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RISK MANAGEMENT IN *TAKĀFUL*

Dr. Waheed Akhter
COMSATS University

ABSTRACT

Risk management is of vital importance in Islam and Takāful provides a way to manage risks in business according to <u>Sharī'ah</u> principles. This research paper attempts to identify various types of risks involved in Takāful business that affect operational and investment functions of Takāful operators across the globe. It lays down criteria for Takāful operator to manage those risks effectively. However, Takāful operators often face difficulty in managing market and credit risks as <u>Sharī'ah</u> compliant nature of Takāful contract does not allow Takāful companies to deal with interest rate and financial derivatives that have been unanimously considered repugnant to <u>Sharī'ah</u> by Islamic jurists. This research identifies Islamic financial instruments like cooperative hedging and bi-lateral mutual adjustment that aim at providing mutual gains to both parties by the way of risk sharing and can be used as an alternative to conventional derivatives. The research paper attempts to provide a framework to enhance risk management culture among Takāful operators. It also discusses the challenges that need to be encountered to enhance risk management practices among Takāful operators.

Key Words: *Risk management, Underwriting Risk, Operational Risk, Credit Risk, Market Risk, Liquidity Risk, Takāful, Re-takāful, <u>Sharī'ah</u>, Financial derivatives, Interest rate.*

INTRODUCTION

"Many Muslims misunderstand the concept of fate. For some Muslims believe that the future is in the hand of Allah, where they are facing with fatalistic mentality by putting themselves in the doctrine, whether one is rich or poor, happy or sad, it is fated by Allah. It is a good dealing with luck. In fact, efforts and prayers should precede this kind of belief" (Iqtisad Al-islamy, 2003). For a long time, same misconceptions have been associated with insurance. Muslim scholars and Islamic jurists have treated insurance illegal, haram and repugnant to *Sharī'ah* without providing an alternative solution to Muslim *Ummah*. As a result of these prevalent misconceptions, any effort or risk management strategy to insure the assets or life has been considered against the fate and will of *Allah*.

In Islamic financial planning, *Takāful* is a way to reduce the financial risk of loss due to accident and misfortunes (Iqtisad Al-islamy, 2003). As a matter of fact, *Takāful* plan is an alternative to the insurance in the conventional financial planning. In *Takāful* plan, the participant would pay particular amount of money as contribution (known as the premium) partly to risk fund (the participants' special account) using the concept of *tabbaru'* (donation) and partly to another party (known as *Takāful* company) with a mutual agreement that, the *kafiil* (*Takāful* company) is under a legal responsibility to provide for the participant a financial protection against unexpected loss, should it happen within the agreed period.

The focus of this research paper is to identify various types of risks associated with *Takāful* business and devise criteria for managing risks and enhancing risk management culture among *Takāful* companies. It also discusses challenges to risk management in *Takāful*.

RISK MANAGEMENT

"Risk is the chance of happening of something that will have an impact upon our objectives. It is measured in terms of likelihood and consequences" (GOWA, 2002). Traditionally, concept of risk has been associated with uncertainty of events in future. Higher the uncertainty of events, higher is the risk. In insurance, risk is the amount of loss associated

with property or life. Risk to property can be a loss or damage to car, building, house, etc. Risk to life can be described as poor health, premature death, bodily injuries as a result of accident etc. (Rejda, 2006; p.23).

Risk management is *a process that identifies loss exposures faced by an organization and selects the most appropriate techniques for treating such exposures* (Rejda, 2006; p. 63). According to New Zealand standard of Risk Management, "*It is the culture, processes and structures that are directed towards the effective management of potential opportunities and adverse effects*". In fact, risk management is an ongoing process that encompasses all aspects of our life.

RISK MANAGEMENT UNDER *SHARI'AH*

Risk traditionally means possibility of meeting danger or suffering, harm or loss (Iqtisad Al-islamy, 2003). Risk is an element of life in this world for being ignorant of the future. It is also factor of investing that one should take time to understand prior to selecting any specific investment instruments or any new adventures. Muslims are asked to work hard in order to be able to change their conditions as obvious in the verse of Holy Quran, "*... Verily never will Allah change the condition of a people until they change it themselves (with their own souls)...*" (Qur'an 3:11). However, it is true that only *Allah* knows one's future and fate, Muslims should strive to achieve the goodness in this world and the hereafter. Submission to *Allah*, of course, has a positive effect on human behavior. For it will lead to peace and contentment. Undoubtedly, one has to submit every single thing to *Allah*, but it supposes to be after his hands stretch out to do the best effort as he can, to change himself, so that he would be able to manage and to cope with unforeseen calamities or misfortune.

Prophet Muhammad peace be upon him once asked a Bedouin who had left his camel untied, "Why do not tie your camel?" the Bedouin answered, " I put my trust in *Allah*" the prophet then said, "tie up your camel first then put your trust in *Allah*"(*Sunan al -Tirmizi,* vol.4, No. 2517, p. 668). This conversation depicts not only how should Muslims accept their fate but it also indicates how do Muslims reduce the risk of loss and calamities.

Qur'an has presented stories of the previous prophets so that Muslims can take the lessons from their experiences. The story of the prophet Joseph, for instance, tells us about financial planning. The story of Prophet Ya'qub, Joseph's father, tells us about the management of risks as Ya'qub commanded his sons to enter Egypt from different gates. Qur'an states, "*Further he said: "O my sons! Enter not all by one gate: enter ye by different gates. Not that I can profit you aught against Allah (with my advice): None can command except Allah: On Him do I put my trust: and let all that trust put their trust on Him*" (Qur'an 12:67).

The history of the prophet's migration to Madinah gives us other lessons on how the Prophet (SAW) managed the risk. The Prophet reduced the risk of getting killed by asking Hazrat Ali (R.A.) to sleep in his bed during the night of emigration. It was reported that as night advanced, the Quraish posted assassins around the Prophet's house. Thus they kept vigil all night long, waiting to kill him the moment he left his house early in the morning, peeping now and then through a hole in the door to make sure that he was still lying in his bed.

All these above examples depict that risk management is in the roots of Islam. We, as a Muslims, should put our trust onto *Allah* only after meticulous planning and best utilization of all the available resources.

NORMS OF ETHICS

Obaidullah (2002, pp.2-4) has identified norms of efficiency and ethics for *Sharī'ah* based risk management in a business contract. These norms are also applicable to *Takāful* contract and are briefly described as follow:

i. Each party in *Takāful* contract should be free to accept the terms and conditions of the contract and no coercion is imposed on any party.

ii. *Takāful* contract should be free from element of *'riba'* (interest) that is prohibited by *Shari'ah*. One of the major objections on the contract of conventional insurance by <u>*Sharī'ah*</u> scholars is element of *'riba'* in its investments for which it is considered illegal and unIslamic.

iii. There should be no uncertainty or ambiguity about the nature of contract. Excessive uncertainty is not permissible in *Shari'ah*. For example, <u>*Sharī'ah*</u> scholars disallow conventional insurance contract where no party clearly knows how and from where the insured amount is to going to be paid in case a loss or catastrophe occurs to the insured.

iv. There should not be any element of gambling in *Takāful* contract. It means that *Takāful* contract should not be aimed at getting a huge advantage at the cost of others. Rather, participants should have sincere intention of helping each other in case of loss or catastrophe from a joint fund.

v. Contribution amount for participants should be adequate and fair and should be determined by actuaries and approved by <u>*Sharī'ah*</u> scholars.

vi. *Takāful* customers (participants) should have equal access to adequate, accurate and timely market information related to *Takāful* products and company's performance where they want to contribute their money.

vii. Rights of any third party should not be adversely affected by *Takāful* contract between two parties. It means *Takāful* contract should not be detrimental to any third party.

viii. There should be unrestricted public interest in *Takāful* products and its business contract which should work for the benefit of people at large.

TYPES OF RISKS IN *TAKĀFUL* BUSINESS

Business industry is prone to a number of risks. Five types of risks in business (Basel, 2006; IAIS, 2004) have been identified that are relevant to *Takāful* business. First two types of risks (underwriting and operational risks) are directly related to operations of *Takāful* company while remaining three (credit, liquidity and market risks) are associated with the investment activities of the company.

i. **Underwriting Risk:**

Underwriting risk is pertinent to insurance and *Takāful*. It occurs due to adverse selection of applicants or due to re-*Takāful* risk as a result of inability of re-*Takāful* operator to meet the obligation towards ceded company under re-*Takāful* agreement (IAIS, 2003; pp.32-33). Adverse selection refers to the tendency of selecting applicants that result in higher than average chance of loss (Rejda, 2006; p. 45). The risk of adverse selection arises when applicants with higher than average chance of loss succeed in obtaining *Takāful* coverage at standard rates e.g. high risk drivers or persons with serious health problems. It results in higher claim ratio and put the firm on high liquidity constraints. Re-*Takāful* risk occurs as the ceded company remains liable for a portion of outstanding claim to the extent re-*Takāful* operator fails to provide financial protection to *Takāful* operator in accordance with agreed terms. Both adverse selection and re-*Takāful* risk hamper the firm's underwriting capacity; disturb the cash flow pattern and hence affect the stability of the profits of the company.

ii. **Operational Risk:**

Operational risk is not a well defined concept , yet Basel Report (2006, p.144) defines it as a loss that occurs as a result of inadequate or failed internal processes, people, technology or from external events.

