IHM conducts ongoing research into heart-rate variability (HRV), a measure of the naturally occurring beat-to-beat changes in heart rate. HRV analysis is a powerful, noninvasive measure of autonomic nervous-system

function and an indicator of neurocardiac fitness. The HeartMath Research Center maintains an extensive HRV normals database, which provides data on the HRV of healthy individuals. HeartMath has published research demonstrating how HRV varies with age and gender and on the use of HRV analyses to assess alterations in autonomic function in conditions such as panic disorder and chronic fatigue. IHM provides HRV analysis services for studies conducted by other institutions. For related Research Publications, go to Clinical and Health Research.

- **Emotional Energetics Research:**

The heart produces by far the body's most powerful rhythmic electromagnetic field, which can be detected several feet away by sensitive instruments. In addition to the physical, neurological and hormonal production aspects of the heart, our research also has led us to consider the heart as an energetic system. For example, we have found that the heart's field is a carrier of emotional information and a mediator of bioelectromagnetic communication, within and outside the body.

Research shows our heart's field changes distinctly as we experience different emotions. It is registered in people's brains around us and apparently is capable of affecting cells, water and DNA studied in vitro.

The implications are: People may be able to affect their environment in ways not previously understood and such "energetic" interactions may be prominently influenced by our emotions. Growing evidence also suggests energetic interactions involving the heart may underlie intuition and important aspects of human consciousness. For related Research Publications, go to Energetic Research.

- **Intuition Research:**

There is evidence that people around the world have believed in the existence and power of intuition dating back through antiquity and one can imagine that the earliest humans depended on it greatly for survival. Intuition has been pondered by great thinkers, scientists and philosophers – Aristotle, Kant, Einstein among them – relied upon by leaders of nations and, as a great number of the world's people today will attest, is applied daily in a multitude of life's decisions.

The Institute of HeartMath's expanding interest in intuition has evolved naturally because of what is now believed to be an intimate relationship between the heart and the intuitive process – the perception or knowing things without conscious reasoning such as an event or act of nature that has yet to happen. As IHM researchers have conducted investigations over the years into stress and emotional management, heart intelligence, the heart-brain connection, heart-rhythm patterns and other areas, they have learned much about this process.

IHM researchers and others who explored intuition for more than a half century have expanded its definition to include not only conscious perception by the mind alone, but also by the body's entire psychophysiological system. This perception often is evidenced by a range of emotions and measurable physiological changes exhibited or detected in the heart and throughout the body, according to the two-part HeartMath study on the Electrophysiological Evidence of Intuition listed below. The conclusions drawn from this study include the following: "Overall, our data suggest that the heart and brain, together, are involved in receiving, processing, and decoding intuitive information. ... (and) there is compelling evidence that the heart appears to receive intuitive information before the brain."

"The only real valuable thing is intuition."

—Albert Einstein, 1879-1955

Though modern scientific investigation of intuition dates back to the early part of the 20th century, research has steadily increased in recent decades. HeartMath, already internationally recognized for groundbreaking research related to stress, emotions and the heart, is committed to furthering scientific knowledge and understanding about the intuitive process. HeartMath tools, techniques and technology have been developed to enhance intuitive ability by helping you achieve heart coherence, a state in which the heart and brain and other bodily systems are in sync. In addition to the study mentioned above, HeartMath has been involved in a number of other intuition-related studies and papers, including the following:

5.5 WILCOXON SIGNED – RANK TEST

Wilcoxon Signed – Rank test is useful in comparing two populations (or medians of two populations) for which we have paired observations. Unlike the Sign Test, the Wilcoxon Test accounts for the magnitude of differences between paired values and not only their signs. The test does so by considering the ranks of these differences. The test is, therefore, more efficient than the Sign test when

the differences may be quantified rather than just given a positive or negative sign. The Sign Test, on the other hand, is easier to carry on.

The Wilcoxon procedure may also be adopted for testing whether the location parameter of a single population (its median or its mean) is equal to any given value. There are one-tailed and two tailed version of each test. We shall discuss the paired observation test for equality of two populations distributions (or the equality of location parameters of the two populations.)

Null hypothesis – H_0 : The median difference between the population 1 and 2 is zero

Alternative hypothesis – H_1 : The median difference between the. population 1 and 2 is not zero

We assume

- I. that the distribution of differences between two populations is symmetric
- II. that the differences are mutually independent.
- III. That the measurement scale is at least interval.

By the assumption of symmetry, the hypothesis may be stated in terms of means. The alternative hypothesis may also be directed one: that the mean (or median) of one population is greater than the mean (or median) of the other population.

Steps for calculation of Test Statistic

- I. List the pairs of observations we are given for the two populations (or on the two variables)

- II. For each pair, calculate the difference: $D_c = X_i - Y_i$
- III. Omit all observation (s) with equal values and reduce the sample size accordingly.
- IV. Rank these differences in ascending order without regard to their signs.
- V. The cases of tied ranks are assigned ranks by the average method.
- VI. Find $\sum(+)$ and $\sum(-)$, where $\sum(+)$ is the sum of ranks with positive D_i and $\sum(-)$ is the sum of ranks with negative.
- VII. The Wilcoxon T-statistic is defined as the smaller of the two sums of ranks
- VIII. $T = \min (\sum(+), \sum(-))$
- IX. Where $\sum(+)$ = sum of the ranks of positive differences;
- X. $\sum(-)$ = sum of the ranks of negative differences
- XI. The Decision Rule: Critical points of the distribution of the test statistic T (when the null hypothesis H_0 is true) are given by the table "Critical values of Wilcoxon T-Test)" given at the end of the book. We carry out the test on the left tail, i.e., we reject the null hypothesis H_0 if the computed value of the test statistic T is less than the critical point from the table (tabulated value) for a given level of significance.

For One-tailed test, suppose that the alternative hypothesis H_1 is that mean (or median) of population 1 is greater than that of population 2, i.e.,

Null hypothesis H_0 : $\mu_1 \leq \mu_2$

Alternative hypothesis H_1 : $\mu_1 > \mu_2$

Here we shall use the sum of the ranks of negative differences $\sum(-)$

If the alternative hypothesis H_1 is reversed (population 1 and 2 are switched), then we shall use the sum of the ranks of positive differences $\sum(+)$ as the statistic T .

In either case, the test is carried out on the left 'tail' of the distribution Table "Critical values of Wilcoxon T-test" gives critical points for both one-tailed and two-tailed tests.

WILCOXON SIGNED RANK TEST – LARGE SAMPLES TEST

In the Wilcoxon test 'n' is defined as the number of pairs of observations from population 1 and 2. As the number of pairs n gets large (as a rule of thumb, $n > 25$ or so), T may be approximated a normal random variable:

$$\text{Mean of } T: E(T) = \frac{n(n+1)}{4}$$

$$\text{Standard Deviation of } T: \sigma_T = \sqrt{\frac{n(n+1)(2n+1)}{24}} = \text{S.E.}(T)$$

$$\text{Z-Statistic: } Z = \frac{T - E(T)}{\sigma_T}$$

Tabled value of Z_α : Find the tabled value of Z_α for a given α -level of significance from table given at the end of the book.

Decision: Accepts H_0 if calculated value of $|Z| < \text{Table value of } Z_\alpha$ otherwise accept the alternative hypothesis H_1

EXAMPLE 1: Two models of a machine are under consideration for purchase. An organization has one of each type for trial and each operator, out of the team of 25 operators, uses each machine for a fixed length of time. Their outputs are:

Operator No	1	2	3	4	5	6	7	8	9	10	11	12	13
Output from Machine I	82	68	53	75	78	86	64	54	62	70	51	80	64
Output from Machine II	80	71	46	58	60	72	38	60	65	64	38	79	37
Operator No	14	15	16	17	18	19	20	21	22	23	24	25	
Output from Machine I	65	70	55	75	64	72	55	70	45	64	58	65	
Output from Machine II	60	73	48	58	60	76	60	50	30	70	55	60	

Is there any significant difference between the output capacities of the two machines?

Test at 5% level of significance.

SOLUTION: Let $D = M_1 - M_2$, where M_1 and M_2 , denote the outputs of the machines I and II respectively.

No.	M_1	M_2	D_i	Ranks	No.	M_1	M_2	D_i	Ranks
1	82	80	2	2	14	65	60	5	10
2	68	71	-3	4.5	15	70	73	-3	4.5
3	53	46	7	15.5	16	55	48	7	15.5
4	75	58	17	20.5	17	75	58	17	20.5
5	78	60	18	22	18	64	60	4	7.5
6	86	72	14	18	19	72	76	-4	7.5
7	64	38	26	24	20	55	60	-5	10
8	54	60	-6	13	21	70	50	20	23
9	62	65	-3	4.5	22	45	30	15	19
10	70	64	6	13	23	64	70	-6	13
11	51	38	13	17	24	58	55	3	4.5
12	80	79	1	1	25	65	60	5	10
13	64	37	27	25					

TABLE: Computation of Ranks

$$\sum(+)= 2 + 15.5 + 20.5 + 22 + 18 + 24 + 13 + 17 + 1 + 25 + 10 + 15.5 + 20.5 + 7.5 + 23$$

$$+ 19 + 4.5 + 10 = 268$$

$$\sum(-) = 4.5 + 13 + 4.5 + 4.5 + 7.5 + 10 + 13 = 57$$

Null Hypothesis H_0 : Output capacities of the two machines are same.

Alternative Hypothesis H_1 : Output capacities are not same.

$$T - \text{Statistic} = \min(\sum(+), \sum(-)) = 57$$

$$\therefore \mu_T = \frac{n(n+1)}{4} = \frac{25 \times 26}{4} = 162.5.$$

$$\text{Standard Deviation of } T: \sigma_T = \sqrt{\frac{n(n+1)(2n+1)}{24}} = \sqrt{\frac{25 \times 26 \times 51}{24}} = 27.2.$$

$$\text{Z-Statistic: } Z = \frac{T - E(T)}{\sigma_T} = \frac{57 - 162.5}{37.2} = -2.84 \Rightarrow |Z| = 2.84$$

Tabled value of Z_α for $\alpha = 5\% = 1.96$.

Since $|Z| > Z_\alpha$ ($\alpha = 5\%$ level), so H_0 is rejected at 5% level of significance.

Hence the output capacities are not same at 5% level of significance.

Wilcoxon test applied to available collected data
Before adoption of technology and after adoption of technology
for Employees of public sector Bank
(Non-Parametric test)

(A) Gender-wise :

(1) Male-View2

Ranks

	N	Mean Rank	Sum of Ranks
MAfter - Negative	0(a)	.00	.00
MBefore Ranks			
Positive	5(b)	3.00	15.00
Ranks			
Ties	0(c)		
Total	5		

a MAfter < MBefore

b MAfter > MBefore

c MAfter = MBefore

Test Statistics(b)

	MAfter - MBefore
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(2) Female-View2

Ranks

		N	Mean Rank	Sum of Ranks
FAfter - FBefore	Negative Ranks	0(a)	.00	.00
	Positive Ranks	5(b)	3.00	15.00
	Ties	0(c)		
	Total	5		

a FAfter < FBefore

b FAfter > FBefore

c FAfter = FBefore

Test Statistics(b)

	FAfter - FBefore
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

Since P Value, that is $0.043 < 0.05$ which shows that the test is significant. We can reject the null hypothesis. That is technology adoption make change in agree views of **male and female** employees.

Adoption of technology make changes in the views of **male and female** employees in respect of agree statement.

Here, we will test whether changes take place after adoption of technology for the employee whose response are agree. i.e We are interested to know whether

any changes took place after adoption of technology in employee of public sector bank.

(B) Education-wise :

(1) Graduate-View2

Ranks

		N	Mean Rank	Sum of Ranks
GAfter - GBefore	Negative Ranks	0(a)	.00	.00
	Positive Ranks	5(b)	3.00	15.00
	Ties	0(c)		
	Total	5		

a GAfter < GBefore

b GAfter > GBefore

c GAfter = GBefore

Test Statistics(b)

	GAfter – Gbefore
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(2) Post Graduate-View2

Ranks

	N	Mean Rank	Sum of Ranks
PGAfter - PGBefore Negative Ranks	0(a)	.00	.00
Positive Ranks	5(b)	3.00	15.00
Ties	0(c)		
Total	5		

a PGAfter < PGBefore

b PGAfter > PGBefore

c PGAfter = PGBefore

Test Statistics(b)

	PGAfter – PGBefore
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

Since P Value, that is $0.043 < 0.05$ which shows that the test is significant. We can reject the null hypothesis. That is technology adoption make change in agree views of **Graduate and Post graduate** employees.

Adoption of technology make changes in the views of **Graduate and Post graduate** employees in respect of agree statement.

Here, we will test whether changes take place after adoption of technology for the employee whose response are agree. i.e We are interested to know whether any changes took place after adoption of technology in employee of public sector bank.

(c) Occupation wise:

(1) Casier-View2

Ranks

		N	Mean Rank	Sum of Ranks
CAfter - CBefore	Negative Ranks	0(a)	.00	.00
	Positive Ranks	5(b)	3.00	15.00
	Ties	0(c)		
	Total	5		

a CAfter < CBefore

b CAfter > CBefore

c CAfter = CBefore

Test Statistics(b)

	CAfter – Cbefore
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(2) Clerk –View2**Ranks**

	N	Mean Rank	Sum of Ranks
ClkAfter - ClkBefore	0(a)	.00	.00
Negative Ranks	5(b)	3.00	15.00
Positive Ranks			
Ties	0(c)		
Total	5		

a ClkAfter < ClkBefore

b ClkAfter > ClkBefore

c ClkAfter = ClkBefore

Test Statistics(b)

	ClkAfter – ClkBefore
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(3) Dy Manager – View2

Ranks

	N	Mean Rank	Sum of Ranks
DymAfter - Negative	0(a)	.00	.00
DymBefore Ranks			
Positive	5(b)	3.00	15.00
Ranks			
Ties	0(c)		
Total	5		

a DymAfter < DymBefore

b DymAfter > DymBefore

c DymAfter = DymBefore

Test Statistics(b)

	DymAfter - DymBefore
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(4) Manager – View2

Ranks

		N	Mean Rank	Sum of Ranks
MngAfter - MngBefore	Negative Ranks	0(a)	.00	.00
	Positive Ranks	5(b)	3.00	15.00
	Ties	0(c)		
	Total	5		

a MngAfter < MngBefore

b MngAfter > MngBefore

c MngAfter = MngBefore

Test Statistics(b)

	MngAfter - MngBefore
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(5) Operator – View2

Ranks

		N	Mean Rank	Sum of Ranks
OpAfter - OpBefore	Negative Ranks	0(a)	.00	.00
	Positive Ranks	5(b)	3.00	15.00
	Ties	0(c)		
	Total	5		

a OpAfter < OpBefore

b OpAfter > OpBefore

c OpAfter = OpBefore

Test Statistics(b)

	OpAfter – OpBefore
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(1) Supervisor – View2

Ranks

	N	Mean Rank	Sum of Ranks
SAfter - SBefore Negative Ranks	0(a)	.00	.00
Positive Ranks	5(b)	3.00	15.00
Ties	0(c)		
Total	5		

a SAfter < SBefore

b SAfter > SBefore

c SAfter = SBefore

Test Statistics(b)

	SAfter – Sbefore
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

Since P Value of all five occupation wise categories that are $0.043 < 0.05$ which shows that the test are significant. We can reject the null hypothesis. That is, technology adoption make change in agree views of all five occupation wise categories employees.

Adoption of technology make changes in the views of all five occupation wise categories employees in respect of agree statement.

Here, we will test whether changes take place after adoption of technology for the employee whose response are agree. i.e. We are interested to know whether any changes took place after adoption of technology in employees of public sector bank.

(D) City – Wise :

(1) Rajkot – View2

Ranks

		N	Mean Rank	Sum of Ranks
RAfter - RBefore	Negative Ranks	1(a)	1.00	1.00
	Positive Ranks	4(b)	3.50	14.00
	Ties	0(c)		
	Total	5		

a RAfter < RBefore

b RAfter > RBefore

c RAfter = RBefore

Test Statistics(b)

	RAfter - RBefore
Z	-1.753(a)
Asymp. Sig. (2-tailed)	.080

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(2) Ahmedabad – View2

Ranks

		N	Mean Rank	Sum of Ranks
AAfter - ABefore	Negative Ranks	0(a)	.00	.00
	Positive Ranks	5(b)	3.00	15.00
	Ties	0(c)		
	Total	5		

a AAfter < ABefore

b AAfter > ABefore

c AAfter = ABefore

Test Statistics(b)

	AAfter - ABefore
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(3) Baroda – View2**Ranks**

		N	Mean Rank	Sum of Ranks
BAfter - BBefore	Negative Ranks	1(a)	1.00	1.00
	Positive Ranks	4(b)	3.50	14.00
	Ties	0(c)		
	Total	5		

a BAfter < BBefore

b BAfter > BBefore

c BAfter = BBefore

Test Statistics(b)

	BAfter - BBefore
Z	-1.761(a)
Asymp. Sig. (2-tailed)	.078

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(4) Bhavnagar – View2

Ranks

		N	Mean Rank	Sum of Ranks
BvAfter - BvBefore	Negative Ranks	0(a)	.00	.00
	Positive Ranks	4(b)	2.50	10.00
	Ties	1(c)		
	Total	5		

a BvAfter < BvBefore

b BvAfter > BvBefore

c BvAfter = BvBefore

Test Statistics(b)

	BvAfter - BvBefore
Z	-1.826(a)
Asymp. Sig. (2-tailed)	.068

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(5) Surat – View2

Ranks

	N	Mean Rank	Sum of Ranks
SAfter - Negative	1(a)	1.00	1.00
SBefore Ranks			
Positive	2(b)	2.50	5.00
Ranks			
Ties	2(c)		
Total	5		

a SAfter < SBefore

b SAfter > SBefore

c SAfter = SBefore

Test Statistics(b)

	SAfter - SBefore
Z	-1.069(a)
Asymp. Sig. (2-tailed)	.285

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

Since P Value of all five Cities i.e **Rajkot, Ahmedabad, Baroda, Bhavnagar and Surat are 0.080,0.043,0.078,0.68 and 0.285** respectively , which shows that

there is changes are takes place in only Employee of Ahmedabad city because the P-Value is 0.043 is less than 0.05 and so the test is significant. We can reject the null hypothesis. That is technology adoption make change in employee of Ahmedabad city in respect of agree views .

Adoption of technology make changes in the views of **only employee of Ahmedabad city in respect of agree statement.**

While, P Value of rest of all four Cities i.e **Rajkot,, Baroda, Bhavnagar and Surat are 0.080,0.078,0.68 and 0.285** respectively , which shows that there are no changes takes place in Employee of above four cities because the P-Value is Greater than 0.05 and so the test is in-significant. We can accept the null hypothesis. That is technology adoption make no change in employee of above four cities in respect of agree views

Here, we will test whether changes take place after adoption of technology for the employee whose response are agree. .i.e We are interested to know whether any changes took place after adoption of technology in employees of public sector bank or not.

(E) AGE-WISE

(1) 35 – 40 - View-2

Ranks

	N	Mean Rank	Sum of Ranks
A1After2 - Negative	1(a)	3.00	3.00
A1Before2 Ranks			
Positive	4(b)	3.00	12.00
Ranks			
Ties	0(c)		
Total	5		

a A1After2 < A1Before2

b A1After2 > A1Before2

c A1After2 = A1Before2

Test Statistics(b)

	A1After2 - A1Before2
Z	-1.214(a)
Asymp. Sig. (2-tailed)	.225

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(2) 40 – 45 - View-2

Ranks

		N	Mean Rank	Sum of Ranks
A2After2 – A2Before2	Negative Ranks	0(a)	.00	.00
	Positive Ranks	5(b)	3.00	15.00
	Ties	0(c)		
	Total	5		

a A2After2 < A2Before2

b A2After2 > A2Before2

c A2After2 = A2Before2

Test Statistics(b)

	A2After2 – A2Before2
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(3) 45 – 50 -View-2

Ranks

		N	Mean Rank	Sum of Ranks
A3After2 - A3Before2	Negative Ranks	0(a)	.00	.00
	Positive Ranks	5(b)	3.00	15.00
	Ties	0(c)		
	Total	5		

a A3After2 < A3Before2

b A3After2 > A3Before2

c A3After2 = A3Before2

Test Statistics(b)

	A3After2 - A3Before2
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(4) 50 – 55 -View-2

Ranks

		N	Mean Rank	Sum of Ranks
A4After2 - A4Before2	Negative Ranks	0(a)	.00	.00
	Positive Ranks	5(b)	3.00	15.00
	Ties	0(c)		
	Total	5		

a A4After2 < A4Before2

b A4After2 > A4Before2

c A4After2 = A4Before2

Test Statistics(b)

	A4After2 - A4Before2
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

Since P Value of all five Age-group i.e 35-40,40-45,45-50,and 50-55 are 0.225,0.043,0.043 and 0.043 respectively , which shows that there is changes are takes place in only Employee of Age Group 40-45,45-50 and 50-55 because their P-Value are 0.043 which is less than 0.05 and so the test is significant. We can reject the null hypothesis. That is technology adoption make change in employee of Age Group 40-45,45-50 and 50-55 in respect of agree views .

Adoption of technology make changes in employee of Age Group 40-45, 45-50 and 50-55 in respect of agree views .

While, P Value of rest of Age Group i.e 35-40 is **0.225** which shows that there is no changes takes place in Employee of above Age-group because the P-Value is Greater than 0.05 and so the test is in-significant. We can accept the null hypothesis. That is technology adoption make no change in employee of above Age-group in respect of agree views .

Here, we will test whether changes take place after adoption of technology for the employee whose response are agree. .i.e We are interested to know whether any changes took place after adoption of technology in employees of public sector bank or not.

(F) EXPERIENCEWISE

(1) 10 – 15 - View-2

Ranks

		N	Mean Rank	Sum of Ranks
E1After2 - E1Before2	Negative Ranks	0(a)	.00	.00
	Positive Ranks	5(b)	3.00	15.00
	Ties	0(c)		
	Total	5		

a E1After2 < E1Before2

b E1After2 > E1Before2

c E1After2 = E1Before2

Test Statistics(b)

	E1After2 - E1Before2
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(2) 15 – 20 - View-2

Ranks

	N	Mean Rank	Sum of Ranks
E2After2 - E2Before2	0(a)	.00	.00
Negative Ranks	5(b)	3.00	15.00
Positive Ranks			
Ties	0(c)		
Total	5		

a E2After2 < E2Before2

b E2After2 > E2Before2

c E2After2 = E2Before2

Test Statistics(b)

	E2After2 - E2Before2
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(3) 20 – 25 -View-2

Ranks

	N	Mean Rank	Sum of Ranks
E3After2 - E3Before2	0(a)	.00	.00
Negative Ranks			
Positive Ranks	5(b)	3.00	15.00
Ties	0(c)		
Total	5		

a E3After2 < E3Before2

b E3After2 > E3Before2

c E3After2 = E3Before2

Test Statistics(b)

	E3After2 - E3Before2
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

(4)25 – 30 -View-2

Ranks

	N	Mean Rank	Sum of Ranks
E4After2 - Negative	0(a)	.00	.00
E4Before2 Ranks			
Positive	5(b)	3.00	15.00
Ranks			
Ties	0(c)		
Total	5		

a E4After2 < E4Before2

b E4After2 > E4Before2

c E4After2 = E4Before2

Test Statistics(b)

	E4After2 - E4Before2
Z	-2.023(a)
Asymp. Sig. (2-tailed)	.043

a Based on negative ranks.

b Wilcoxon Signed Ranks Test

Since P Value of all four Experience--group i.e 15-20,20-25,25-30,and 30-35 are 0.043 , which shows that there is changes are takes place in all four Employee of Experience Group 15-20,20-25,25-30,and 30-35 because their P-Value are 0.043 which is less than 0.05 and so the test is significant. We can reject the null hypothesis. That is technology adoption make change in employee of Experience Group of 15-20,20-25,25-30,and 30-35 in respect of agree views .

Adoption of technology make changes in employee of Experience Group of 15-20 ,20-25 ,25-30,and 30-35 in respect of agree views .

.

Here, we will test whether changes take place after adoption of technology for the employee whose response are agree. .i.e We are interested to know whether any changes took place after adoption of technology in employees of public sector bank or not.

5.6 CONCLUSION:

5.6.1 Since P Value, that is $0.043 < 0.05$ which shows that the test is significant. We can reject the null hypothesis. That is technology adoption make change in agree views of **male and female** employees.

Adoption of technology make changes in the views of **male and female** employees in respect of agree statement

5.6.2 Since P Value, that is $0.043 < 0.05$ which shows that the test is significant. We can reject the null hypothesis. That is technology adoption make change in agree views of **Graduate and Post graduate** employees.

Adoption of technology make changes in the views of **Graduate and Post graduate** employees in respect of agree statement

5.6.3 Since P Value of all five occupation wise categories that are $0.043 < 0.05$ which shows that the test are significant. We can reject the null hypothesis. That is, technology adoption make change in agree views of all five occupation wise categories employees.

Adoption of technology make changes in the views of all five occupation wise categories employees in respect of agree statement.

1.6.4 Since P Value of all five Cities i.e **Rajkot, Ahmedabad, Baroda, Bhavnagar and Surat** are **0.080,0.043,0.078,0.68 and 0.285** respectively , which shows that there is changes are takes place in only Employee of Ahmedabad city because the P-Value is 0.043 is less than

0.05 and so the test is significant. We can reject the null hypothesis. That is technology adoption make change in employee of Ahmedabad city in respect of agree views .

Adoption of technology make changes in the views of **only employee of Ahmedabad city in respect of agree statement.**

While, P Value of rest of all four Cities i.e **Rajkot,, Baroda, Bhavnagar and Surat are 0.080,0.078,0.68 and 0.285** respectively , which shows that there are no changes takes place in Employee of above four cities because the P-Value is Greater than 0.05 and so the test is in-significant. We can accept the null hypothesis. That is technology adoption make no change in employee of above four cities in respect of agree views

5.6.5 Since P Value of all five Age-group i.e 35-40,40-45,45-50,and 50-55 are 0.225,0.043,0.043 and 0.043 respectively , which shows that there is changes are takes place in only Employee of Age Group 40-45,45-50 and 50-55 because their P-Value are 0.043 which is less than 0.05 and so the test is significant. We can reject the null hypothesis. That is technology adoption make change in employee of Age Group 40-45,45-50 and 50-55 in respect of agree views .

Adoption of technology make changes in employee of Age Group 40-45, 45-50 and 50-55 in respect of agree views .

While, P Value of rest of Age Group i.e 35-40 is **0.225** which shows that there is no changes takes place in Employee of above Age-group because the P-Value is Greater than 0.05 and so the test is in-significant.

We can accept the null hypothesis. That is technology adoption make no change in employee of above Age-group in respect of agree views .

5.6.6

Since P Value of all four Experience--group i.e 15-20,20-25,25-30,and 30-35 are 0.043 , which shows that there is changes are takes place in all four Employee of Experience Group 15-20,20-25,25-30,and 30-35 because their P-Value are 0.043 which is less than 0.05 and so the test is significant. We can reject the null hypothesis. That is technology adoption make change in employee of Experience Group of 15-20,20-25,25-30,and 30-35 in respect of agree views .

Adoption of technology make changes in employee of Experience Group of 15-20,20-25,25-30,and 30-35 in respect of agree views .

CHAPTER-6

Data Analysis Through Factor Analysis

6.0 INTRODUCTION :

Richard B. Darlington introduced Factor analysis includes both component analysis and common factor analysis. Compare to other statistical techniques, factor analysis has suffered from confusion concerning its very purpose. This affects the presentation in two ways. Firstly, I devote a long section to

describing what factor analysis does before examining in later sections how it does it. Secondly, I have decided to reverse the usual order of presentation. Component analysis is simpler, and most discussions present it first. However, I believe common factor analysis comes closer to solving the problems most researchers actually want to solve.

6.1 Some Examples of Factor-Analysis Problems

1. Factor analysis was invented nearly 100 years ago by psychologist Charles Spearman, who hypothesized that the enormous variety of tests of mental ability--measures of mathematical skill, vocabulary, other verbal skills, artistic skills, logical reasoning ability, etc.--could all be explained by one underlying "factor" of general intelligence that he called g . He hypothesized that if g could be measured and you could select a subpopulation of people with the same score on g , in that subpopulation you would find no correlations among any tests of mental ability. In other words, he hypothesized that g was the only factor common to all those measures.

It was an interesting idea, but it turned out to be wrong. Today the College Board testing service operates a system based on the idea that there are at least three important factors of mental ability--verbal, mathematical, and logical abilities--and most psychologists agree that many other factors could be identified as well.

2. Consider various measures of the activity of the autonomic nervous system--heart rate, blood pressure, etc. Psychologists have wanted to know whether, except for random fluctuation, all those measures move up and down together--the "activation" hypothesis. Or do groups of autonomic measures move up and down together, but separate from other groups? Or are all the measures largely independent? An unpublished analysis of mine found that in one data set, at any rate, the data fitted the activation hypothesis quite well.

3. Suppose each of 500 people, who are all familiar with different kinds of automobiles, rates each of 20 automobile models on the question, "How much would you like to own that kind of automobile?" We could usefully ask about the number of dimensions on which the ratings differ. A one-factor theory would posit that people simply give the highest ratings to the most expensive models. A two-factor theory would posit that some people are most attracted to sporty models while others are most attracted to luxurious models. Three-factor and four-factor theories might add safety and reliability. Or instead of automobiles you might choose to study attitudes concerning foods, political policies, political candidates, or many other kinds of objects.

6.2 The Goal: Understanding of Causes

Many statistical methods are used to study the relation between independent and dependent variables. Factor analysis is different; it is used to study the patterns of relationship among many dependent variables, with the goal of discovering something about the nature of the independent variables that affect them, even though those independent variables were not measured directly. Thus answers obtained by factor analysis are necessarily more hypothetical and tentative than is true when independent variables are observed directly. The inferred independent variables are called *factors*. A typical factor analysis suggests answers to four major questions:

- How many different factors are needed to explain the pattern of relationships among these variables?
- What is the nature of those factors?
- How well do the hypothesized factors explain the observed data?
- How much purely random or unique variance does each observed variable include?