Internal processes failure occurs (Ahmed & Khan, 2001; pp.29-30) as a result of inaccurate processing of transactions, inefficient record keeping, violating operational control

limits, non-compliance of regulations etc. people risk may occur due to incompetence of employees, fraud and failure to perform the duties. Technology risk may arise as a result of telecommunication system or computer network breakdown. Risks from external events include unenforceability of regulatory policies, legislation and regulations that affect the fulfillment of contracts and transactions in the organizations. These risks are also called legal risks and are considered a part of operational risks.

iii. **Credit Risk:**

Credit risk occurs a result of default of counterparty when it fails to meet its obligations in time and in accordance with agreed terms (IAIS, 2004; p.14).

In case of insurance, credit risk may be treated as default risk, migration risk, spread risk or concentration risk. Default risk occurs when *Takāful* operator does not receive or partially receive cash flows or assets to which it is entitled because the other party fails to meet the obligations of the contract. Migration risk occurs when probability of a future default of an obligator adversely affect the contract today. Spread risk occurs due to market perception of increased risk on either macro or micro basis. Concentration risk is the result of increased exposure to losses due to concentration of investments in a particular geographical area or economic or industrial sector. *Takāful* industry is also exposed to these risks.

iv. **Liquidity Risk:**

Liquidity risk is the risk resulting from *Takāful* company's inability to meet its obligations (i.e. claims payments and maturity price of policy) when they fall due. This risk occurs because the company has insufficient liquid assets or high level of liabilities (IAIS, 2004; p.18). Liquidity risk includes liquidation risk, affiliation investment risk and capital funding risk.

Liquidation value risk is the risk under circumstance when assets are liquidated below their real (market) value. Affiliated investment risk is the risk that investment in an affiliated or member company might result in drain of financial or operating resources. Capital fund risk is the risk that insurance company will not be able to outsource funds in case of large claims. *Takāful* industry, just like conventional insurance company, faces similar types of liquidity risks.

v. **Market Risk:**

Market risk is the volatility of prices in instruments and assets of *Takāful* company in the market. It can be classified as equity price risk, interest rate risk, currency risk and commodity price risk (IAIS, 2004, p.12). Equity price risk is the risk of loss resulting from changes in market price of equities or other assets. Interest rate risk is the risk of loss resulting from changes in interest rates that adversely affect the cash flows of the insurance company. Currency risk is the risk of loss resulting from volatility of exchange rates that adversely affect the operations of insurance company.

For a *Takāful* company, it does not include interest rate risk, however *Takāful* operators are exposed to mark up price risk as avoidance of interest based transactions is distinctive feature of *Sharī'ah* compliance.

MANAGING RISKS

All types of risks in *Takāful* require specific risk management strategy and need to be managed on individual basis.

i. **Underwriting Risk Management:**

Underwriting risk can be managed by establishing standard selection procedure consistent with the company's objectives. Most of the *Takāful* operators require physical inspection or medical reports of the applicants that have serious health problems or prone to

higher than average risk. Some have introduced computerized underwriting system to standardized underwriting procedure and minimizing the chance of adverse selection. For example, *Takāful* Ikhlas Sdn. Bhd. of Malaysia uses computerized underwriting procedure for motor *Takāful* where applicants who meet standard requirements are automatically selected for *Takāful*. Others are rejected or alternatively are offered higher contribution rates for the extra risk. To minimize re-*Takāful* risk, *Takāful* operator can evaluate the financial strength of re-*Takāful* operators in the region and diversify the risk geographically by making arrangements with more than one re-*Takāful* operator.

ii. Operational Risk Management:

Management of this risk is more complex as it arises from failure of internal processes, people, information system breakdown and non-compliance with regulatory standards (Ahmed & Khan, 2001; pp. 38-39). Senior management and board of directors of *Takāful* company should devise policies and develop strategies to manage and reduce operational risks. Sources of operational risk (i.e. people, processes and technology) should be handled carefully. This raises the importance of corporate governance culture in the organization. Given the newness of *Takāful* industry, computer software available for conventional insurance might not be appropriate for *Takāful* industry. This calls for recruiting talented professionals in the field of informational technology so that they could develop software to meet peculiar needs of *Takāful* industry. Independent external auditors can also play an important role in mitigating operational risk as they point out flaws in internal processes of the organization. This calls for proper disclosure of activities and independent and secure reporting system.

iii. Credit Risk Management:

Under conventional insurance system, credit exposure limits are established within company's investment policies to mitigate and manage default risk, migration risk, spread risk and concentration risk as discussed under credit risk. Usually, following credit exposure limits can be established for insurance company investment and credit activities (IAIS, 2004; pp.16-18).
- Internal and external rating of counterparties
- Limit on maturity of credit facility (prefer short term credit over long term credit)
- Limit on maximum investment amount or a certain percentage of investment exposure to a single issuer, industry, geographical region or some other risk classification.

Prohibition of interest does not allow *Takāful* companies to investment in interest-based instruments (Chapra and Khan, 2000). Moreover, *Takāful* companies do not have access to credit derivatives that are considered effective instruments for credit risk mitigation. Yet Al-Suwailem (2006; pp.67-68) argues that futures and Option contracts result in losses for more than 70% of the time and hence such instruments are considered as factors of loss, not of gain. The non-availability of Islamic derivatives raises the importance of internal control mechanism for *Takāful* operators which ensures that credit risk exposures are maintained within limits of prudential standards defined by internal controls.

iv. Liquidity Risk Management:

IAIS Report (2004, p.20) identifies two approaches in order to hedge liquidity risk that are also applicable to *Takāful* industry. These are:
  i. Cash flow modeling
  ii. Liquidity ratios

Cash flow modeling is done in order to assess the amount of deficit, surpluses or liquidation value risk in order to meet the needs of *Takāful* industry. *Takāful* operator should make sure that it has sufficient liquid assets in order to meet liquidity risk and unexpected liquidity requirements.

Use of liquidity ratios will help *Takāful* operator to set the amount of liquid assets required to meet demands of liability portfolio, desired level of liquidity ratio will also help in determining *Takāful* operator's investment policies.

Capital funding risk could be mitigated by setting contingency plans and drawing cash from re-*Takāful* policies. This form of liquidity hedging could be recognized by knowing current level of liquid assets in hand to meet *Takāful* operator's investment policies. In order to identify and evaluate liquidity risks, Ahmed and Khan (2001, p.38) emphasize the need of adequate internal control and proper disclosure of information in the organization. Towards this end, it is essential to have regular independent reports and internal audit function should periodically review the liquidity risk management process.

v. Market Risk Management:

In conventional insurance, management of market risk includes devising strategies to manage interest rate risk, exchange rate, and commodity price risk as well as equity price fluctuations. *Takāful* operators are not involved in interest based transactions so they do not face this risk. However, KIBOR (Karachi Inter Bank Offered Rate) can be used as bench mark for markup in Islamic financial institutions in their financing activities.

Conventional institutions manage the market risk using financial derivatives such as futures, forward, option or swap contracts (Chapra & Khan, 2000; p.55). *Takāful* operators face difficulty in managing market risk as these financial derivatives are not compatible with *Sharī'ah* in the eyes of Islamic scholars. However, according to Al-Suwailem (2006; pp.118-126), cooperative hedging and bi-lateral mutual adjustment are acceptable instruments under *Sharī'ah* to mitigate currency risk and interest rate risk respectively. Additionally, *Takāful* operators could apply stress tests and Value at Risk (VaR) techniques to mitigate commodity price risk and equity risk. Stress testing is one of the risk management tools that can be employed to assess the vulnerability of portfolios to abnormal shocks and market conditions. Value at Risk is the probability of portfolio losses exceeding some specified proportion.[1]

ENHANCING RISK MANAGEMENT CULTURE

Cultivation of risk management culture is extremely important to form a robust and resilient *Takāful* industry in Pakistan. This objective, however, could not be achieved without active participation and collaboration of regulatory authorities, senior management of *Takāful* companies and members of *Sharī'ah* Supervisory Board (SSB). Towards this end, regularities authorities should make sure that stress testing and Value at Risk (VaR) reports as identified above are regularly produced and obtained from senior management of *Takāful* operators in addition to reports of *Takāful* risks. Regular review of these reports will greatly facilitate the regulatory authorities as well as *Takāful* operators to enhance risk management practices in *Takāful* industry.[2]

Moreover, effective implementation of internal control and corporate governance system could prove to be of vital importance to *Takāful* operator as well as to concerned regulatory authority. It will help the authorities in effective monitoring of *Takāful* activities and managing different types of risks hence enhancing the functioning of *Takāful* operators in the industry.