6.3 Absolute Versus Heuristic Uses of Factor Analysis

A *heuristic* is a way of thinking about a topic which is convenient even if not absolutely true. We use a heuristic when we talk about the sun rising and setting as if the sun moved around the earth, even though we know it doesn't. "Heuristic" is both a noun and an adjective; to use a heuristic is to think in heuristic terms.

The previous examples can be used to illustrate a useful distinction--between *absolute* and *heuristic* uses of factor analysis. Spearman's *g* theory of intelligence, and the activation theory of autonomic functioning, can be thought of as absolute theories which are or were hypothesized to give complete descriptions of the pattern of relationships among variables. On the other hand, Rubenstein never claimed that her list of the seven major factors of curiosity offered a complete description of curiosity. Rather those factors merely appear to be the most important seven factors--the best way of summarizing a body of data. Factor analysis can suggest either absolute or heuristic models; the distinction is in how you interpret the output.

6.4 Factor Analysis Objective:

The concept of heuristics is useful in understanding a property of factor analysis which confuses many people. Several scientists may apply factor analysis to similar or even identical sets of measures, and one may come up with 3 factors while another comes up with 6 and another comes up with 10. This lack of agreement has tended to discredit all uses of factor analysis. But if three travel writers wrote travel guides to the United States, and one divided the country into 3 regions, another into 6, and another into 10, would we say that they contradicted each other? Of course not; the various writers are just using convenient ways of organizing a topic, not claiming to represent the only correct way of doing so. Factor analysts reaching different conclusions contradict each other only if they all claim absolute theories, not heuristics. The fewer

factors the simpler the theory; the more factors the better the theory fits the data. Different workers may make different choices in balancing simplicity against fit.

A similar balancing problem arises in regression and analysis of variance, but it generally doesn't prevent different workers from reaching nearly or exactly the same conclusions. After all, if two workers apply an analysis of variance to the same data, and both workers drop out the terms not significant at the .05 level, then both will report exactly the same effects. However, the situation in factor analysis is very different. For reasons explained later, there is no significance test in component analysis that will test a hypothesis about the number of factors, as that hypothesis is ordinarily understood. In common factor analysis there is such a test, but its usefulness is limited by the fact that it frequently yields more factors than can be satisfactorily interpreted. Thus a worker who wants to report only interpretable factors is still left without an objective test.

A similar issue arises in identifying the nature of the factors. Two workers may each identify 6 factors, but the two sets of factors may differ--perhaps substantially. The travel-writer analogy is useful here too; two writers might each divide the US into 6 regions, but define the regions very differently.

Another geographical analogy may be more parallel to factor analysis, since it involves computer programs designed to maximize some quantifiable objective. Computer programs are sometimes used to divide a state into congressional districts which are geographically contiguous, nearly equal in population, and perhaps homogeneous on dimensions of ethnicity or other factors. Two different district-creating programs might come up with very different answers, though both answers are reasonable. This analogy is in a sense too good; we believe that factor analysis programs usually don't yield answers as different from each other as district-creating programs do.

6.5 Factor Analysis Versus Clustering and Multidimensional Scaling

Another challenge to factor analysis has come from the use of competing techniques such as cluster analysis and multidimensional scaling. While factor analysis is typically applied to a correlation matrix, those other methods can be applied to any sort of matrix of similarity measures, such as ratings of the similarity of faces. But unlike factor analysis, those methods cannot cope with certain unique properties of correlation matrices, such as reflections of variables. For instance, if you reflect or reverse the scoring direction of a measure of "introversion", so that high scores indicate "extroversion" instead of introversion, then you reverse the signs of all that variable's correlations: $-.36$ becomes $+.36$, $+.42$ becomes $-.42$, and so on. Such reflections would completely change the output of a cluster analysis or multidimensional scaling, while factor analysis would recognize the reflections for what they are; the reflections would change the signs of the "factor loadings" of any reflected variables, but would not change anything else in the factor analysis output.

Another advantage of factor analysis over these other methods is that factor analysis can recognize certain properties of correlations. For instance, if variables A and B each correlate $.7$ with variable C, and correlate $.49$ with each other, factor analysis can recognize that A and B correlate zero when C is held constant because $.7^2 = .49$. Multidimensional scaling and cluster analysis have no ability to recognize such relationships, since the correlations are treated merely as generic "similarity measures" rather than as correlations.

We are not saying these other methods should never be applied to correlation matrices; sometimes they yield insights not available through factor analysis. But they have definitely not made factor analysis obsolete. The next section touches on this point.

6.6 Factors "Differentiating" Variables Versus Factors "Underlying" Variables

When someone says casually that a set of variables seems to reflect "just one factor", there are several things they might mean that have nothing to do with factor analysis. If we word statements more carefully, it turns out that the phrase "just one factor *differentiates* these variables" can mean several different things, none of which corresponds to the factor analytic conclusion that "just one factor *underlies* these variables".

One possible meaning of the phrase about "differentiating" is that a set of variables all correlate highly with each other but differ in their means. A rather similar meaning can arise in a different case. Consider several tests A, B, C, D which test the same broadly-conceived mental ability, but which increase in difficulty in the order listed. Then the highest correlations among the tests may be between adjacent items in this list (r_{AB} , r_{BC} and r_{CD}) while the lowest correlation is between items at the opposite ends of the list (r_{AD}). Someone who observed this pattern in the correlations among the items might well say the tests "can be put in a simple order" or "differ in just one factor", but that conclusion has nothing to do with factor analysis. This set of tests would *not* contain just one common factor.

A third case of this sort may arise if variable A affects B, which affects C, which affects D, and those are the only effects linking these variables. Once again, the highest correlations would be r_{AB} , r_{BC} and r_{CD} while the lowest correlation would be r_{AD} . Someone might use the same phrases just quoted to describe this pattern of correlations; again it has nothing to do with factor analysis.

A fourth case is in a way a special case of all the previous cases: a perfect Guttman scale. A set of dichotomous items fits a Guttman scale if the items can be arranged so that a negative response to any item implies a negative response to all

subsequent items while a positive response to any item implies a positive response to all previous items. For a trivial example consider the items

- Are you above 5 feet 2 inches in height?
- Are you above 5 feet 4 inches in height?
- Are you above 5 feet 6 inches in height?

To be consistent, a person answering negatively to any of these items must answer negatively to all later items, and a positive answer implies that all previous answers must be positive. For a nontrivial example consider the following questionnaire items:

- Should our nation lower tariff barriers with nation B?
- Should our two central banks issue a single currency?
- Should our armies become one?
- Should we fuse with nation B, becoming one nation?

If it turned out that these items formed a perfect Guttman scale, it would be easier to describe peoples' attitudes about "nation B" than if they didn't. When a set of items does form a Guttman scale, interestingly it does not imply that factor analysis would discover a single common factor. A Guttman scale implies that one factor *differentiates* a set of items (e.g, "favorableness toward cooperation with nation B"), not that one factor *underlies* those items.

Applying multidimensional scaling to a correlation matrix could discover all these simple patterns of differences among variables. Thus multidimensional scaling seeks factors which *differentiate* variables while factor analysis looks for the factors which *underlie* the variables. Scaling may sometimes find simplicity where factor analysis finds none, and factor analysis may find simplicity where scaling finds none.

6.7 Rotation :

Rotation is the step in factor analysis that allows you to identify meaningful factor names or descriptions like these.

.Simple Structure in Factor Analysis

The points of the previous section apply when the predictor variables are factors. Think of the m factors F as a set of independent or predictor variables, and think of the p observed variables X as a set of dependent or criterion variables. Consider a set of p multiple regressions, each predicting one of the variables from all m factors. The standardized coefficients in this set of regressions form a $p \times m$ matrix called the *factor loading matrix*. If we replaced the original factors by a set of linear functions of those factors, we would get exactly the same predictions as before, but the factor loading matrix would be different. Therefore we can ask which, of the many possible sets of linear functions we might use, produces the simplest factor loading matrix. Specifically we will define simplicity as the number of zeros or near-zero entries in the factor loading matrix--the more zeros, the simpler the structure. Rotation does not change matrix C or U at all, but does change the factor loading matrix.

In the extreme case of simple structure, each X -variable will have only one large entry, so that all the others can be ignored. But that would be a simpler structure than you would normally expect to achieve; after all, in the real world each variable isn't normally affected by only one other variable. You then name the factors subjectively, based on an inspection of their loadings.

In common factor analysis the process of rotation is actually somewhat more abstract than I have implied here, because you don't actually know the individual scores of cases on factors. However, the statistics for a multiple regression that are most relevant here--the multiple correlation and the standardized regression slopes--can all be calculated just from the correlations of the variables and factors involved. Therefore

we can base the calculations for rotation to simple structure on just those correlations, without using any individual scores.

A rotation which requires the factors to remain uncorrelated is an *orthogonal* rotation, while others are *oblique* rotations. Oblique rotations often achieve greater simple structure, though at the cost that you must also consider the matrix of factor intercorrelations when interpreting results. Manuals are generally clear which is which, but if there is ever any ambiguity, a simple rule is that if there is any ability to print out a matrix of factor correlations, then the rotation is oblique, since no such capacity is needed for orthogonal rotations.

6.8 Principal Component Analysis (PCA)

Basics

Principal Component Analysis solves a problem similar to the problem of common factor analysis, but different enough to lead to confusion. It is no accident that common factor analysis was invented by a scientist (differential psychologist Charles Spearman) while PCA was invented by a statistician. PCA states and then solves a well-defined statistical problem, and except for special cases always gives a unique solution with some very nice mathematical properties. One can even describe some very artificial practical problems for which PCA provides the exact solution. The difficulty comes in trying to relate PCA to real-life scientific problems; the match is simply not very good. Actually PCA often provides a good approximation to common factor analysis, but that feature is now unimportant since both methods are now easy enough.

The central concept in PCA is representation or summarization. Suppose we want to replace a large set of variables by a smaller set which best summarizes the larger set. For instance, suppose we have recorded the scores of hundreds of pupils on

30 mental tests, and we don't have the space to store all those scores. (This is a very artificial example in the computer age, but was more appealing before then, when PCA was invented.) For economy of storage we would like to reduce the set to 5 scores per pupil, from which we would like to be able to reconstruct the original 30 scores as accurately as possible.

Let p and m denote respectively the original and reduced number of variables-- 30 and 5 in the current example. The original variables are denoted X , the summarizing variables F for factor. In the simplest case our measure of accuracy of reconstruction is the sum of p squared multiple correlations between X -variables and the predictions of X made from the factors. In the more general case we can weight each squared multiple correlation by the variance of the corresponding X -variable. Since we can set those variances ourselves by multiplying scores on each variable by any constant we choose, this amounts to the ability to assign any weights we choose to the different variables.

We now have a problem which is well-defined in the mathematical sense: reduce p variables to a set of m linear functions of those variables which best summarize the original p in the sense just described. It turns out, however, that infinitely many linear functions provide equally good summaries. To narrow the problem to one unique solution, we introduce three conditions. First, the m derived linear functions must be mutually uncorrelated. Second, any set of m linear functions must include the functions for a smaller set. For instance, the best 4 linear functions must include the best 3, which include the best 2, which include the best one. Third, the squared weights defining each linear function must sum to 1. These three conditions provide, for most data sets, one unique solution. Typically there are p linear functions (called *principal components*) declining in importance; by using all p you get perfect reconstruction of the original X -scores, and by using the first m (where m ranges from 1 to p) you get the best reconstruction possible for that value of m .

Define each component's *eigenvector* or *characteristic vector* or *latent vector* as the column of weights used to form it from the X-variables. If the original matrix R is a correlation matrix, define each component's *eigenvalue* or *characteristic value* or *latent value* as its sum of squared correlations with the X-variables. If R is a covariance matrix, define the eigenvalue as a weighted sum of squared correlations, with each correlation weighted by the variance of the corresponding X-variable. The sum of the eigenvalues always equals the sum of the diagonal entries in R .

Nonunique solutions arise only when two or more eigenvalues are exactly equal; it then turns out that the corresponding eigenvectors are not uniquely defined. This case rarely arises in practice, and I shall ignore it henceforth.

Each component's eigenvalue is called the "amount of variance" the component explains. The major reason for this is the eigenvalue's definition as a weighted sum of squared correlations. However, it also turns out that the actual variance of the component scores equals the eigenvalue. Thus in PCA the "factor variance" and "amount of variance the factor explains" are always equal. Therefore the two phrases are often used interchangeably, even though conceptually they stand for very different quantities.

The Number of Principal Components

It may happen that m principal components will explain all the variance in a set of X-variables--that is, allow perfect reconstruction of X--even though $m < p$. However, in the absence of this event, there is no significance test on the number of principal components. To see why, consider first a simpler problem: testing the null hypothesis that a correlation between two variables is 1.0. This hypothesis implies that all points in the population fall in a straight line. It then follows that all points in any sample from that population must also fall in a straight line. From that it follows that if the correlation

is 1.0 in the population, it must also be 1.0 in every single sample from that population. Any deviation from 1.0, no matter how small, contradicts the null hypothesis. A similar argument applies to the hypothesis that a multiple correlation is 1.0. But the hypothesis that m components account for all the variance in p variables is essentially the hypothesis that when the variables are predicted from the components by multiple regression, the multiple correlations are all 1.0. Thus even the slightest failure to observe this in a sample contradicts the hypothesis concerning the population.

If the last paragraph's line of reasoning seems to contain a gap, it is in the failure to distinguish between sampling error and measurement error. Significance tests concern only sampling error, but it is reasonable to hypothesize that an observed correlation of, say, .8 differs from 1.0 only because of measurement error. However, the possibility of measurement error implies that you should be thinking in terms of a common factor model rather a component model, since measurement error implies that there is some variance in each X-variable not explained by the factors.

6.9 Eigenvalue-Based Rules for Selecting the Number of Factors

Henry Kaiser suggested a rule for selecting a number of factors m less than the number needed for perfect reconstruction: set m equal to the number of eigenvalues greater than 1. This rule is often used in common factor analysis as well as in PCA. Several lines of thought lead to Kaiser's rule, but the simplest is that since an eigenvalue is the amount of variance explained by one more factor, it doesn't make sense to add a factor that explains less variance than is contained in one variable. Since a component analysis is supposed to summarize a set of data, to use a component that explains less than a variance of 1 is something like writing a summary of a book in which one section of the summary is longer than the book section it summarizes--which makes no sense. However, Kaiser's major justification for the rule was that it matched pretty well the ultimate rule of doing several factor analyses with

different numbers of factors, and seeing which analysis made sense. That ultimate rule is much easier today than it was a generation ago, so Kaiser's rule seems obsolete.

An alternative method called the *scree test* was suggested by Raymond B. Cattell. In this method you plot the successive eigenvalues, and look for a spot in the plot where the plot abruptly levels out. Cattell named this test after the tapering "scree" or rockpile at the bottom of a landslide. One difficulty with the scree test is that it can lead to very different conclusions if you plot the square roots or the logarithms of the eigenvalues instead of the eigenvalues themselves, and it is not clear why the eigenvalues themselves are a better measure than these other values.

Another approach is very similar to the scree test, but relies more on calculation and less on graphs. For each eigenvalue L , define S as the sum of all later eigenvalues plus L itself. Then L/S is the proportion of previously-unexplained variance explained by L . For instance, suppose that in a problem with 7 variables the last 4 eigenvalues were .8, .2, .15, and .1. These sum to 1.25, so 1.25 is the amount of variance unexplained by a 3-factor model. But $.8/1.25 = .64$, so adding one more factor to the 3-factor model would explain 64% of previously-unexplained variance. A similar calculation for the fifth eigenvalue yields $.2/ (.2+.15+.1) = .44$, so the fifth principal component explains only 44% of previously unexplained variance.

6.10 Comparing Two Factor Analyses

Since factor loadings are among the most important pieces of output from a factor analysis, it seems natural to ask about the standard error of a factor loading, so that for instance we might test the significance of the difference between the factor loadings in two samples. Unfortunately, no very useful general formula for such a purpose can be derived, because of ambiguities in identifying the factors themselves. To see this, imagine that "math" and "verbal" factors explain roughly equal amounts of variance in a population. The math and verbal factors might emerge as factors 1 and 2

respectively in one sample, but in the opposite order in a second sample from the same population. Then if we mechanically compared, for instance, the two values of the loading of variable 5 on factor 1, we would actually be comparing variable 5's loading on the math factor to its loading on the verbal factor. More generally, it is never completely meaningful to say that one particular factor in one factor analysis "corresponds" to one factor in another factor analysis. Therefore we need a completely different approach to studying the similarities and differences between two factor analyses.

Actually, several different questions might be phrased as questions about the similarity of two factor analyses. First we must distinguish between two different data formats:

1. *Same variables, two groups.* The same set of measures might be taken on men and women, or on treatment and control groups. The question then arises whether the two factor structures are the same.
2. *One group, two conditions or two sets of variables.* Two test batteries might be given to a single group of subjects, and questions asked about how the two sets of scores differ. Or the same battery might be given under two different conditions.

The next two sections consider these questions separately.

Comparing Factor Analyses in Two Groups

In the case of two groups and one set of variables, a question about factor structure is obviously not asking whether the two groups differ in means; that would be a question for MANOVA (multivariate analysis of variance). Unless the two sets of means are equal or have somehow been made equal, the question is also not asking

whether a correlation matrix can meaningfully be computed after pooling the two samples, since differences in means would destroy the meaning of such a matrix.

The question, "Do these two groups have the same factor structure?" is actually quite different from the question, "Do they have the same factors?" The latter question is closer to the question, "Do we need two different factor analyses for the two groups?" To see the point, imagine a problem with 5 "verbal" tests and 5 "math" tests. For simplicity imagine all correlations between the two sets of tests are exactly zero. Also for simplicity consider a component analysis, though the same point can be made concerning a common factor analysis. Now imagine that the correlations among the 5 verbal tests are all exactly .4 among women and .8 among men, while the correlations among the 5 math tests are all exactly .8 among women and .4 among men. Factor analyses in the two groups separately would yield different factor structures but identical factors; in each gender the analysis would identify a "verbal" factor which is an equally-weighted average of all verbal items with 0 weights for all math items, and a "math" factor with the opposite pattern. In this example nothing would be gained from using separate factor analyses for the two genders, even though the two factor structures are quite different.

Another important point about the two-group problem is that an analysis which derives 4 factors for group A and 4 for group B has as many factors total as an analysis which derives 8 in the combined group. Thus the practical question may be not whether analyses deriving m factors in each of two groups fit the data better than an analysis deriving m factors in the combined group. Rather the two separate analyses should be compared to an analysis deriving $2m$ factors in the combined group. To make this comparison for component analysis, sum the first m eigenvalues in each separate group, and compare the mean of those two sums to the sum of the first $2m$ eigenvalues in the combined group. It would be very rare that this analysis suggests that it would be

better to do separate factor analyses for the two groups. This same analysis should give at least an approximate answer to the question for common factor analysis as well.

Suppose the question really is whether the two factor structures are identical. This question is very similar to the question as to whether the two correlation or covariance matrices are identical--a question which is precisely defined with no reference to factor analysis at all. Tests of these hypotheses are beyond the scope of this work, but a test on the equality of two covariance matrices appears in Morrison (1990) and other works on multivariate analysis.

Comparing Factor Analyses of Two Sets of Variables in a Single Group

One question people often ask is whether they should analyze variable sets A and B together or separately. My answer is usually "together", unless there is obviously no overlap between the two domains studied. After all, if the two sets of variables really are unrelated then the factor analysis will tell you so, deriving one set of factors for set A and another for set B. Thus to analyze the two sets separately is to prejudge part of the very question the factor analysis is supposed to answer for you.

As in the case of two separate samples of cases, there is a question which often gets phrased in terms of factors but which is better phrased as a question about the equality of two correlation or covariance matrices--a question which can be answered with no reference to factor analysis. In the present instance we have two parallel sets of variables; that is, each variable in set A parallels one in set B. In fact, sets A and B may be the very same measures administered under two different conditions. The question then is whether the two correlation matrices or covariance matrices are identical. This question has nothing to do with factor analysis, but it also has little to do with the question of whether the AB correlations are high. The two correlation or covariance matrices within sets A and B might be equal regardless of whether the AB correlations are high or low.

Darlington, Weinberg, and Walberg (1973) described a test of the null hypothesis that the covariance matrices for variable sets A and B are equal when sets A and B are measured in the same sample of cases. It requires the assumption that the AB covariance matrix is symmetric. Thus for instance if sets A and B are the same set of tests administered in years 1 and 2, the assumption requires that the covariance between test X in year 1 and test Y in year 2 equal the covariance between test X in year 2 and test Y in year 1. Given this assumption, You can simply form two sets of scores I'll call A+B and A-B, consisting of the sums and differences of parallel variables in the two sets. It then turns out that the original null hypothesis is equivalent to the hypothesis that all the variables in set A+B are uncorrelated with all variables in set A-B. This hypothesis can be tested with MANOVA.

6.11 Factor and Component Analysis in Public sector Bank

Output

The basic output of FACTOR consists of four tables:

- eigenvalues
- factor loading matrix (called factor pattern for IPA)
- variance explained by factors (usually equal to eigenvalues)
- proportion of variance explained by factors
 - rotated factor loadings
 - variance explained by rotated factors
 - proportion of variance explained by rotated factors

IPA adds three others:

- initial communality estimates
- an index of changes in communality estimates
- final communality estimates

RINT LONG adds two others:

- Input correlation or covariance matrix R
- Matrix of residual covariances--the off-diagonal part of U

The PLOT option to the FACTOR command adds two other items:

- a scree plot
- plots of factor loadings, two factors at a time

There is no overlap in these lists. Thus choosing all these options will cause FACTOR to print 12 tables, a scree plot, and $m(m-1)/2$ factor loading plots.

6.12 FACTOR analysis : AGE-WISE

We are selecting some component among large No. of components which has maximum contribution. In factor analysis we have to select some of the component which has maximum contribution. On the basis of some technique, This technic is called principal component extraction hence we can say that in factor analysis, the selection produce on solution using the techniques of principal component extraction which is Rotated for ease of interpretation In this process we are finding the eigen values of the component. Here we decided the component whose eigen values will serve for our purpose for further analysis while those components whose eigen value will be discarded from the further analysis because this component will have less contribution among entire components.

Following are the result for solving the problem using SPSS,

```
/VARIABLES CULTURE MOTIVATION QWL STRESS HR /MISSING LISTWISE /ANALYSIS  
CULTURE MOTIVATION QWL STRESS HR  
/PRINT INITIAL EXTRACTION ROTATION FSCORE  
/PLOT EIGEN  
/CRITERIA MINEIGEN(1) ITERATE(25)  
/EXTRACTION PC  
/CRITERIA ITERATE(25)  
/ROTATION VARIMAX  
/SAVE REG(ALL)  
/METHOD=CORRELATION .
```

Factor Analysis (Correlation Matrix(a)

a This matrix is not positive definite.

Table 6.12.1 Communalities

	Initial	Extraction
CULTURE	1.000	.977
MOTIVATION	1.000	.232
QWL	1.000	.992
STRESS	1.000	.988
HR	1.000	.990

Extraction Method: Principal Component Analysis.

Output :-

6.12.1 Communalities:

Identification of the variable. Here, we can see that in initial column the values for all the component are 1 in table No 6.12.1 which indicates that the co-relation

analysis. With value will always be 1, while in extraction column this indicates amount of variance in each variable i.e Content from extraction component. In table 6.12.1 we found that extraction value for culture, Quality of work life (QWL), stress and HR practice are very high which indicate that extracted components represents the variable well. However, the extraction value for motivation is not very high. This indicates that the extracted component represents variable not in well. and hence for such communities, it is required to extract other component which I have shown in another table 6.12.2. showing the principal component analysis using extration Method.

Table 6.12.2 Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.178	83.567	83.567	4.178	83.567	83.567
2	.816	16.322	99.889			
3	.006	.111	100.000			
4	8.00E-017	1.60E-015	100.000			
5	-2.21E-016	-4.42E-015	100.000			

6.12.2 Total variable table

In this **table 6.12.2** the intial eigen values for all the components are given which are 4.178, 0.816, 0.006, 8.00E-017 and -2.21E-016 for factor analysis we know that those value will be extracted whoes eigen value >1. In our problem we can see from the **table 6.12.2** that eigen value of component 1 is greater than 1. Hence we extract this one compoent which are given below.

Sr. No.	Component	% Percent	Variable	Cumm. Variance
---------	-----------	-----------	----------	----------------

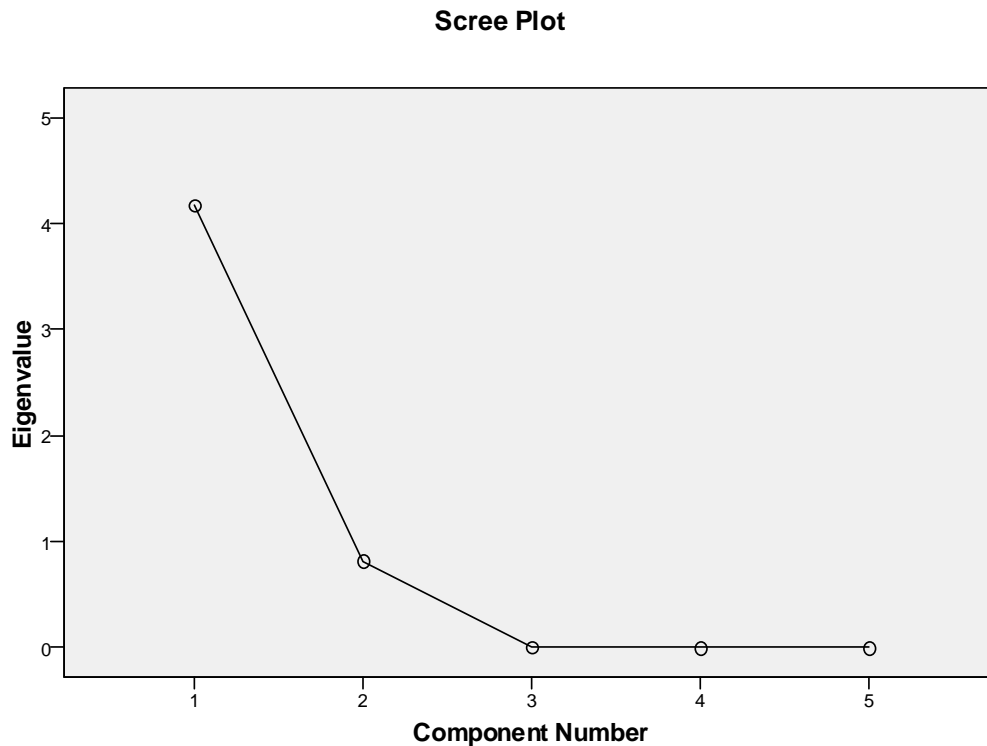
1.	1	4.178	83.567	83.567
----	---	-------	--------	--------

From above table we see that this one component namely culture explain about 83.567% of the variable from the 5 Variable so it reduce the complexity of data. By using this component 16.433% only loss of information.

In total variable explain table we can see that in the Rotation sum of square columne it contains only 1 component .i.e We can see that at the rotation maintain the cumulative % of variable explain by the extracted component. However this variations is now spread more evenly over the component.

This large changes use the individual total suggest that the rotated Matrix is easier to explain than the un-rotated Matrix.

Scree Plot diagram



From the Scree plot we can determine optimal number of components whose contribution are more. From graph it is clear that components - 3 , 4 and 5 i.e. QWL, stress and HR have little contribution while component 1 and 2, i.e. **culture and motivation** have more contribution after adoption of technology

Table 6.12.3 Component Matrix(a)

	Component
	1
CULTURE	.988
MOTIVATION	.481
QWL	.996

STRESS	.994
HR	.995

6.12.3 Rotated Component Matrix(a)

a Only one component was extracted. The solution cannot be rotated.

Table 6.12.4 Component Score Coefficient Matrix

	Component
	1
CULTURE	.237
MOTIVATION	.115
QWL	.238
STRESS	.238
HR	.238

6.12.4 Rotated Matrix

a Only one component was extracted. The solution cannot be rotated.

Table 6.12. 5 Component Score Covariance Matrix

Component	1
1	1.000

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Component Scores.

6.12.5 Conclusion

From **Table number 6.12.1 to 6.12.5** it is clear **that culture and QWL** are main components which are mainly affected after adoption of modern technology.

If we consider **AGE-wise we found that from factor analysis, the employee of age-group 40-45 having more contribution in respect of culture & QWL after adoption of technology.**

6.13 FACTOR ANALYSIS MALE-FEMALE-WISE

In Factor Analysis,

We are selecting some component among large No. of components which has maximum contribution. In factor analysis we have to select some of the component which has maximum contribution. On the basis of some technique, This technique is called principal component extraction hence we can say that in factor analysis, the selection produces a solution using the techniques of principal component extraction which is Rotated for ease of interpretation. In this process we are finding the eigen values of the component. Here we decided the component whose eigen value will serve for our purpose for further analysis while those components whose eigen value will be discarded from the further analysis because this component will have less contribution among entire components.

Following are the result for solving the problem using SPSS,

```
/VARIABLES culture motivation QWL STRESS HR /MISSING LISTWISE /ANALYSIS  
culture motivation QWL STRESS HR  
/PRINT INITIAL EXTRACTION ROTATION FSCORE
```

```

/PLOT EIGEN
/CRITERIA MINEIGEN(1) ITERATE(25)
/EXTRACTION PC
/CRITERIA ITERATE(25)
/ROTATION VARIMAX
/SAVE REG(ALL)
/METHOD=CORRELATION .

```

Factor Analysis

6.13.1 Correlation Matrix(a)

a This matrix is not positive definite.

Table 6.13.1 Communalities

	Initial	Extraction
CULTURE	1.000	1.000
MOTIVATION	1.000	1.000
QWL	1.000	1.000
STRESS	1.000	1.000
HR	1.000	1.000

Extraction Method: Principal Component Analysis.