Figure 1 shows the steps for effectively manage the risks in *Takāful* business. In the first step, possible risks in the way of *Takāful* business are identified. In the second step, strategies are developed to cope with and manage the risks effectively. In the third step, process of identification and strategy formulation and implementation related to each type of risk is
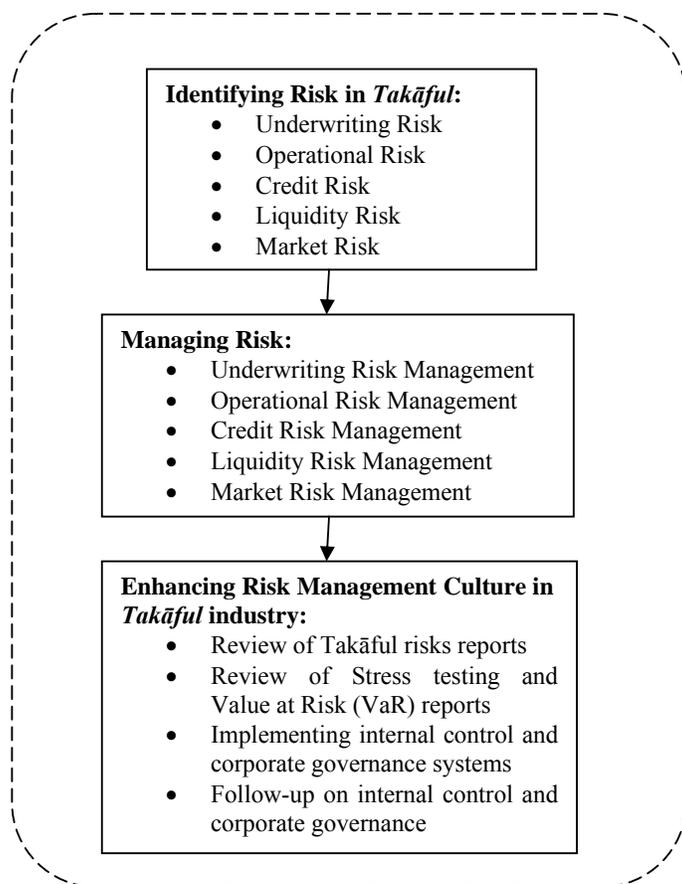
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[1] For details of stress tests and Value at Risk (VAR) techniques, see BIS (2000). *"Stress testing by large financial institutions: Current practice and aggregation issues"* and Blaschke et al. (2001). *"Stress testing for financial systems: An overview of issues, methodologies and FSAP experiences"*

[2] See Chapra, U. & Khan, T. (2000). *"Regulation and Supervision of Islamic Banks",* Occasional paper No. 3, Islamic Research Training Institute, Islamic Development Bank, Jeddah, pp. 56-57

examined through review reports and effective measures are taken to counter any flaw or discrepancy in the previous process.

FIGURE 1: FLOW CHART OF RISK MANAGEMENT IN *TAKĀFUL*

Identifying Risk in *Takāful*:
- Underwriting Risk
- Operational Risk
- Credit Risk
- Liquidity Risk
- Market Risk

Managing Risk:
- Underwriting Risk Management
- Operational Risk Management
- Credit Risk Management
- Liquidity Risk Management
- Market Risk Management

Enhancing Risk Management Culture in *Takāful* industry:
- Review of Takāful risks reports
- Review of Stress testing and Value at Risk (VaR) reports
- Implementing internal control and corporate governance systems
- Follow-up on internal control and corporate governance

CHALLENGES TO RISK MANAGEMENT

In spite of effective risk management techniques discussed above, there are certain challenges in the way of risk management for *Takāful.*

i. *Internal Controls:*

Internal controls are indispensable for recognizing and assessing risks faced by financial institutions including *Takāful* companies. Basel Committee (2005) and IAIS (2006a) reports have focused on the importance of internal controls for banking institutions as well as for conventional insurance companies respectively. Chapra and Ahmad (2002) found that existence of effective internal control have prevented the financial institutions from systemic crisis and enabled them to have early detection of problems and associated risks they might face in future. These experiences highlight the importance and need of internal controls for *Takāful* companies. Unique nature of these companies from conventional insurance demands the fulfillment of *Sharī'ah* aspects. IFSB and IAIS joint working group (2006) maintains that to have effective internal control mechanism, *Takāful* companies must ensure *Sharī'ah* controls in addition to all statutory regulations. It urges the need of a regular *Sharī'ah* audit as a part of an on-going internal control system.

ii. *Corporate Governance:*

The corporate governance structure specifies the distribution of rights and responsibilities of the Board, manager, shareholders and other stakeholders (OECD Report, 1999) yet effective corporate governance ensures the independence of board of directors (BOD) who in turn devise polices and implement strategies for risk management and hold the management accountable to shareholders (Psaros and Seamer, 2002; p.7). Lack of an effective corporate governance framework hampers the independence of board of directors (BOD) and hence poses a challenge to risk management. It in turn increases the operational risk which might result in failure of operations due to inability of BOD to implement unbiased and independent decisions for the best interest of all stakeholders. *Takāful* companies are confronted with an additional challenge related to corporate governance of *Sharī'ah* Supervisory Board (SSB). Grais and Pellegrini (2006b) identify corporate governance issues that affect their role and functioning in the organizations. It calls for a greater need to incorporate corporate governance culture to overcome related issues of *Takāful* industry.

iii. *Sharī'ah Based Challenges:*

According to Ahmed & Khan (2001), most of the risk management techniques are not applicable to Islamic financial institutions due to the requirements of *Sharī'ah* compliance. It creates *Sharī'ah* based challenges to risk management for *Takāful* companies as well. These challenges arise as *Sharī'ah* restricts the use certain instruments that are considered useful in conventional risk management e.g. derivatives (futures, options, swaps etc.) and sale of debts. Al-Suwailem (2006, pp.89-90) argues that *Sharī'ah* constraints to human behavior do not hinder creativity, rather these constraints are the major driving force behind the creation of innovative financial instruments. He suggests several Islamic financial instruments for risk management and concludes that *Sharī'ah* is abundant with real solutions to the present problems of gambling and speculation. It provides directions to *Sharī'ah* scholars and experts of Islamic finance to explore the dimensions of *Sharī'ah* in order to integrate risk management practices with value creation.

iv. *Financial Engineering:*

Financial engineering aims at designing new and innovative *Sharī'ah* compliant Islamic financial instruments for IFIs including *Takāful* companies. Chapra and Ahmad (2002) maintain that financial engineering has emerged as the greatest challenge faced by *Sharī'ah* scholars of present time as it poses major threat to IFIs to become competitive in the contemporary business environment. Process of giving *fatwās* by *Sharī'ah* scholars regarding the permissibility of a financial instrument is quite slow and over-conservative (Iqbal et al, 1998; pp.47-48) as *Sharī'ah* scholars and experts of modern finance have different academic backgrounds. They use technical terms related to their own field that are most of the time not easily understandable to other party. The need is to produce scholars with *Sharī'ah* background that also have working knowledge of modern finance to meet the acute challenge of financial engineering.

v. *Islamic Financial Market:*

Islamic financial market provides a secondary market for trading of Islamic financial instruments. In the absence of this market, it will be extremely difficult for *Takāful* companies to maintain its liquidity position to make prompt claim payments when they become due. Retaining a large portion of *Takāful* fund to maintain high liquidity ratio will affect the efficiency of the firm and its competitiveness as compared to conventional insurance companies that have ready access to liquid bonds and t-bills. Islamic Financial Market will greatly facilitate the *Takāful* companies to invest large portion of their fund in Islamic financial instruments and increasing their efficiency and competitiveness while maintaining low liquidity ratio. It will also help *Takāful* companies in hedging market risk by providing alternative instruments to financial derivatives that are not acceptable under *Shari'ah*.

vi.   *Need of Private Credit Rating Agencies:*

Although International Islamic Rating Agency (IIRA) has been set up in Bahrain to judge the *Sharī'ah* compliance and financial strength of Islamic financial institutions (IFIs) including *Takāful* companies, it is not be possible for IIRA to rate thousands of counterparties with whom *Takāful* companies deal. Consequently, it calls for the need of private credit rating agencies in each Muslim country that could provide information related to financial strengthen, fiduciary risk and credit worthiness of thousands of counterparties that privately issue financial instruments (Chapra & Ahmed, 2002; pp.80-81). This information could provide great help to IIRA in rating these companies and make it readily available to *Takāful* companies and other interested parties.

CONCLUSION AND RECOMMENDATIONS

Risk management is of vital importance in Islam and *Takāful* provides a way to manage risks in business according to *Sharī'ah* principles. Five types of risks have been identified in *Takāful* business that affect operational and investment functions of *Takāful* operator. Operational risk can be managed by enhancing corporate governance culture in the organizations. Cash flow modeling and use of liquidity ratios is quite helpful to identify liquidity constraints. *Takāful* operators might face difficulty in managing market and credit risks as *Sharī'ah* compliant nature of *Takāful* contract does not allow *Takāful* companies to deal with interest rate and financial derivatives due to their speculative nature by which they tend to benefit one party at the loss of other. On the other hand, Islamic financial instruments like cooperative hedging and bi-lateral mutual adjustment aim at providing mutual gains to both parties by the way of risk sharing.

Risks associated to *Takāful* have raised several challenges that need to be encountered to enhance risk management practices. Regular *Sharī'ah* audit is found to be an integral part of effective internal controls that prevent the companies from systemic crisis. Corporate governance calls for independence of BOD to devise policies for effective risk management, make unbiased decisions and resolve issues related to functioning of SSB. *Sharī'ah* based challenges call for devising innovative Islamic financial instruments as *Sharī'ah* is abundant with real solutions to present business dilemma and does not hinder creativity. Exploring those solutions will help to meet the challenge of financial engineering. Islamic financial market will greatly facilitate the task of *Takāful* companies to invest large portion of their fund in Islamic financial instruments and increase their efficiency and competitiveness. There is need to establish private credit rating agencies that could assist IIRA to rate thousands of counterparties for the benefit of *Takāful* operators.