Output :-

16.13.1 Communalities:

Identification of the variable. Here, we can see that in initial column the values for all the component are 1 in table 6.13.1 which indicates that the co-relation analysis. With value will always be 1, while in extraction column this indicates amount of variance in each variable i.e Content from extraction component are estimate of variance in each variable accounted for by the component. In table 6.13.1 we found that extraction value for culture, motivation, Quality of work life (QWL) ,stress and HR are very high which indicate that extracted components represents the variable well. it is required to extract other component which I have shown in another table.

Table 6.13.2

showing the principal component analysis using extretion method

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.000	100.000	100.000	5.000	100.000	100.000
2	4.72E-016	9.43E-015	100.000			
3	3.64E-016	7.27E-015	100.000			
4	4.65E-017	9.29E-016	100.000			
5	-2.22E-016	-4.44E-015	100.000			

16.13.2 Total variable table

The variable explained by initial eigen value. In this table 6.13.2 : the intial eigen values for all the components are given which are 5.0, 4.72E-016, 3.64E-016, 4.65E-017 and -2.22E-016. We know that those value will be extracted whoes eigen value >1. In our problem we can see from the table 6.13.2 that component 1 whose eigen value of

component 1 is greater than 1. Hence, we extract this one component which is given below.

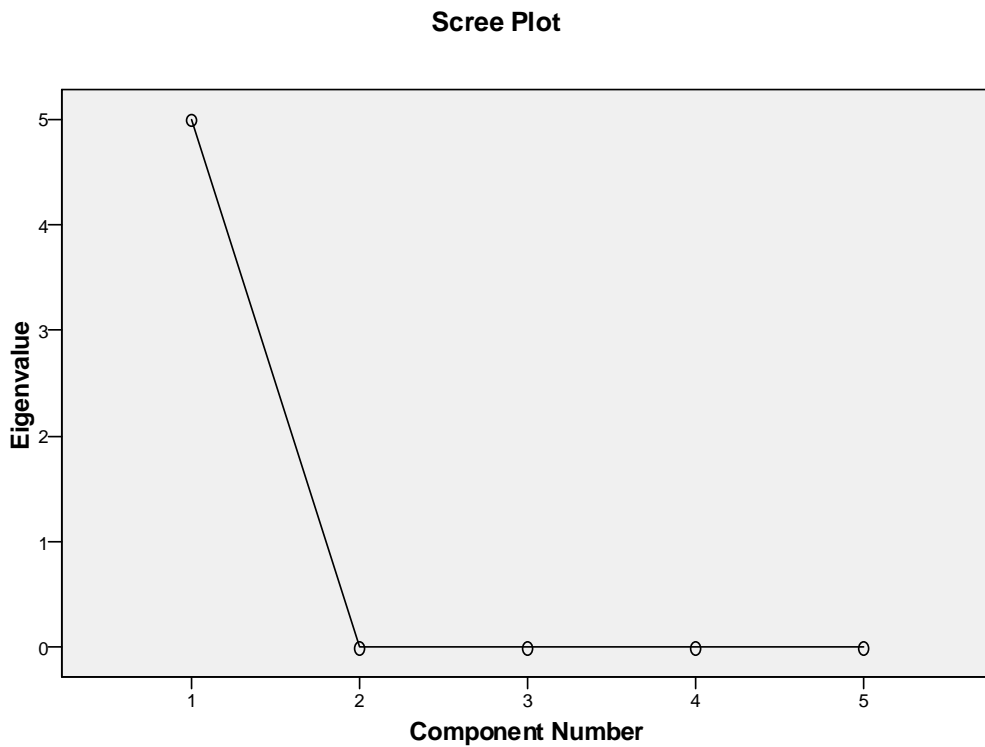
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.000	100.000	100.000	5.000	100.000	100.000

From above table we see that this one component namely culture explain about 100% of the variable from the 5 variable so it reduce the complexity of data. By using this component loss of information is 0%.

In total variable explain table 6.13.2 we can see that in the Rotation sum of square column it contains only 1 component i.e. We can see that at the rotation maintain the cumulative % of variable explain by the extracted component. However this variations is now spread more evenly over the component.

This large changes use the individual total suggest that the rotated Matrix is easier to explain than the un-rotated Matrix.

16.13.3 Scree Plot diagram



16.13.3 Scree Plot Diagram

From the Scree plot we can determine optimal No. of components whose contribution are more. From graph it is clear that component – 2, 3, 4 and 5 i.e. Motivation, QWL, stress & HR have little contribution while **component 1 i.e. culture**, has more contribution after adoption of technology in respect of Male-female.

Table 6.13.3 Component Matrix(a)

	COMPONENT
	1
CULTURE	1.000
MOTIVATION	1.000
QWL	1.000
STRESS	1.000
HR	1.000

16.13.4 Rotated Component Matrix(a)

a Only one component was extracted. The solution cannot be rotated.

16.13.4 Rotated Matrix

Rotated component, matrix help us determine what the component represents. In this table you can see that Only one component was extracted. The solution cannot be rotated.

Table 6.13.4 Component Score Coefficient Matrix

	COMPONENT
	1
CULTURE	.200
MOTIVATION	.200
QWL	.200
STRESS	.200
HR	.200

Table 6.13.5 Component Score Covariance Matrix

Component	1
1	1.000

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Component Scores.

16.13.5 Conclusion

From entire table 6.13.1 to table 6.13.5 it is clear that culture is main component which is mainly affected after adoption of modern technology

If we consider Male-female-wise, The employee of male has more contribution in respect of culture with respect to female employees in the public sector bank after adoption of technology.

6.14 FACTOR analysis : CADER-WISE

Following are the result for solving the problem using SPSS,

```
/VARIABLES CULTURE MOTIVATION QWL STRESS HR /MISSING LISTWISE /ANALYSIS  
CULTURE MOTIVATION QWL STRESS HR  
/PRINT INITIAL EXTRACTION ROTATION FSCORE  
/PLOT EIGEN  
/CRITERIA MINEIGEN(1) ITERATE(25)  
/EXTRACTION PC
```



```
/CRITERIA ITERATE(25)
/ROTATION VARIMAX
/SAVE REG(ALL)
/METHOD=CORRELATION .
```

Factor Analysis

Table 6.14.1 Communalities

	Initial	Extraction
CULTURE	1.000	.021
MOTIVATION	1.000	.927
QWL	1.000	.926
STRESS	1.000	.992
HR	1.000	.984

Extraction Method: Principal Component Analysis.

Output :-

6.14.1 Communalities:

Identification of the variable. Here, we can see that in initial column the values for all the component are 1 in table 6.14.1 which indicates that the co-relation analysis. With value will always be 1, while in extraction column this indicates amount of variance in each variable i.e Content from extraction component are estimate of variance in each variable accounted for by the component.

In this table 6.14.1 we found that extraction value for Motivation, Quality of work life (QWL) Stress and HR-practice are very high which indicate that extracted components represents the variable well. However, the extraction value for Culture is not very high. This indicates that the extracted component represents variable not in

well. Hence for such communities it is required to extract other component which I have shown in another table.

Table 6.14.2
showing the principal component analysis using extraction method

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.850	77.001	77.001	3.850	77.001	77.001
2	.993	19.859	96.860			
3	.138	2.753	99.613			
4	.017	.342	99.955			
5	.002	.045	100.000			

In this table 6.14.2 : the initial eigen values for all the components are given which are 3.850, 0.993, 0.138, 0.017 and 0.002. We know that those value will be extracted whose eigen value >1. In our problem we can see from the table 6.14.2 that eigen value of component 1 is greater > 1. Hence we extract this one component which is as given below.

Sr. No.	Component	% of Variance	Cumulative %	Cumm.
---------	-----------	---------------	--------------	-------

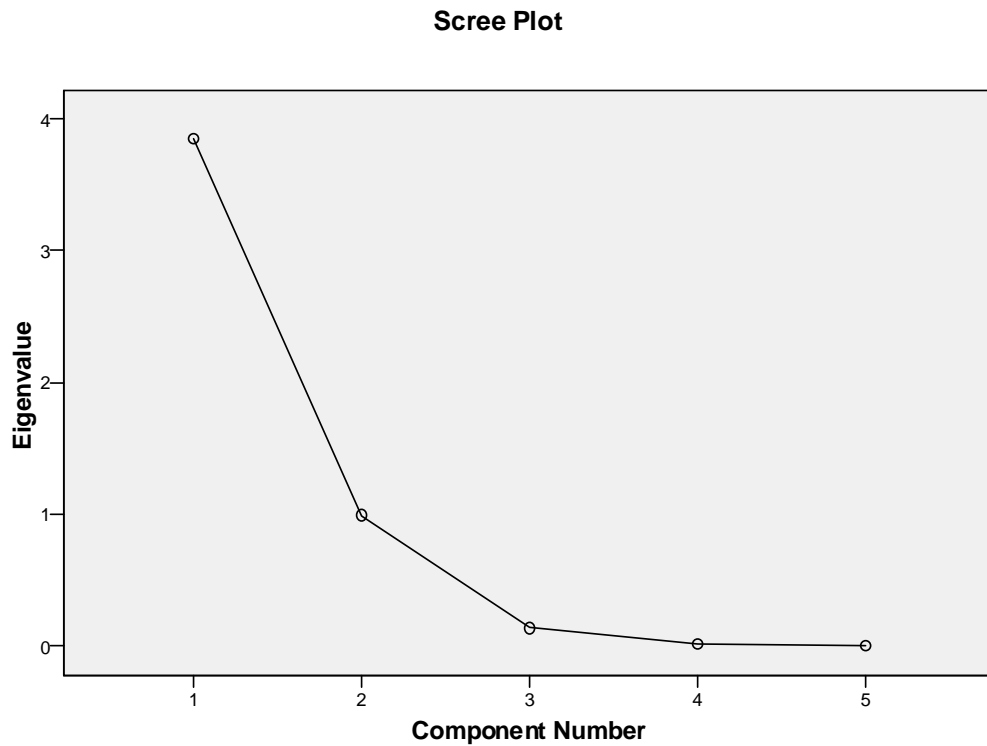
				Variance
1.	1	3.850	77.001	77.001

From this table We see that this one component namely culture explain about 77% of the variable from the 5 Variable so it reduce the complexity of data. By using this component with only the loss of information is 23%.

In total variable explain table 6.14.2 we can see that in the Rotation sum of square columne it contains only 1 component No: 1 i.e We can see that at the rotation maintain the cumulative % of variable explain by the extracted component. However this variations is now spread more evenly over the component.

This large changes use the individual total suggest that the rotated Matrix is easier to explain than the un-rotated Matrix.

Scree Plot diagram



6.14.3 Scree Plot Diagram

From the scree plot we can determine optimal No. of components whose contribution are more. From graph it is clear that component - 3 ,4 and 5 i.e. QWL, Stress & HR have little contribution while **component 1 & 2 culture and motivation have more contribution after adoption of technology in cader-wise distribution.**

Table 6.14.3 Component Matrix(a)

	Component
	1
CULTURE	.146
MOTIVATION	.963

QWL	.963
STRESS	.996
HR	.992

6.14.4 Rotated Component Matrix(a)

a Only one component was extracted. The solution cannot be rotated.

4. Rotated Matrix

Rotated component, matrix help us determine what the component represents. In this table you can see that Only one component was extracted. The solution cannot be rotated.

Table 6.14.4 Component Score Coefficient Matrix

	Component
	1
CULTURE	.038
MOTIVATION	.250
QWL	.250
STRESS	.259
HR	.258

Table 6.14.5 Component Score Covariance Matrix

Component	1
1	1.000

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Component Scores.

6.14.5 Conclusion

From entire table 6.14.1 to 6.14.5 it is clear that culture is main component which is mainly affected after adoption of modern technology.

If we consider cader-wise, The employee of managerial and supervisory cader having more contribution in respect of culture after adoption of the technology.

6.15 FACTOR ANALYSIS CITY-WISE

Following are the result for solving the problem using SPSS,

```
/VARIABLES CULTURE MOTIVATION QWL STRESS HR /MISSING LISTWISE /ANALYSIS  
CULTURE MOTIVATION QWL STRESS HR  
/PRINT INITIAL EXTRACTION ROTATION FSCORE  
/PLOT EIGEN  
/CRITERIA MINEIGEN(1) ITERATE(25)  
/EXTRACTION PC  
/CRITERIA ITERATE(25)  
/ROTATION VARIMAX  
/SAVE REG(ALL)  
/METHOD=CORRELATION .
```

Factor Analysis

Correlation Matrix(a)

a This matrix is not positive definite.

Table 6.15.1 Communalities

	Initial	Extraction

CULTURE	1.000	.992
MOTIVATION	1.000	.510
QWL	1.000	.942
STRESS	1.000	.981
HR	1.000	.646

Output :-

6.15.1 Communalities:

Identification of the variable. Here, we can see that in initial column the values for all the component are 1 in table 6.15.1 which indicates that the co-relation analysis. With value will always be 1, while in extraction column this indicates amount of variance in each variable i.e Content from extraction component are estimate of variance in each variable accounted for by the component. In this table we found that extraction value for culture, motivation, Quality of work life (QWL) ,stress are very high which indicate that extracted components represents the variable well. However, the extraction value for motivation & HR practice are not very high. This indicates that the extracted component represents variable not in well hence for such communities it is required to extract other component which I have shown in table 6.15.2.

Table 6.15.2
Total Variance Explained
showing the principal component analysis using extretion method

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums	
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% V
1	2.852	57.037	57.037	2.852	57.037	57.037	2.849	5
2	1.220	24.393	81.429	1.220	24.393	81.429	1.222	2
3	.823	16.454	97.884					
4	.106	2.116	100.000					
5	1.83E-016	3.65E-015	100.000					

Extraction Method: Principal Component Analysis.

In this table 6.15.2 : the initial eigen values for all the components are given which are 2.852, 1.220, 0.823, 0.106, - 1.83 E- 0.16. We know that those value will be extracted whose eigen value >1. In our problem we can see from the table 6.15.2 that eigen value of component 1 and 2 are greater than 1. Hence we extract this two component which are given below.

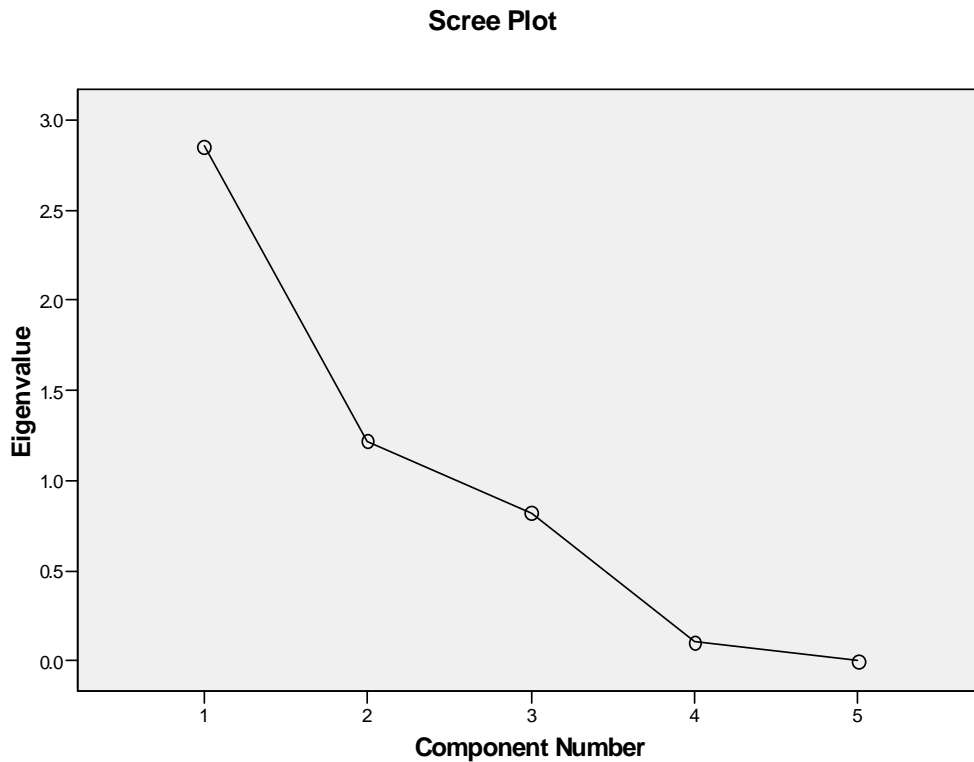
Sr. No.	Component	% Percent	Variable	Cumm. Variance
1.	1	2.852	57.07	57%
2.	2	1.220	24.393	24%

From this table we see that this two component namely culture & motivation explain about 81% of the variable from the 5 Variable so it reduce the complexity of data. By using this component the loss of information is 19% only.

In total variable explain table 6.15.2 we can see that in the Rotation sum of square column it contains only 2 component 1 & 2 i.e We can see that at the rotation maintain the cumulative % of variable explain by the extracted component. However this variations is now spread more evenly over the component.

This large changes use the individual total suggest that the rotated Matrix is easier to explain than the un-rotated Matrix.

6.15.3 Scree Plot diagram



6.15.3 Scree Plot Diagram

From the scree plot we can determine optimal No. of components whose contribution are more. From graph it is clear that component - 4 and 5 i.e. stress & HR have little contribution while **component 1,2,3 i.e. culture, motivation and QWL have more contribution after adoption of technology.**

Table 6.15.3 Component Matrix(a)

	Component	
	1	2
CULTURE	.977	-.195
MOTIVATION	.694	.168
QWL	.946	-.219
STRESS	.027	.990
HR	.722	.353

Table 6.15.4 Rotated Component Matrix(a)

	Component	
	1	2
CULTURE	.984	-.155
MOTIVATION	.687	.196
QWL	.954	-.180
STRESS	-.014	.991
HR	.707	.383

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a Rotation converged in 3 iterations.

6.15.4 Rotated Matrix

Rotated component, matrix help us determine what the component represents. In this table 6.15.4 you can see that component 1 highest value is 0.984 for culture, hence We can say that Component No 1 is most highly Co-related with cultur. Qwl which value is 0.954 next Co-related value 0.707, 0.687 for HR-Pract and Motivation respectively. It also review that component -1 is less Co-related with stress. Simillarily for component 2 is highly co related with stress which value is 0.9 While other values are not co-related. Which shows that there is relation between motivation & stress. Which proof that after introduction of modern technology in banking system the motivation are increase and same time stress is also highly increase.In this case employee should give entertainment programme to that rid of stress.

After introductory of new technology the head of institute always demand do work very fast and hence stress occur in mind of employee.

Table 6.15.5**Component Transformation Matrix**

Component	1	2
1	.999	.041
2	-.041	.999

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Table 6.15.6 Component Score Coefficient Matrix

	Component	
	1	2
CULTURE	.349	-.146
MOTIVATION	.237	.148
QWL	.339	-.166
STRESS	-.024	.812
HR	.241	.300

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Component Scores.

Table 6.15.7 Component Score Covariance Matrix

Component	1	2
1	1.000	.000
2	.000	1.000

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Component Scores.

6.15.5 Conclusion :

From entire table 6.15.1 to 6.15.5 it is clear that **culture & motivation** are main components. which are mainly affected after adoption of modern technology

If we consider **city-wise**,The employee of **Rajkot** city having more contribution in respect of culture & motivation.

6.15 .2 FACTOR analysis to observe reverse effect

Following are the result for solving the problem using SPSS,

```
/VARIABLES RAJKOT AHMEDABAD BARODA BHAVNAGAR SURAT /MISSING LISTWISE
/ANALYSIS RAJKOT AHMEDABAD BARODA BHAVNAGAR SURAT
/PRINT INITIAL EXTRACTION ROTATION FSCORE
/PLOT EIGEN
/CRITERIA MINEIGEN(1) ITERATE(25)
/EXTRACTION PC
/CRITERIA ITERATE(25)
/ROTATION VARIMAX
/SAVE REG(ALL)
/METHOD=CORRELATION .
```

Factor Analysis

Correlation Matrix(a)

a This matrix is not positive definite.

Table 6.15.2.1 Communalities

	Initial	Extraction
RAJKOT	1.000	.990
AHMEDABAD	1.000	.972
BARODA	1.000	.945
BHAVNAGAR	1.000	.961
SURAT	1.000	.851

Extraction Method: Principal Component Analysis.

Output :-**6.15.2.1 Communalities:**

Identification of the variable. Here, we can see that in initial column the values for all the component are 1 In table 6.15.2.1 which indicates that the correlation analysis. With value will always be 1, while in extraction column this indicates amount of variance in each variable i.e Content from extraction component are estimate of variance in each variable accounted for by the component. In this table we found that extraction value for Employee of Rajkot, AHMEDABAD, BHAVNAGAR and BARODA city are very high which indicate that extracted components represents the variable well. However, the extraction value for Employee of SURAT city are not very high. This indicates that the extracted component represents variable not in well hence for such communities it is required to extract other component which I have shown in r table 6.15.2.2

Table 6.15.2.2**Total Variance Explained**

showing the principal component analysis using extretion method

Comp.	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.719	94.384	94.384	4.719	94.384	94.384
2	.206	4.123	98.506			
3	.073	1.455	99.961			
4	.002	.039	100.000			
5	-9.44E-017	-1.89E-015	100.000			

In this table 6.15.2.2 : the initial eigen values for all the components are given which are 4.719, 0.206, 0.073, 0.002 and -9.44E -017. We know that those value will be extracted whose eigen value >1. In our problem we can see from the table 6.15.2.2 that eigen value of component 1 is greater than 1. Hence we extract this one component which is given below.

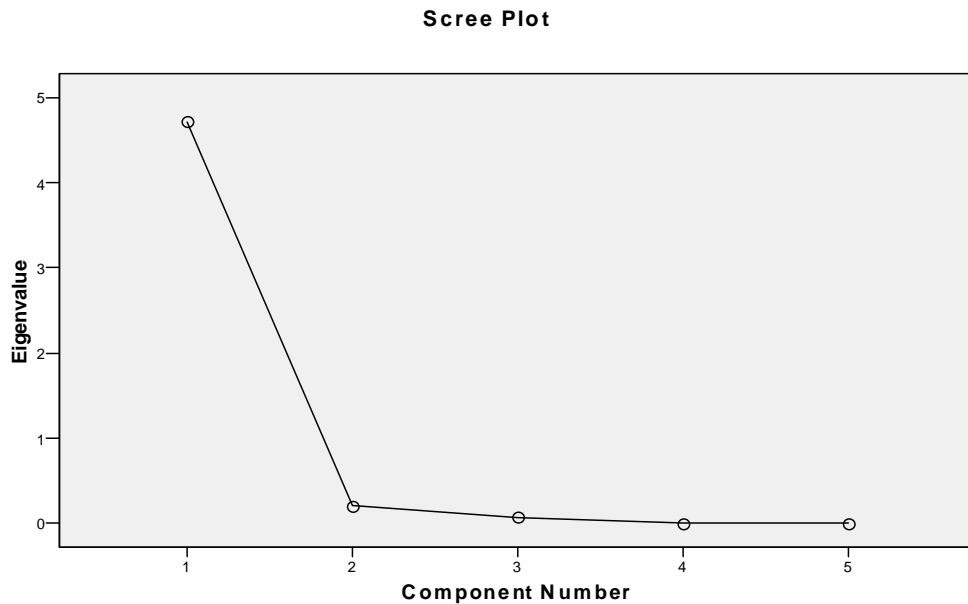
Sr. No.	Component	% Percent	Variable	Cumm. Variance
1.	1	4.719	94.384	94.384

From this above table We see that this one component namely Employee of Rajkot city explain about 94% of the variable from the 5 Variable so it reduce the complexity of data. By using this component the loss of information is 6% only.

In total variable explain table 6.15.2.2 we can see that in the Rotation sum of square column it contains only 1 component 1 . We can see that at the rotation maintain the cumulative % of variable explain by the extracted component. However this variations is now spread more evenly over the component.

This large changes use the individual total suggest that the rotated Matrix is easier to explain than the un-rotated Matrix.

6.15.2.3 Scree Plot diagram



6.15.2.3 Scree Plot Diagram

From the scree plot we can determine optimal No. of components whose contribution are more. From graph it is clear that component – 2,3,4 and 5 i.e. Employee of city AHMEDABAD,BARODA,SURAT and BHAVNAGAR have little contribution **while component 1, i.e. Employee of city Rajkot has more contribution after adoption of technology.**

Table 6.15.2.3 Component Matrix(a)

	Component
	1
RAJKOT	.995
AHMEDABAD	.986
BARODA	.972
BHAVNAGAR	.980
SURAT	.923

Extraction Method: Principal Component Analysis.

a 1 components extracted.

6.15.2.4 Rotated Component Matrix(a)

a Only one component was extracted. The solution cannot be rotated.

6.15.2.4 Rotated Matrix

Rotated component, matrix help us determine what the component represents. In this table you can see that Only one component was extracted. The solution cannot be rotated.

Table 6.15.2.4 Component Score Coefficient Matrix

	Component
	1
RAJKOT	.211
AHMEDABAD	.209
BARODA	.206
BHAVNAGAR	.208
SURAT	.195

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Component Scores.

Table 6.15.2.5 Component Score Covariance Matrix

Component	1
-----------	---

1	1.000
---	-------

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Component Scores.

6.15.2.5 Conclusion

From entire table 6.15.2.1 to 6.15.2.5 it is clear that Employee of Rajkot city is main component which is mainly affected after adoption of modern technology

If we consider city-wise, The employee of Rajkot city having more contribution in respect of culture & motivation.

6.16 FACTOR ANALYSIS SERVICE-SPAN-WISE

Following are the result for solving the problem using SPSS,

```

/VARIABLES CULTURE MOTIVATION QWL STRESS HR /MISSING LISTWISE
/ANALYSIS
CULTURE MOTIVATION QWL STRESS HR
/PRINT INITIAL EXTRACTION ROTATION FSCORE
/PLOT EIGEN
/CRITERIA MINEIGEN(1) ITERATE(25)
/EXTRACTION PC
/CRITERIA ITERATE(25)
/ROTATION VARIMAX
/SAVE REG(ALL)

```

/METHOD=CORRELATION .

Factor Analysis

Correlation Matrix(a)

a This matrix is not positive definite.

Table 6.16.1 Communalities

	Initial	Extraction
CULTURE	1.000	.980
MOTIVATION	1.000	.684
QWL	1.000	.979
STRESS	1.000	.989
HR	1.000	.838

Extraction Method: Principal Component Analysis.

Output :-

6.16.1 Communalities:

Identification of the variable. Here, we can see that in initial column the values for all the component are 1 in table 6.16.1 which indicates that the correlation analysis. With value will always be 1, while in extraction column this indicates amount of variance in each variable i.e Content from extraction component are estimate of variance in each variable accounted for by the component. In this table we found that extraction value for culture, Quality of work life (QWL) and stress are very high which indicate that extracted components represents the variable well. However, the extraction value for motivation & HR practice are not very high. This indicates that the extracted component represents variable not in

well hence for such communities it is required to extract other component which I have shown in table 6.16.2.

Table 6.16.2.

Total Variance Explained

showing the principal component analysis using extretion method

Comp.	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.471	89.411	89.411	4.471	89.411	89.411
2	.404	8.089	97.500			
3	.125	2.500	100.000			
4	3.65E-016	7.29E-015	100.000			
5	-4.55E-017	-9.11E-016	100.000			

The variable explained by initial eigen value. In this table : the intial eigen values for all the components are given which are 4.471, 0.404, 0.125, 3.65E-016 and -4.55E-017. We know that those value will be extracted whoes eigen value >1. In our problem we can see from the table 6.16.2 that eigen value of component 1 is greater than 1. Hence we extract this one compoent which is given below.

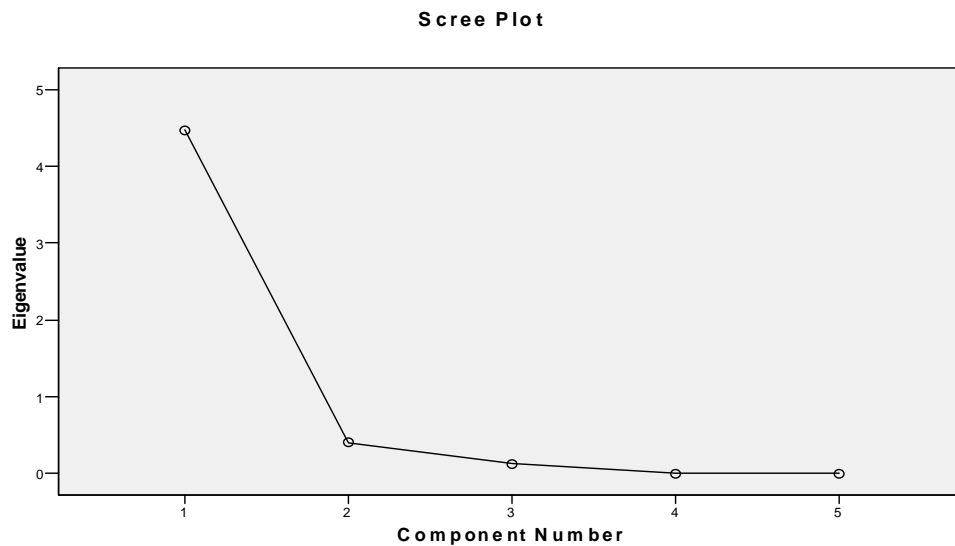
Sr. No.	Component	Initial Eigenvalues		
		Total	% of Variance	Cumulative %
1.	<i>Culture</i>	4.471	89.411	89.411

From this above table We see that this one component namely culture explain about 89% of the variable from the 5 Variable so it reduce the complexity of data. By using this component loss of information is 11% only.

In total variable explain table we can see that in the Rotation sum of square colume it contains only 1 component No : 1 i.e We can see that at the rotation maintain the cumulative % of variable explain by the extracted component. However this variations is now spread more evenly over the component.

This large changes use the individual total suggest that the rotated Matrix is easier to explain than the un-rotated Matrix.

6.16.3 Scree Plot diagram



6.16.3 Scree Plot Diagram

From the **Scree** plot we can determine optimal No. of components whose contribution are more. From above graph it is clear that component – 2, 3, 4 and 5 i.e. Motivation, QWL, stress & HR have little contribution while component 1 i.e. culture, has more contribution after adoption of technology in respect of length of services.