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HUMAN POWERED WEARABLE BATTERY CHARGER

Sohaib Rehman,   **Prof. Dr. M. Akbar,**   **Dr. Saad Rehman,**
NUML   NUML   NUST

ABSTRACT

Despite major advances in portable electronics, batteries have changed little. Even so, they continue to be the main power source for portable products. Apart from many advantages, the use of batteries can be cumbersome as well; they run out of energy when you need them the most, they're not always available, and they have to be replaced in a troublesome way. Also batteries are quite an expensive power source in the long run especially in energy consuming applications. As a consequence of the increasing number of battery powered portable products, the environmental impact of battery use is also increasing. This paper explores a better design of a system that utilizes a dead battery or recharges a battery while in use by means of human energy. This work is an attempt to improve the output of the harvesting design first carried out at MIT media lab.

INTRODUCTION

A substantial amount of research is being done to reduce the environmental impact of portable products, in part focusing on the use of alternative power sources such as human power. The foremost goal of this project is to explore and experiment with the energy obtained from human body and to convert it to power electronic consumer products.

The goal of this project as described earlier is to explore and experiment with the energy obtained from human body and to convert it to power electronic consumer products. After having analyzed the current electronic devices on power consumption, marketing and aesthetic aspects, a problem definition was compiled comprising the following issues: reliability, comfort and environment.

In the analysis phase of the project, a flow diagram, as shown in fig 1, has been designed to model the energy input and output of the electronic device.

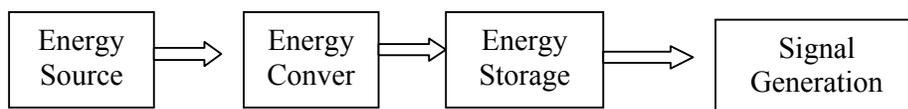| Energy Source		Energy Conver		Energy Storage		Signal Generation

Fig 1. Flow chart of energy analysis

SUITABLE ENERGY SOURCE

Previous researches shows that the most suitable way to harvest most of human energy is while walking or sprinting. The reason being is that the traveller puts up to 30 percent more force on the balls of his feet than that provided by body weight[1]. Thus it was decided to harvest human energy in this project via walking. For this reason the peizo sensor have to be fixed in the shoe sole. As shown in the fig 2 the sensor is fixed in the shoe sole where the heel will be in contact with the sensor.

Further, the capacitance of the bimorph source was determined (at both 1 kHz and 10 kHz) to be 143 nF. That value is intuitively tenable given the bimorph insert is a parallel electrical connection of two "TH 6-R" devices."[6]

The pressure is applied on the dome shape of the sensor. The terminals of the sensor is shown in fig 2. As seen the sensor produce charge when the pressure is applied. The charge produced is in the form of a pulse. To keep the charge flowing through the sensor terminals we have to apply force on the sensor with some frequency depending upon the charge required. The sensor requirements and its physical limitations are mentioned in the data sheet. Keeping them in mind we can use this sensor to convert mechanical force into electrical charge and vice versa[6].

The sensor is shown in the following figure.

Fig 2. TH-6R Peizo Electric Sensor [5].

ALTERNATIVE ENERGY SOURCE

As we know that capacity to do work is known as energy. *Energy is measured in Joules (J acting through a distance of one meter.). A joule (kg × m2/sec2, i.e., kilogram multiplied by meters squared divided by seconds squared) is the product of a force of one newton [2].*

The first block of the flow diagram(Fig 1) deals with the probable sources of mechanical energy(acting as input) obtained from the human movement that can be converted in to efficient electric energy. The energy type from the user can either be kinetic (muscle power/body motion), electric (skin potential) or thermal (body heat). The last two possibilities have been found to provide an insufficient amount of energy and are therefore discarded. The first type of energy (muscle power) can be divided in to two categories: 'active' and 'passive', the distinction is made on the basis of level of awareness of the user while delivering energy to a device[1]. As example of passive use of human power is the generator inside so-called 'kinetic watches' of various brands; it converts the movement of the wrist into electricity to power the watch. An example of active power is the use of the hand while gripping, squeezing or pinching[1].

The table provides a perspective on the amount of power used by the human body during various activities. Everyday human activity consumes power at a rate of 81-1630W. Bearing in mind that any technique that parasitically harvests background energy from unrelated human activity must be totally unobtrusive to be commonly adopted, perhaps a couple of watts might be scavenged somewhere for a mobile phone or on-body human computer without putting an onerous load on the user, this design project examines this possibility with respect to power recovery from body heat, breathing, blood pressure, typing, arm motion, pedaling, and walking. A summary of the potentially scavengable power and the total power from, various body-centered actions is also provided.

Note, however, that energy harvested from the user may require considerable conditioning (storage, voltage/current or impedance conversion, etc) before it can be used for any application.

Human energy expenditures for selected activities are summarized in table 1[1].

Table 1 Human energy expenditures for selected activities [1]

Activity	Kilo-cal/Hr	Watts
Sleeping	70	81
Lying quietly	80	93
Sitting	100	116
Standing at ease	110	128
Conversation	110	128
Eating meal	110	128
Strolling	140	163
Playing an instrument	140	163
Driving car	140	163
House keeping	150	175
Carpentry	230	268
Hiking 4mph	350	407
Swimming	500	582
Mountain climbing	600	698
Long distance run	900	1,048
Sprinting	1,400	1,630

ENERGY CONVERSION

A suitable and specific sensor was required which was efficient enough to convert the pressure energy in to charge which can be utilized to charger and sort of battery. Thus after a number of days of research a *Peizo Electric* sensor manufactured only by *Face International* was found which was initially used by MIT students. There was a variety of sensors available which could be used in this project but TH-6R was preferred over others since it was already tested by MIT and secondly the physical limitations of other sensor were beyond this project.

Thus the energy produced by the human while walking was the best way to recover wasted energy using a Peizo material (sensor) like TH-6R. This will be explained in detail later in this thesis report.

The sensor shown in figure 2 is used to convert mechanical energy in to electrical energy. The mechanical energy is in the form of pressure exerted by the hell of the human feet.

ENERGY STORAGE

The storage of energy converted is an important issue. There are number of ways to store the energy converted. This thesis is based on storing the converted energy. The project was to charge a battery using human energy, and this is the way the energy is being stored in the form of electric charge. This electric charge then can be utilized anywhere required. The enhancement of this project can lead us to charge a cell phone battery which would be a great achievement in the field of Human Powered Wearable Computing.

In this thesis the battery used for storage is a low specification battery which is explained in later. The storage efficiency is also not great but the best part of this project is that the battery is

being charged without any external voltage source. The only source of charging the battery is human itself and that is possible during the walking.

DESIGN

Human powered wearable computing circuit designed at MIT was our start point. The circuit is shown in fig 3[3]. Our goal was to charge a battery using the concept of MIT research. We were successful to charge a battery without any power source except the TH 6-R sensor. The beauty of this design is that a battery can be charged where ever and whenever we want to.
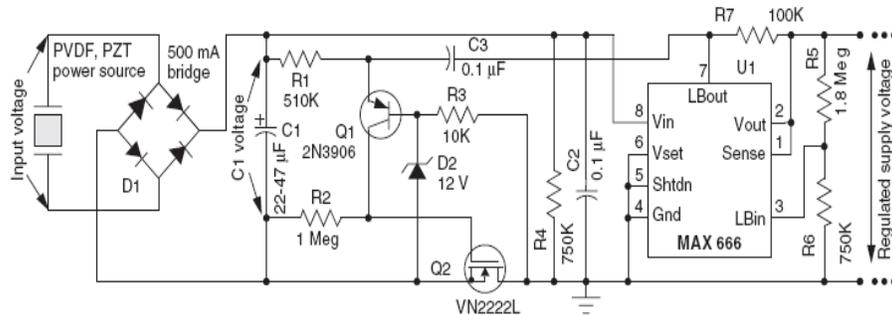
Fig. 3 RF-ID Circuit (MIT Design)

A number of problems were faced during the design stage of the project. Charging a battery using an independent source which works on its own and provides enough power to charge a battery was the main aim of our design. MIT design was using RFID. Our design is different since load was different as compared to MIT design. We had to make some changes in the original design to make it more suitable to charge a battery.

MIT media lab's design was analysed in detail, and short comings and unnecessary current drains within the circuit which reduced the efficiency and overall power scavenged were identified. These are listed as under:

- The biasing resistor R3, shown in fig. 3, causes the premature activation of the latch i.e. when only 9V have appeared on the capacitor. The reason being that R3 forces the bypassing of the 12 V zener diode by providing the current with an alternate source to the ground, activating Q1 and hence Q2. The result is a drastically reduced duty cycle at the output.

- The 750K resistor (R4) and the 0.1uF capacitor (C2) were unnecessary as they create a small RC drain within the circuit. So, these were removed[11].

- With mathematical calculations we found that a 13V zener diode helps to increase power ratings at the output by limiting the current drive of the latch. This was achieved by increasing the value of biasing resistor R1.

- By using the relationship between energy transfers of capacitors of differing size, we found it slightly more efficient to use a capacitor of smaller size[11].

- The feedback from the regulator IC to deactivate the latch wasn't required as the RC discharge of the capacitor C1 is fast. The feedback only created an unnecessary current drain via the latch and inefficient charging of the capacitor. Hence, the latch was eliminated.