Table 6.16.3 Component Matrix(a)

	Component
	1
CULTURE	.990
MOTIVATION	.827
QWL	.989
STRESS	.995
HR	.915

Extraction Method: Principal Component Analysis.

a 1 components extracted.

6.16.4 Rotated Component Matrix(a)

a Only one component was extracted. The solution cannot be rotated.

4. Rotated Matrix

Rotated component, matrix help us determine what the component represents. In this table you can see that Only one component was extracted. The solution cannot be rotated.

Table 6.16.4 Component Score Coefficient Matrix

	Component
	1
CULTURE	.221
MOTIVATION	.185
QWL	.221
STRESS	.222
HR	.205

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Component Scores.

Table 6.16.5 Component Score Covariance Matrix

Component	1
1	1.000

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Component Scores.

6.16.5 Conclusion

From entire table 6.16.1 to 6.16.5 it is clear that culture is main component which is mainly affected after adoption of modern technology.

If we consider service-span, The employee of service span 20-25 and 25-30 years having more contribution in respect of culture after adoption of technology.

6.17 Findings from factor analysis :

In this Investigations, The following are the culture criteria

- 4 Relation with HOD (Good / Normal / Bad)
- 5 Relation with sub-ordinate (Good / Normal / Bad)
- 28 Do you have tea break in your office ?
- 29 Duration of tea break ?
- 30 Does this time is sufficient
- 31 Do you need more time during tea break ?
- 32 During tea break do you perform Gossiping / Official discussion / Politics / family discussion.
- 33 Do you see that work culture changes with the introduction of computer Network ?
- 34 With the introduction of computer do your work get faster than earlier
- 35 Time taken in dealing with one customer is more / less ?
- 36 How do you feel difference between Manual & computerize work ?

Using factor analysis using principal component analysis, It is found that culture is main responsible for satisfaction of employee in the banking sector after introduction of modern technology. From the culture criteria you can see that : All criteria are the important criteria for satisfaction of the employee. Which comes true in this investigation using factor analysis.

CHAPTER -07

Findings, Conclusions And Suggesions

7.1 Findings :

1. On the basis of Chi-Square test value comes out as 0.994 which is grater than .05 (Level of Significance at 95%), which shows that test is Insignificant and hence accepte the null Hypothesis, that is

There is no significant difference between gender in respect of Culture before adoption of technology .

2. On the basis of Chi-Square test value comes out as $0.959 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accepte the null Hypothesis, that is

There is no significant difference between gender in respect of Motivation before adoption of technology .

3. On the basis of Chi-Square test value comes out as $0.974 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accepte the null Hypothesis, that is

There is no significant difference between gender in respect of Quality of work life before adoption of technology .

4. On the basis of Chi-Square test value comes out as $0.989 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accepted the null Hypothesis, that is,

There is no significant difference between gender in respect of Stress before adoption of technology .

5. On the basis of Chi-Square test value comes out as $0.95 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between gender in respect of HR. Practice before adoption of technology .

6. On the basis of Chi-Square test value comes out as $0.985 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between gender in respect of Culture after adoption of technology .

7. On the basis of Chi-Square test value comes out as $0.945 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between gender in respect of Motivation after adoption of technology .

8. On the basis of Chi-Square test value comes out as $0.971 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between gender in respect of Quality of work life after adoption of technology.

9. On the basis of Chi-Square test value comes out as $0.962 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between gender in respect of Stress after adoption of technology .

10. On the basis of Chi-Square test value comes out as $0.942 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between gender in respect of HR. Practice after adoption of technology .

11. On the basis of Chi-Square test value comes out as $0.975 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Education in respect of Culture before adoption of technology .

12. On the basis of Chi-Square test value comes out as $0.915 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Education in respect of Motivation before adoption of technology .

13. On the basis of Chi-Square test value comes out as $0.968 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between Education in respect of Quality of work life before adoption of technology .

14. On the basis of Chi-Square test value comes out as $0.991 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accepted the null Hypothesis, that is,

There is no significant difference between Education in respect of Stress before adoption of technology .

15. On the basis of Chi-Square test value comes out as $0.894 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between Education in respect of HR. Practice before adoption of technology .

16. On the basis of Chi-Square test value comes out as $0.975 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between Education in respect of Culture after adoption of technology .

17. On the basis of Chi-Square test value comes out as $0.911 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is,

There is no significant difference between Education in Motivation after adoption of technology .

18. On the basis of Chi-Square test value comes out as $0.971 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Education in respect of Quality of work life after adoption of technology .

19. On the basis of Chi-Square test value comes out as $0.988 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Education in respect of Stress after adoption of technology .

20. On the basis of Chi-Square test value comes out as $0.914 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Education in respect of HR. Practice after adoption of technology .

21. On the basis of Chi-Square test value comes out as $0.998 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of Culture before adoption of technology .

22. On the basis of Chi-Square test value comes out as $0.0 < 0.05$ (Level of Significance at 95%), which shows that test is significant and hence reject the null Hypothesis, that is

There is significant difference between Cader in respect of Motivation before adoption of technology .

23. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of Quality of work life before adoption of technology .

24. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of Stress before adoption of technology .

25. On the basis of Chi-Square test value comes out as $0.997 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of HR. Practice before adoption of technology .

26. On the basis of Chi-Square test value comes out as $0.629 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of Culture after adoption of technology .

27. On the basis of Chi-Square test value comes out as $0.988 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of Motivation after adoption of technology .

28. On the basis of Chi-Square test value comes out as $0.998 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader Quality of work life after adoption of technology .

29. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of Stress after adoption of technology .

30. On the basis of Chi-Square test value comes out as $0.998 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Cader in respect of HR. Practice after adoption of technology .

31. On the basis of Chi-Square test value comes out as $0.906 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between City in respect of Culture before adoption of technology .

32. On the basis of Chi-Square test value comes out as $0.149 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between City in respect of Motivation before adoption of technology .

33. On the basis of Chi-Square test value comes out as $0.244 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between City in respect of Quality of work life before adoption of technology .

34. On the basis of Chi-Square test value comes out as $0.004 < 0.05$ (Level of Significance at 95%), which shows that test is significant and hence the null hypothesis is rejected, that is,

There is significant difference between City in respect of Stress before adoption of technology .

35. On the basis of Chi-Square test value comes out as $0.058 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between City in respect of HR. Practice before adoption of technology .

36. On the basis of Chi-Square test value comes out as $0.857 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between City in respect of Culture after adoption of technology .

37. On the basis of Chi-Square test value comes out as $0.279 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between City in respect of Motivation after adoption of technology .

38. On the basis of Chi-Square test value comes out as $0.23 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between City respect of Quality of work life after adoption of technology .

39. On the basis of Chi-Square test value comes out as $0.002 < 0.05$ (Level of Significance at 95%), which shows that test is significant and hence the null Hypothesis is rejected, that is,

There is significant difference between City respect of Stress after adoption of technology .

40. On the basis of Chi-Square test value comes out as $0.995 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accepte the null Hypothesis, that is

There is no significant difference between City in respect of HR. Practice after adoption of technology .

41. On the basis of Chi-Square test value comes out as $0. < 0.05$ (Level of Significance at 95%), which shows that test is significant and hence reject the null Hypothesis, that is,

There is no significant difference between Age in respect of Culture before adoption of technology .

42. On the basis of Chi-Square test value comes out as $0.982 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accepte the null Hypothesis, that is

There is no significant difference between Age in respect of Motivation before adoption of technology .

43. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Age in respect of Quality of work life before adoption of technology .

44. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Age in respect of Stress before adoption of technology .

45. On the basis of Chi-Square test value comes out as $0.997 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Age in respect of HR. Practice before adoption of technology .

46. On the basis of Chi-Square test value comes out as $0.998 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Age in respect of Culture after adoption of technology .

47. On the basis of Chi-Square test value comes out as $0.952 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference Age wise in respect of Motivation after adoption of technology .

48. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Age in respect of Quality of work life after adoption of technology .

49. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Age in respect of Stress after adoption of technology .

50. On the basis of Chi-Square test value comes out as $0.999 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Age in respect of HR. Practice after adoption of technology .

51. On the basis of Chi-Square test value comes out as $0.998 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Culture before adoption of technology .

52. On the basis of Chi-Square test value comes out as $0.973 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Motivation before adoption of technology .

53. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Quality of work life before adoption of technology .

54. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Stress before adoption of technology .

55. On the basis of Chi-Square test value comes out as $0.995 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of HR. Practice before adoption of technology .

56. On the basis of Chi-Square test value comes out as $0.999 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Culture after adoption of technology .

57. On the basis of Chi-Square test value comes out as $0.997 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Motivation after adoption of technology .

58. On the basis of Chi-Square test value comes out as $0.999 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Quality of work life after adoption of technology.

59. On the basis of Chi-Square test value comes out as $1 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of Stress after adoption of technology .

60. On the basis of Chi-Square test value comes out as $0.997 > 0.05$ (Level of Significance at 95%), which shows that test is Insignificant and hence accept the null Hypothesis, that is

There is no significant difference between Experience in respect of HR.
Practice after adoption of technology .

7.2 CONCLUSION

7.2.1 ON BASIS OF CHI-SQUARE TEST:

1. On the basis of Chi-Square test value comes out as $0.0 < 0.05$ (Level of Significance at 95%), which shows that test is significant and hence reject the null Hypothesis, that is

There is significant difference between Cader in respect of Motivation before adoption of technology .

2. On the basis of Chi-Square test value comes out as $0.004 < 0.05$ (Level of Significance at 95%), which shows that test is significant and hence the null hypothesis is rejected, that is,

There is significant difference between City in respect of Stress before adoption of technology .

3. On the basis of Chi-Square test value comes out as $0.002 < 0.05$ (Level of Significance at 95%), which shows that test is significant and hence the null Hypothesis is rejected, that is,

There is significant difference between City respect of Stress after adoption of technology .

4. On the basis of Chi-Square test value comes out as $0. < 0.05$ (Level of Significance at 95%), which shows that test is significant and hence reject the null Hypothesis, that is,

There is significant difference between Age in respect of Culture before adoption of technology .

7.2.2 ON BASIS OF WILCOXON SIGN TEST:

- 1 Since P Value, that is $0.043 < 0.05$ which shows that the test is significant. We can reject the null hypothesis. That is technology adoption make change in agree views of **male and female** employees.

Adoption of technology make changes in the views of **male and female** employees in respect of agree statement

- 2 Since P Value, that is $0.043 < 0.05$ which shows that the test is significant. We can reject the null hypothesis. That is technology adoption make change in agree views of **Graduate and Post graduate** employees.

Adoption of technology make changes in the views of **Graduate and Post graduate** employees in respect of agree statement

- 3 Since P Value of all five occupation wise categories that are $0.043 < 0.05$ which shows that the test are significant. We can reject the null hypothesis. That is, technology adoption make change in agree views of all five occupation wise categories employees.

Adoption of technology make changes in the views of all five occupation wise categories employees in respect of agree statement.

4. Since P Value of all five Cities i.e **Rajkot, Ahmedabad, Baroda, Bhavnagar and Surat** are **0.080,0.043,0.078,0.68 and 0.285**

respectively , which shows that there is changes are takes place in only Employee of Ahmedabad city because the P-Value is 0.043 is less than 0.05 and so the test is significant. We can reject the null hypothesis. That is technology adoption make change in employee of Ahmedabad city in respect of agree views .

Adoption of technology make changes in the views of **only employee of Ahmedabad city in respect of agree statement.**

While, P Value of rest of all four Cities i.e **Rajkot,, Baroda, Bhavnagar and Surat are 0.080,0.078,0.68 and 0.285** respectively , which shows that there are no changes takes place in Employee of above four cities because the P-Value is Greater than 0.05 and so the test is in-significant. We can accept the null hypothesis. That is technology adoption make no change in employee of above four cities in respect of agree views

- 5** Since P Value of all five Age-group i.e 35-40,40-45,45-50,and 50-55 are 0.225,0.043,0.043 and 0.043 respectively , which shows that there is changes are takes place in only Employee of Age Group 40-45,45-50 and 50-55 because their P-Value are 0.043 which is less than 0.05 and so the test is significant. We can reject the null hypothesis. That is technology adoption make change in employee of Age Group 40-45,45-50 and 50-55 in respect of agree views .

Adoption of technology make changes in employee of Age Group 40-45, 45-50 and 50-55 in respect of agree views .

While, P Value of rest of Age Group i.e 35-40 is **0.225** which shows that there is no changes takes place in Employee of above Age-

group because the P-Value is Greater than 0.05 and so the test is insignificant. We can accept the null hypothesis. That is technology adoption make no change in employee of above Age-group in respect of agree views .

2. Since P Value of all four Experience--group i.e 15-20,20-25,25-30,and 30-35 are 0.043 , which shows that there is changes are takes place in all four Employee of Experience Group 15-20,20-25,25-30,and 30-35 because their P-Value are 0.043 which is less than 0.05 and so the test is significant. We can reject the null hypothesis. That is technology adoption make change in employee of Experience Group of 15-20,20-25,25-30,and 30-35 in respect of agree views .

Adoption of technology make changes in employee of Experience Group of 15-20,20-25,25-30,and 30-35 in respect of agree views

7.2.3 ON BASIS OF FACTOR ANALYSIS

- 1 From entire table it is clear that culture & QWL are main component for upgradation of modern technology.
If we consider AGE-wise,The employee of age-group 40-45 having more contribution in respect of culture & QWL after adoption of technology.
- 2 From entire table it is clear that culture is main component for upgradation of modern technology.
If we consider Male-female-wise, The employee of male has more contribution in respect of culture with respect to female

employees in the public sector bank after adoption of technology.

- 3** From entire table it is clear that culture is main component for upgradation of modern technology.

If we consider cader-wise, The employee of managerial and supervisory cader having more contribution in respect of culture after adoption of the technology.

- 4** From entire table it is clear that culture & motivation is main component for upgradation of modern technology.

If we consider city-wise, The employee of Rajkot city having more contribution in respect of culture & motivation.

- 5** From entire table it is clear that Employee of Rajkot city is main component for adoption of modern technology.

If we consider city-wise, The employee of Rajkot city having more contribution in respect of culture & motivation.

- 6** From entire table it is clear that culture is main component for upgradation of modern technology.

If we consider service-span, The employee of service span 20-25 and 25-30 years having more contribution in respect of culture after adoption of technology.

7.3 SUGGESITIONS :

1. CULTURE :

In respect of Culture after adoption of Technology for Gender wise, Cader-wise, Experience wise, City-wise, Education-wise, it is observed that there is no difference. However, there is difference of Age-wise in respect of culture before adoption of technology. Hence, it is suggested that there must be entertainment programmed for employee and their family.

2. MOTIVATION :

In respect of Motivation after adoption of Technology for Gender wise, Experience wise, City-wise, Education-wise, Age-wise, There is no difference however it is observed that there is difference of cader wise in respect of motivation before adoption of technology. There must be some motivation after adoption of the technology caderwise. For this purpose we suggested that cader wise employee must be given some extra incentives & some motivation programme. Apart from this there must be different technological facilities-cader wise should be provided to boost the motivation in the employee.