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The latch present in MIT design shown in fig 3 was redesigned, shown in fig 4, according to the steps discussed above.
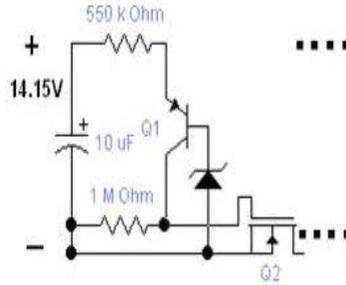

Fig 4: Isolating the latch and calculating current drive for it.

Amount of current drained in the latch shown in fig. 4 can be calculated as:

(When latch is active, VE=13.6V)

$$IE = \frac{14.14 - VE}{RE} = \frac{14.14 - 13.6}{550K}$$

$$IE = 1\mu A$$

$$(\beta = 100 \Longrightarrow \alpha = 0.99)$$

$$IC = \alpha \times IE = 0.99\mu A$$

$$IB = IE - IC = 0.01\mu A$$

$$VC = IC.RC + (-14.14) = -13.5V \qquad (1)$$

Now, for **Q2**

$$VGS = -13.5 - (-14.5) = 1V \qquad (2)$$

$$VDS = -5 - (-14.5) = 9.5V \qquad (3)$$

(Where VGS is enough to induce a channel for the NMOS and make it functional)

The current flowing through the latch is as small as 1 µA, hence justifying our claim for a reduced current that flows through the latch.

After all the reconditioning and modifications, the final successful design of a human powered battery charger was complete as shown in fig 5.

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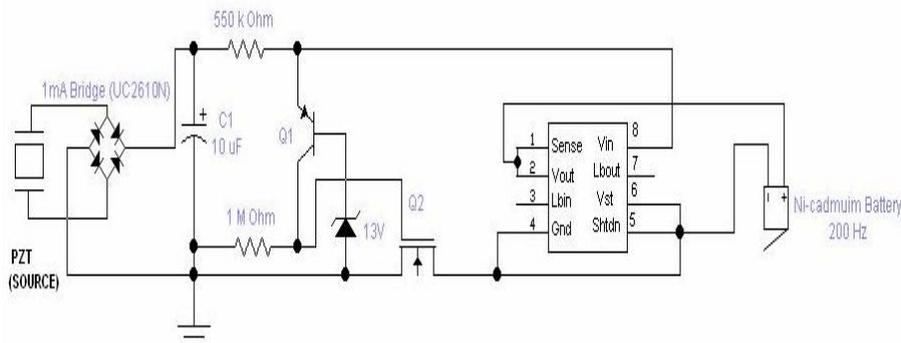
Fig 5: Modified circuit for battery Recharging

Since the design is low powered, the maximum current we noticed during the circuit design was 10mA. Initially we intended to use 4 schottkey Diodes rather than UC2610N IC. The output and the schottkey diodes were more of a power loss for the circuit and was not helping the great deal. Since this design was low powered we made another change by replacing the schottky diodes by a schottky IC (UC2610N).

The characteristic curve of the UC2610N[7] shows its better performance as compared to the schottky diodes. Forward current Vs Voltage graph is shown in fig. 6.
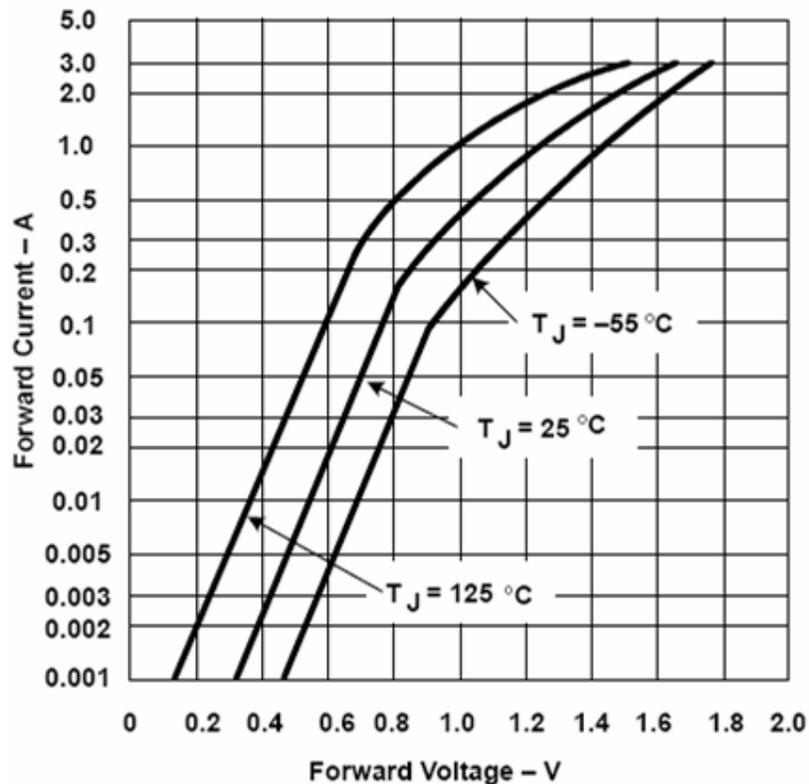
Fig 6 Forward Current Vs Voltage [7]

The characteristic curves when compared to those of the schottky diode used, the difference was clear. The current ratings for the UC2610N was better than the schottky diode we used and also the conduction voltage. Characteristics of the schottky diodes used in our initial design re shown in fig 7.
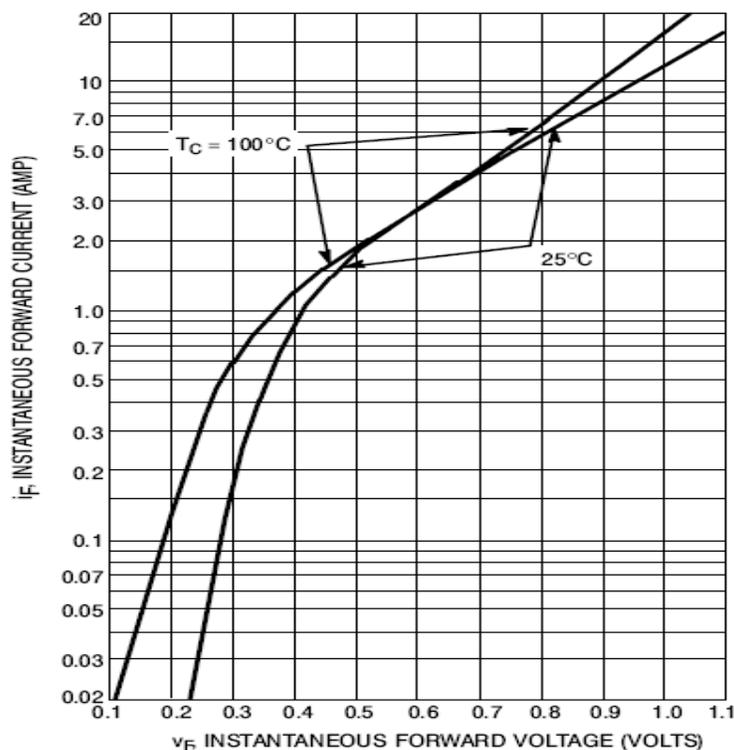
16

Fig 7 Forward Current vs Voltage [12]

The performance comparison shows that the diodes used in our design were more stable since there is less change in forward current for every change in voltage.

The signal rectified by the UC2610N IC was then used to charge a capacitor of 10µF. The capacitor was then used as an input to the latch shown in fig. 4. The latch input is through 2N3906 [9] which is a P-N-P transistor. This transistor is actually being used as a switch. When there is a 13.6 volts at the emitter of the 2N3906 transistor, it activates the latch shown in fig 4. the minimum 13.6 voltage required to activate the latch is because there is a 13V zener diode attached at the base of the transistor and also a 0.6 V functional drop at the transistor junction. As soon as the capacitor discharges below 13.6 volts the transistor Q1 deactivates the latch and waits for the capacitor to be charged to 13.6 volts which is possible when we apply the pressure on the sensor again.

The MOSFET in the circuit is used as a connecting path to MAX666 regulator IC [8]. As soon as there is a 13.6 V on the capacitor and the transistor Q1 is activated, the path for the current is established so it can be regulated by the MAX666 IC.

The zener diode plays an important role is this circuit. It us used to hold to the Q1 in a non active mode so that the capacitor charges up to the required minimum voltage. The minimum voltage required across the Q1 is 13.6V. 13 volts is because of the zener diode and 0.6 volts is the junction voltage of the transistor as explained above.

MAX666 is an IC regulator manufactured by MAXIM. This IC has number of functions. It senses its input every time and regulates the voltage to 5 volts accordingly. MAX666 can be used either as 5 volts, fixed output regulators with no additional components, or it can be adjusted from 1.3V to 16V using two external resistors. MAX66X series is ideally suitable for

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battery powered systems, has an input voltage range from 2 to 16 Volts and an output current capability of 40mA. MAX666 IC in this project is used to regulate the inconsistent current supply from the source to a regulated voltage of approximately 5 Volts. The input of the MAX666 IC is connected via a path from Q2[10] (VN2222L). As discussed above Q2 act as a connecting path between MAX666 and the rest of the circuit. The input signal is then regulated to a voltage and is then used to charge a battery connected at its output.

BATTERY CHARGING

We succeeded in charging a Nickel cadmium battery. Although there was no specific way to show the charging process. An LED was connected in series with the battery which blinked each time there was a voltage spike at the output. This was the best possible test to show the charging process, as the Peizo element and the power conditioning circuitry had to be mounted on a shoe.