3. STRESS :

In respect of Stress after adoption of Technology for Gender wise, Caderwise, Experience wise, Education-wise, Age-wise, it is observed that there is no difference. However there is difference of City wise in term of stress before and after adoption of technology. It is herewith suggested that the facilities which is given to employee who working in a good city should also be provided to the employee who working in the lower grade city.

Stress is coming due to insufficient time available spent with their family as in the city employee are staying with nuclear family. Hence, there must be some

provision that the employee and his/her family member should join the club, Gymnasium, Swimming and indoor as well as outdoor games time to time.

Some time house is located very far from the offices because in the main city rent is very high. So employee take cheaper rent house which is only available far from the city. because of this Problem, employee are reaching late due to the Traffic jam in the city and hence having more stress. There for It is suggested that employee's quarter must be near to the office so that they can attend the office by walk which can reduce this stress.

4. HR PRACTICES.

It is observed that there is no difference in HR criteria before and after adoption of technology to make differences it is suggested that :

All public sector bank must provide complete modern technology and other infrastructure as provided by private sector bank to increase the HR criteria

Modernization of technology must be updated and implemented time to time as and when required.

5. QUALITY OF WORK LIFE : (QWL)

It is observed that there is no difference in QWL before and after adoption of technology to make differences it is suggested that

Continuous training of the modern and latest technology should be provided to each cader of the employee as provided in private sector bank

APPENDIX- A

Topic for the Ph.D.

**“A STATISTICAL ANALYSIS AND COMPARATIVE STUDY OF
MODERN TECHNOLOGY WITH IMPACTS ON HUMAN RESOURCE
DEVELOPMENT”**

QUESTIONARY FOR Ph.D. WORK

(A) Personal Details

Name :-

Age :-

Male / Female :-

**Address of
Service / Occupation :-**

**Designation at
Service / Occupation :-**

**Service / Occupation :-
(Public / Private / Govt.)**

Qualification :-

Date of Joining :-

(B) HR COMPONENT CRITERIA

1. Are you satisfy with present job ? (0 / 1 / 2)
2. If (N), are you try to change your present job ? (0 / 1 / 2)
3. Which sector would you like to join ? (Public / Private / Govt.) (0 / 1 / 2)
4. Relation with HOD (Good / Normal / Bad) (0 / 1 / 2)
5. Relation with sub-ordinate (Good / Normal / Bad) (0 / 1 / 2)
6. Satisfaction with quality of work. (0 / 1 / 2)
7. Satisfaction with organization culture. (0 / 1 / 2)
8. Chances of promotion (5/10/15 Years) (0 / 1 / 2)
9. Working time (from to) (0 / 1 / 2)
10. Are you satisfy with timing ? (if not do you want to Change the office time. Give its reason) (0 / 1 / 2)
11. Are you supposed to do over time work ? (If yes) How many times (No. of Hours), are you paid for over time work ? (0 / 1 / 2)
12. Are you satisfy with over time work ? (0 / 1 / 2)
13. Since you are in the office during the day time, how would you manage to complete daily routine and domestic work (Like Electric bill, Marketing, etc.) (0 / 1 / 2)
14. How many holidays do you have ?(CL / EL, Medical or Declared holidays) (0 / 1 / 2)
15. Are you satisfy with these holidays ? (0 / 1 / 2)
16. How often you visit your relatives / friends house (0 / 1 / 2)

17. Are you satisfied with above visit ? (0 / 1 / 2)
18. Do you go for recreation (0 / 1 / 2)
19. Are you satisfy with recreation (0 / 1 / 2)
20. Do you ever take lunch dinner at hotel ? (0 / 1 / 2)
21. If yes how frequently ? (0 / 1 / 2)
22. Are you satisfy with hotel meal ? (0 / 1 / 2)
23. Are you satisfy with pay ? (0 / 1 / 2)
24. If not what is your expectation ? (0 / 1 / 2)
25. What facility you have (Computer / Internet / Fax) ? (0 / 1 / 2)
26. Do you think these facilities are sufficient (0 / 1 / 2)
27. Do you require more facility in the office
What type of facility do you require ? (0 / 1 / 2)
28. Do you have tea break in your office ? (0 / 1 / 2)
29. Duration of tea break ? (0 / 1 / 2)
30. Does this time is sufficient (0 / 1 / 2)
31. Do you need more time during tea break ? (0 / 1 / 2)
32. During tea break do you perform Gossiping / Official
discussion / Politics / family discussion. (0 / 1 / 2)
33. Do you see that work culture changes with the
introduction of computer Network ? (0 / 1 / 2)
34. With the introduction of computer do your work get faster
than earlier (0 / 1 / 2)
35. Time taken in dealing with one customer is more / less ? (0 / 1 / 2)
36. How do you feel difference between Manual &
computerize work ? (0 / 1 / 2)
37. Continues sitting with computer do you feel any stress (0 / 1 / 2)

38. Do you complete more work using computer compare to manual work. (0 / 1 / 2)
39. To find old record which is favorable (Manuals / computer) (0 / 1 / 2)
40. Reason for preferring computerize System ? (0 / 1 / 2)
41. Do you enjoy with your family more after introduction of computerized system at your organization ? (0 / 1 / 2)
42. Do you feel your work efficiency increase after modernization ? (0 / 1 / 2)
43. Your Impression about effect of technology ? (0 / 1 / 2)
44. What do you suggest for further improvement with Human Recourse practice in term of Head & Friends. (0 / 1 / 2)
45. Productivity increase (0 / 1 / 2)
46. Healthyness increase (0 / 1 / 2)
47. Human Growth increase (0 / 1 / 2)
48. Human values Incease (0 / 1 / 2)
49. Behaviou patter improved (0 / 1 / 2)
50. Satisfaction level increase (0 / 1 / 2)
51. Comfortability Increase (0 / 1 / 2)
52. Perfectness in Job increase (0 / 1 / 2)
53. Effectiveness in job increase (0 / 1 / 2)
54. Efficiency increase (0 / 1 / 2)
55. Social development increase (0 / 1 / 2)
56. Accuracy in Job increase (0 / 1 / 2)
57. Punctualitu increase (0 / 1 / 2)
58. Stress level decrease (0 / 1 / 2)
59. Overall Progress increase (0 / 1 / 2)

(0 / 1 / 2)

**NOTE : - 0 INDICATES NUTRAL
1 INDICATES NOT AGREE,
2 INDICATES AGREE**

APPENDIX- B

Topic for the Ph.D.

**“A STATISTICAL ANALYSIS AND COMPARATIVE STUDY OF MODERN
TECHNOLOGY WITH IMPACTS ON HUMAN RESOURCE DEVELOPMENT”**

QUESTIONARY FOR Ph.D. WORK

(A) Personal Details

Name :-

Age :-

Male / Female :-

**Address of :-
Service / Occupation**

**Designation at :-
Service / Occupation**

**Service / Occupation :-
(Public / Private / Govt.)**

Qualification :-

Date of Joining :-

(B) CULTURE CRITERIA

- 4 Relation with HOD (Good / Normal / Bad)
- 5 Relation with sub-ordinate (Good / Normal / Bad)
- 28 Do you have tea break in your office ?
- 29 Duration of tea break ?
- 30 Does this time is sufficient
- 31 Do you need more time during tea break ?
- 32 During tea break do you perform Gossiping / Official discussion / Politics / family discussion.
- 33 Do you see that work culture changes with the introduction of computer Network ?
- 34 With the introduction of computer do your work get faster than earlier
- 35 Time taken in dealing with one customer is more / less ?
- 36 How do you feel difference between Manual & computerize work ?

(C) MOTIVATION CRITERIA

- 1 Are you satisfy with present job ?
- 2 If (N), are you try to change your present job ?
- 8 Chances of promotion (5/10/15 Years)
- 13 Since you are in the office during the day time, how would you manage to complete daily routine and domestic work (Like Electric bill, Marketing, etc.)
- 14 How many holidays do you have ?(CL / EL, Medical or Declared holidays)
- 15 Are you satisfy with these holidays ?
- 16 How often you visit your relatives / friends house
- 17 Are you satisfied with above visit ?
- 18 Do you go for recreation
- 19 Are you satisfy with recreation
- 20 Do you ever take lunch dinner at hotel ?

- 21 If yes how frequently ?
- 22 Are you satisfy with hotel meal ?
- 23 Are you satisfy with pay ?
- 24 If not what is your expectation ?

(D) QWL CRITERIA

- 3 Which sector would you like to join ?
(Public / Private / Govt.)
- 6 Satisfaction with quality of work.
- 7 Satisfaction with organization culture.
- 9 Working time (from to)
- 10 Are you satisfy with timing ? (if not do you want to Change the office time. Give its reason)
- 11 Are you supposed to do over time work ? (If yes) How many times (No. of Hours), are you paid for over time work ?
- 12 Are you satisfy with over time work ?
- 25 What facility you have (Computer / Internet / Fax) ?
- 26 Do you think these facilities are sufficient
- 27 Do you require more facility in the office
What type of facility do you require ?

(E) STRESS CRITERIA

- 37 Continues sitting with computer do you feel any stress
- 38 Do you complete more work using computer compare to manual work.
- 39 To find old record which is favorable (Manuals / computer)
- 40 Reason for preferring computerize System ?
- 41 Do you enjoy with your family more after introduction of

- computerized system at your organization ?
- 42 Do you feel your work efficiency increase after modernization ?
- 43 Your Impression about effect of technology ?
- 44 What do you suggest for further improvement with Human
Recourse practice in term of Head & Friends.

(F) HR CRITERIA

- 45 Productivity increase
- 46 Healthyness increase
- 47 Human Growth increase
- 48 Human values Incease
- 49 Behaviou patter improved
- 50 Satisfaction level increase
- 51 Comfortability Increase
- 52 Perfectness in Job increase
- 53 Effectiveness in job increase
- 54 Efficiency increase
- 55 Social development increase
- 56 Accuracy in Job increase
- 57 Punctualitu increase
- 58 Stress level decrease
- 59 Overall Progress increase

BIBLIOGRAPHY

REFERENCES :

1. Research Methodology Practice – P. Philominathan – Shri A.V.V.M. Pushpam College – Poondi –Thanjavur
2. Research Methodology – Methods & Techniques 2 ed, Kothari C. R. – Vishwa Prakashan – New Delhi 1990.
3. An Introduction to Research Procedure in Social Sciences – Gopal M. A. – Asia Publishing House - Bombay
4. Darlington, Richard B., Sharon Weinberg, and Herbert Walberg (1973). Canonical variate analysis and related techniques. *Review of Educational Research*, 453-454.
5. Gorsuch, Richard L. (1983) *Factor Analysis*. Hillsdale, NJ: Erlbaum
6. Morrison, Donald F. (1990) *Multivariate Statistical Methods*. New York: McGraw-Hill.
7. Rubenstein, Amy S. (1986). An item-level analysis of questionnaire-type measures of intellectual curiosity. Cornell University Ph. D. thesis.

BOOKS:

1. Argyris C. "Personality and Organisation: The Conflict Between System and Individuals "Harper and Row, New York, 1995.
2. Arthur G., Beclein and Glueck W.G., Management., Hold sounders international edition, 1983.

3. Argyris C., "Interpersonal Competence and organizational Effectiveness", Erwin Dorsey Press, Moscow, 1992.
4. Batten.D. "Tough Minded Management" American Management Association, New York, 1963.
5. Beach S. "personnel – the management f people at work", Macmillan publishing co. Inc., New York.
6. Cellerman S.W. "Management by otivation", American Management Association, New York, 1968.
7. Chopra B.S., et.al., "Leadership for the Indian Managers, A human relation approach" , The Times research foundation.
8. Calhoon R.P. "Personal Management and supervision", Application Century crafts, New York, 1967.
9. Chatterjee N.N. "Management of Personal in Indian enterprises : Concept, Practices and emerging trends", Allied book agency, Calcutta.
10. Calhoon R.P. "Personnel Management and Supervision" Appleton Century, New York, 1964.
11. Desai K.G. "Human Problem in Indian Industries", : Sindhu, Bombay, 1969.
12. Devis Keith "Human Relation at work, McGrow Hill book company, Inc., New York, 1957.
13. Dunette M.D., Campbell J.P. Hakel M.D. "Factors Contributing to job satisfaction and job dissatisfaction six occupational group, organizational Behaviour and Human Performance" 1967, p.no. 143-174.
14. Davis K. "Human behavior at work", Tata McGrow Hill, New Delhi – 1977.
15. Dwivedi R.S., "Supervisor Personality" Samilya Publication, Bombay, 1978.
16. Flippo E.B. "Principles of personnel Management", McGrow Hill, New York, 1931.
17. Ford Martin E., "Motivating Human", Sage Publication, New Delhi, 1995.
18. Ghosh "Personnel Administration in India", Sudha Publication New Delhi, 1969.

19. Gongali H.C. "Structure and Process of organization" – Asia Publishing House, Bombay, 1964.
20. Gonguli S, Chaudhari S. and Guha S.C., "A motivation test for measuring entrepreneurial traits", Management and Labour Studies, 1980, 44-49.
21. Gonguli T., "An Experimental Study of Workers morale and productivity Industrial Health in India", Series No.77 – All India Institute of Hygiene and public health, Calcutta.
22. Guha T.N., "Job Satisfaction among shoe factory workers." Productivity 1965, P.no. 89 to 94.
23. Gonguli H.C., "Structure and Process of Organisation", Asia Publishing House, Bombay, 1964.
24. Gupta, "Development of Bank of rural development", Deep & Deep Publication.
25. Herzberg F., "Job Work and the nature of man", world publishing co., New York, 1966.
26. Hunt J.W., "Managing People at Work", McGraw Hill – 1986.
27. Jacob Mankidy – "Human Resource Management in Bank Contemporary Issue" – National Institute of Bank Management, Pune.
28. Jacob Mankidy – "Study of Profile and Report", National Institute of Bank Management, Pune, 1996.
29. Jacob Mankidy & Zarin Dastar. "Organisation in Conflict – A study in Andhra Bank", National Institute of Bank Management Mumbai, 1976.
30. Jacob K.K. "Personnel Management in India" – Himanshu Publication, Udaipur.
31. James A.F., Stonner and Charles Wankel, "Management", Prentice Hall of India, New Delhi, 1986.
32. Koontz H. and O'Donnel C., "Principle of Management", McGraw Hill, New York, 1959.
33. Luthan F., "Organisational behavior" third edition, McGraw Hill, 1985.
34. McGregor D. "The human side of Enterprise", McGraw Hill New York, 1960.

35. Monappa A. and Saiyadain M.S., "Personnel Management", New Delhi, Tata McGraw Hill, 1979.
36. Miraza S. Saiyadain, "Human Resource Management", Tata McGraw Hill, New Delhi, 1979
37. Shah B.G., "Human Resource Management in Banking Industry – Text and case", South asian publication, New Delhi – 1984

ARTICLES

1. Mehta P. "Work motivation in public sector, some conceptualizations", National Labour Institute Bulletin, 1978, 4(3), 90-99.
2. Sinha D., "Job Satisfaction and Job Behaviour", in S.K., Roy and A. Sreekomar Menon (Eds), "Motivation and Organisational Effectiveness", : Shree Ram Centre, New Delhi, 1974.