The efficiency of the charging battery would be very low as the amount of current compared to the battery's capacity was too low. A nickel metal hydride battery would have charged up much more efficiently. Unfortunately, this battery wasn't available. The Ni-Cd battery used in this project would take about 1 day to be charged completely by the human powered wearable computing circuit designed. The Ni-Cd battery used in this project was 80 mAh. The output voltage was approximately 5 Volts. The output current was variable depending on the frequency and the amount of pressure applied on the sensor. So on the average the output current was taken as 7mA.

According to the specifications of the battery, if it is supplied 80 mA, it will take an hour to charge the battery. The output current in this circuit was found out as 7 mA on average. Thus, the output power was calculated as,

$$P_{out} = I_{out} \text{ x } V_{out} \qquad (4)$$

$$= 7 \text{ mA x 5 V}$$

$$= 35 \text{ Watts.}$$

That is the output power the circuit had. The power required for the battery to be charged in an hour is calculated below.

$$P_{out} = I_{out} \text{ x } V_{out} \qquad (5)$$

$$= 80 \text{ mA x 5 V}$$

$$= 400 \text{ Watts}$$

According to the above calculations it is clear that the power required to charge the NI-Cd battery is 11 times (approximately) more than that of the power produced by the designed circuit.

$$\text{Time Required to Charge the battery} = 400 \text{ watts } / 35 \text{ watts}$$

$$= 11.4 \text{ Hours.}$$

Thus, the design will take approximately 11 hours to charge a battery. The results don't look efficient at all but keeping in mind the charge that is produced by the sensor when pressure is applied on it plays an important role. The greater the charge the larger the current is.

CIRCUIT PCB LAYOUT AND DESIGN

The final PCB design was laid out using DIPTRACE. The PCB layout was designed to ensure least amount of interconnections. The layout is shown in the fig. 8.
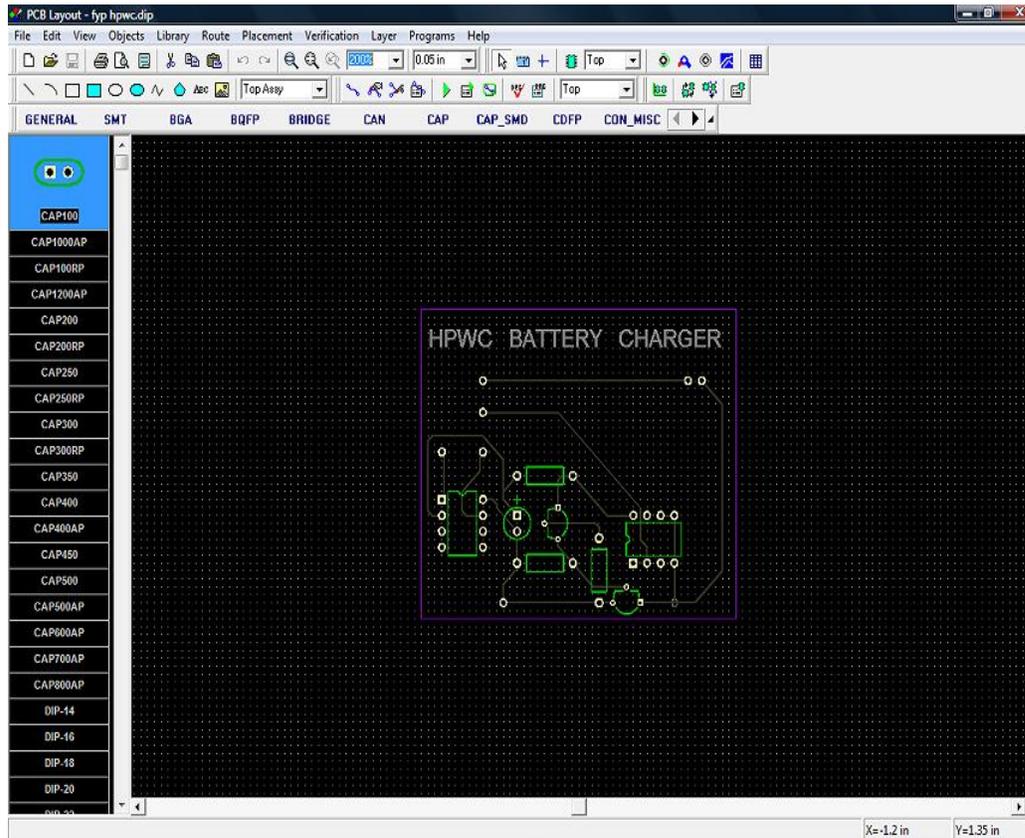

Fig 8 PCB Layout of the design.

CONCLUSION

We succeeded in charging a Nickel cadmium battery. Although there was no specific way to show the charging process. we connected an LED in series with the battery which blinked each time there was a voltage spike at the output. This was the best possible test to show the charging process, as the piezo element and the power conditioning circuitry had to be mounted on a shoe. The efficiency of the charging battery would be very low as the amount of current compared to the battery's capacity was too low. A nickel metal hydride battery would have charged up much more efficiently. Unfortunately, this battery wasn't available to us.

This project was almost 70% successful in achieving its goal. We were able to recreate the results achieved from earlier work into the PZT system with improved efficiency - from utilization, to the application of charging a battery. In future a wireless charging of battery will be a new source of energy. Charging a battery in a wireless mode will be a new field and it can be as common as a cell phone these days. Charging a battery using a transmitter receiver kit is

totally a new concept just like charging a battery using human energy. With a powerful source this wireless power transfer can be used in number of applications and it will be a great achievement.

From research we found that no suitable IC's exist for the high voltage low current transients present in the piezo-electric systems studied. The trend is towards medium voltage and medium current. In the future, if an IC can be integrated into the power conditioning circuitry of the shoe there is up to 50% ore energy available from the course using the open circuit PZT calculations.

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MOBILE COMMUNICATIONS & SOCIAL DEVELOPMENT
: PROS & CONS

Dr Irfan Zafar
National Univeristy of Modern Languages

ABSTRACT:

Broadly speaking, technology should be developed and adopted for benefit of mankind. Unfortunately there are very few technologies to date from which middle class and poor people can benefit, especially in the under developed countries like Pakistan.
This paper discusses the penetration of Mobile Communications in different segments of society, its usage trends, life style effects, growth factors, value addition, security, coverage and the role played by it in the social development of the masses while keeping a close watch on its fallouts and the negative effects. Various factors have been studied in this research to ascertain various variables which have contributed towards the growth of mobiles and subsequently understanding the social impact on the society at large. The paper gives a road map for the future development and deployment of mobile communication infrastructures in the under developed areas of the country and further exploring potentials in the already developed market areas.
Like all other technologies mobiles too have their positive and negative effects on the society and its norms. This paper further discusses the positive and negative effects of mobile communications on social life in Pakistan.

BACKGROUND:

In Pakistan mobile communication started quite late as compared to the rest of the world. Mobile communications was first started in Pakistan by two cellular companies; Paktel (1991) and Mobilink (1994) based on AMPS (Advanced Mobile Phone Systems) and GSM (Global System for Mobile Communications) technologies, respectively. Initially the services were only offered in the major cities of Pakistan because of huge investments involved in the procurement and deployment of the telecom infrastructures and the monetary concerns of the operators in terms of return on investment's (ROI's).

In the start due to the high cost of mobiles and the SIM's (Subscriber Identity Module) cellular communication was only adapted by the elite class of Pakistan as a status symbol. Another factor contributing to this slow growth was the fragile economic condition of the country in 90's with low per capita income thus making mobiles out of reach of the middle and lower classes. However starting 2000 and in the subsequent years, Pakistan's economy started to show signs of recovery with increasing per capita income thus making the overall condition of the people a bit better.

In the meantime Pakistan Telecommunication Authority (PTA) also started implementing its de-regulation policy which attracted more operators and vendors thus increasing competition and compelling the operators to lower their prices. All these factors attracted the customers from all the classes of the society. As a consequence of decreasing rates of mobile equipment, SIMs, call rates and increasing coverage, more people were attracted towards mobiles. A communication revolution thus took place in Pakistan. Social life of the people changed the way people worked.

Today there are five mobile service operators in Pakistan which are Zong (merging of Paktel & Instaphone), Mobilink, Telenor, Warid & UFone with cellular density reaching to 58.2% for fiscal year 2008-09 (July 2008 - June 2009) **[1]**. According to Pakistan Telecommunications

Authority (PTA), approximately 2.7 million subscribers are added monthly. In fact Pakistan has the highest mobile penetration rate in the region. All mobile companies are now working to broaden their network in AJK and Northern Areas which were ignored previously. In 2006 GSMA awarded Pakistan Government leadership award for the exceptional growth of mobile industry in Pakistan [2].

MATERIAL & METHODS:

This paper thus discusses the reasons and social effects of mobile communications on Pakistani society through a survey, asking people's opinions about mobiles effects on social life. Five mobile operators were studied with samples from 100 users of each company were analyzed. A total number of 600 users were interviewed and questionnaire given. The questionnaire incorporating various factors as detailed in this paper was distributed among people from all walks of life, different ages, genders and income classes. The results are compiled and based on people's opinion analysis made and the conclusions drawn.

RESULTS:

There are various factors which have been studied in depth in this research paper for the researchers to ascertain various variables which have contributed towards the growth of mobiles and subsequently understanding the social impact on the society at large.

- PRICE REDUCTION

If you ask anyone in Pakistan a single factor for the growth and popularity of mobiles you will get a patent answer regardless of income level of the person i.e. price reduction; the answer you should expect from a third world country where quality of service is not much of a consideration in general. The statistics also supports this fact.

Mobiles came to Pakistan in early 90s but they only became popular after 2000 with the economic growth showing slight improvement and more importantly as a result of more operators coming in and reducing their call rates. There was a time when people would use the mobile phone just to be contacted by others (incoming calls) as call rates were too high and as the majority of population of Pakistan is classified/belongs to middle or lower income category and they could not really afford the rates that the operators offered initially. Thanks to increasing competition, people can now even call @ 50 paisas per 30 seconds [3] and some operators even offering less than that thus making mobile calls even cheaper than the local landline calls. This attracts people to make more and more calls because when the calls were expensive people used to prefer SMS as it was cheaper. Today when there is not much difference between SMS and calls people prefer calls to convey message. Another factor is that it is also a bit time consuming typing SMS messages.

Not only country wide mobile calls are becoming cheaper, international calls and SMS are becoming cheaper too. The most important thing to note is that even the lowest income groups/segments of the society like cobblers, daily wages workers also use mobiles nowadays. This is most appreciable aspect of the technology to be equally used by all the income classes of Pakistan and the technology should benefit whole mankind irrespective of their income class. Another important/contributing factor is the reduced mobile set prices because after all it's essentially the mobile set you need even if the connection and the call rates are cheaper. Mobile sets prices have also reduced considerably because of the growing competition with many new mobile manufacturing companies offering prices as low as Rs 500 for a basic mobile set.

- EASY LOAD PACKAGES

There was a time (2005) when people used to load credit in the mobile phones after 6 months i.e. just before the end of the package to save the number from being blocked. Cards were expensive even four years (2005) back with minimum 250 rupees card available which was out of reach of many poor people.

Telenor for the first time made history by allowing people to recharge as low as Rs 10. The name of the package was Easy load **[4]**. The package gave the flexibility of recharging pre-pay account from Rs 10 to 1000. The package was greatly appreciated by the customers and became very popular. Other operators too followed the suite by introducing their easy load packages. The package gave people the flexibility of recharging account according to their use and budget.
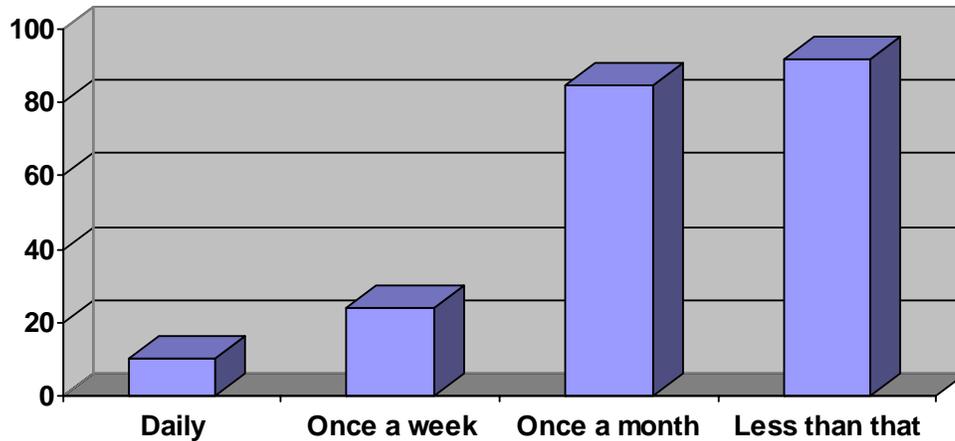
Figure 1: Recharging account

Graph 1 shows the results of the question asked from people that how often they recharge their account (in terms of percentages). As expected daily recharges were very few. Typically two types of people fall in this category; first those who load fewer amounts for example say Rs 10 to 40, finish it up/consume that very day and then load the amount again next day. Second ones are those whose usage is very high. Once a month loaders are typically employees working in different organizations who load in the start of the month when they get the pay and also includes the students who get pocket money from their parents or elders in the start of the month. Similarly there are people who have very less monthly pay and even can't afford to load monthly hence recharging their account after six months.

- INCREASED COVERAGE

Initially the coverage of mobile phones was limited only to major cities which was a bottleneck in the growth of the mobile industry. Eventually companies felt the need for greater coverage to make mobile phones "truly mobile". The good part was that they targeted villages and far flung areas where tele-density was low; as a result they got overwhelming response from the people which encouraged them to further increase their coverage areas. Now most of the mobile operators are targeting Northern and Southern Pakistan even in smallest towns and villages.

The Figure 2 below shows the response from public relating to question asked about the major reasons for the growth of mobile industry.
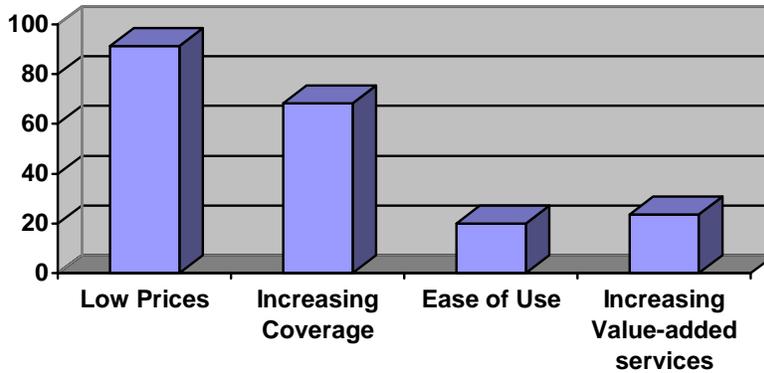
Figure 2: Reasons for mobile industry growth

- INCREASING VALUE-ADDED SERVICES

As the number of educated people in Pakistan has grown **[5].** so has the awareness among the people. Mobile phones are no longer used now just for making calls and sending SMS (Short Message Service); people now want more than that. Currently a number of people using value-added services is low primarily due to two reasons; the mobile sets that support these services such as Wireless Access protocol (WAP), Multi Media Services (MMS), and General Packet Radio Service (GPRS) etc. are expensive and secondly the rates of using these services are too high. However this trend is changing and it can be further improved when the mobile prices and service charges will come down. Currently these services are typically used by two types of people; business class managers who can't afford getting offline even in the car and those people living abroad sharing their pictures and videos with their relatives back home.
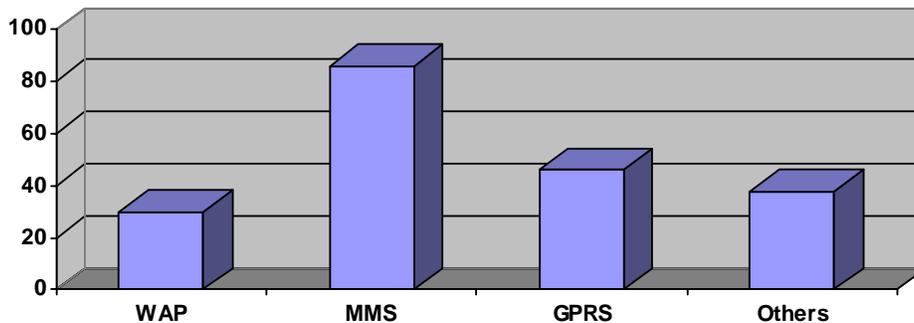
Figure 3: Value-added services usage (the figure shows only the value added services usage patterns of those people who use these services).

In "others" category (figure 3), there are several operator specific services provided only by certain operators such as a service launched by Telenor named Mobile TV and even some operators provide car security services installing devices in the cars and communicating through their base-transceiver systems.

- EASE OF USE

There was a time when it would take months to have a landline connection at home after submitting the application. The process was very slow and people had to go from one office to another for getting the connection. At that time they had no other option because of the monopoly of Pakistan Telecommunication Company Limited (PTCL) in Pakistan. But today

people get SIM on the spot just by filling in the application form and take away the SIM and get connected immediately on the spot. As the prices of mobile calls are comparable and in some cases even less than local calls people have started preferring mobiles instead of getting a landline number.

- SENSE OF SECURITY

The feel of "connectedness" everywhere gives people a sense of security. Especially parents feel relaxed when their children are out in the school, with friends or on picnic thus enabling them to know about their whereabouts any time. This is also the case with people who have a kind of job where they have to move constantly from place to place while staying connected with their families and businesses while on the go.

- STRONGER SOCIAL CONNECTEDNESS

Mobile phones have eliminated the distances with people staying connected to their friends and relatives easily and cost effectively all the time. By social connectedness it means that today people can easily talk to the person they want to at once which was not the case previously with the landline phones as usually the person you were calling wasn't available.

Figure 4 shows the results of a question asked from people: "Does the mobile phone provide new opportunities for broader and stronger social connectedness?"
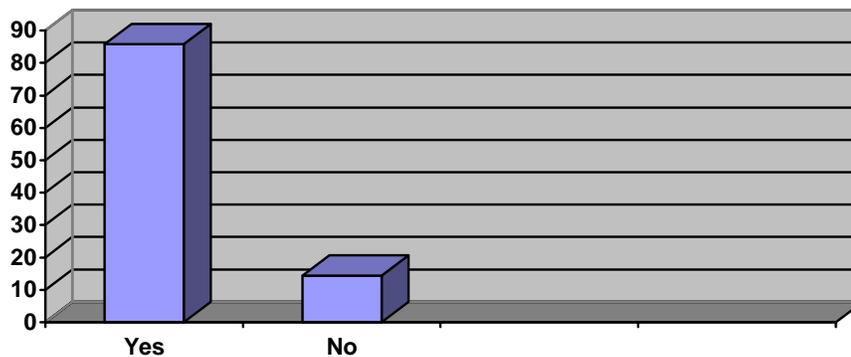

Figure 4: Mobiles and Social Connectedness

One would be astonished by the "No" answers but it is not very strange. The people who gave "No" answer were of the opinion that though mobiles have decreased the distances among people living at far away places but have definitely increased the distances among people physically close to each other as new technologies specially internet and mobile phones keep the new generation so much busy that they don't have time to meet close relatives and friends with even in some families it is a routine that parents and children meeting each other at weekends only.

- CHANGING LIFESTYLES

Eid cards were considered a hot item and their selling a viable business opportunity at least five years back but same is the case no more. The EID cards in the first phase of the electronic revolution have been gradually replaced by Electronic greeting cards via internet. However today sending e-cards on the net has been replaced by simply sending more convenient SMS messages. This is not just only restricted to EID but also hold true for other occasions, like weddings, engagements, child birth and other special occasions. The most appealing factor

towards this trend is the cost effectiveness and time savings. There are some packages offered by mobile operators where after subscribing you can send SMS at the rate of just few paisas. It is much easier for most of the people to type and send greetings instantly to their friends and relatives instead of logging on to internet and send e-greetings.

Figure 5 shows the results of a question asked regarding which medium people use the most to send greetings to their near and dear ones.
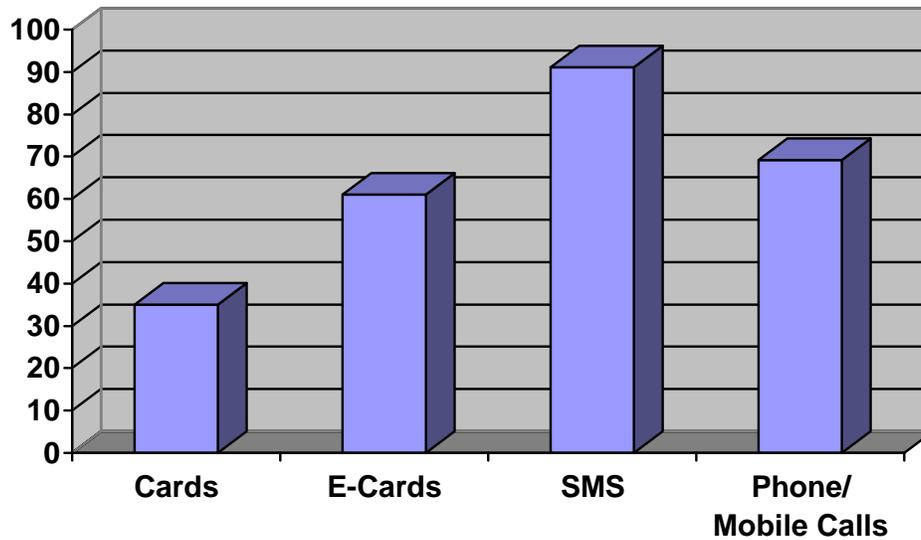

Figure 5: Medium of greetings

- MOBILE: ALL ROUNDER EQUIPMENT

Mobile equipment nowadays are not used only for making calls and SMS, there is much more than that; a camera, an MP3 player, FM Radio, a minicomputer and complete multimedia facilities. In fact buying a new mobile today isn't as easy as it was few years back where you had only to bargain for price and look for good shape. Now people find it difficult making choice of the mobile for the kind of facilities they are interested in.

The Figures (6.1 and 6.2) show the preference's of people for buying a new mobile:
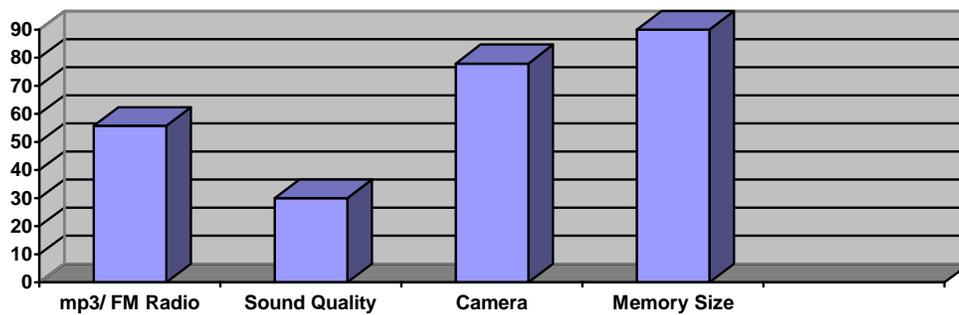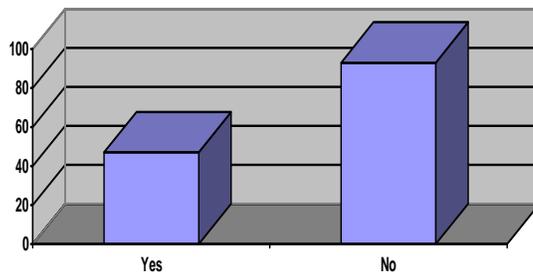

Figure 6.1
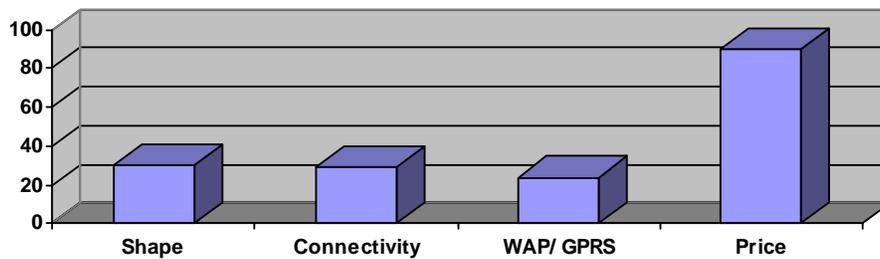
Figure 6.2

- NEGATIVE EFFECTS OF MOBILES

(i) Increased Working Hours

There was a time when people would take a sigh or relief after returning from offices but gone are the days. Now because of the presence of the mobile phone you in fact carry your office to your home thus compromising on the family privacy and other obligations. Initially people got rid of this situation by turning their cell phones off but now the companies compel them to keep their cell phones always on. The Figure 7 below shows the results of the question asked whether mobiles have increased their working hours:


Figure 7: Have mobiles increased working hours?

You might infer from the results that the number of people who think mobiles have increased their working hours is less. However this fact is basically a self deception instinct of denial as a psyche coming out from human nature to justify one's life style without realizing its fallouts and turning one's face away from reality.

(ii) Increasing distances

Seems a contradictory statement, but not contradictory enough. Refer to the Graph 4 results. Many people think that mobiles have decreased the distances between people living apart, but they have increased the physical interactions between human beings. There are many people one will find who call their friends/relatives in foreign countries daily but have no time to meet their friends and family living just close to one's homes. Mobile phones along with internet are the main contributories to these factors and social trends. The social gatherings among friends and relatives are decreasing. People are closer to digital equipment than people. Human bondings have some how vanished from the scene. Figure 8 shows some results of this analysis.
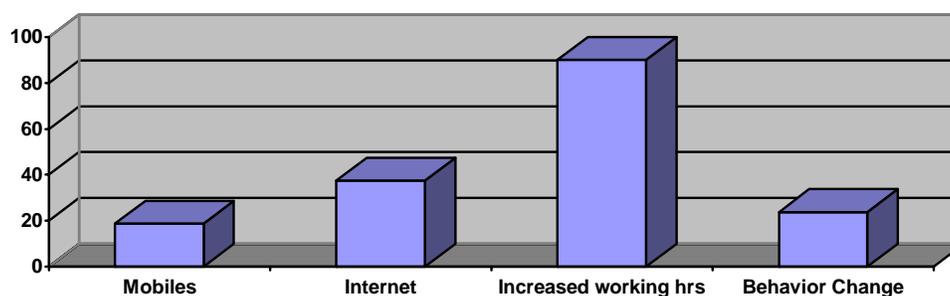
Figure 8: Decreasing social distances

(iii) Bad mobile etiquettes

In most of the worshiping places (Mosque etc) silence is required so that people can concentrate on their worship. As today there are different types of ring tones available, some are even based on movies music and are very noisy. Nowadays in some of the worship places the following phrase is written: "Close the connection with people, start the connection with GOD". Although this trend is somewhat changing as most of the people turn their cells off or keep them on the silent mode when they enter the worship places. Same is the case with funerals etc. The list of bad etiquettes doesn't end here. Lecture halls, conference rooms, board meetings, libraries and other zones where silence is mandatory suffer all the time.

(iv) Mobile Camera misuses

Although camera in mobile phones is very useful but like all other equipments, it has also been misused enormously. It is morally illegal to take the pictures or video of someone without his/her will. Incidents have happened where pictures/videos have been taken without the knowledge of the person then with the help of video editing tools they were changed to portray them in a negative manner to blackmail them.

(v) Driving Safety

Incidents have occurred where drivers were talking on the mobile and paying less attention to the roads that leading to fatal accidents. It is necessary to avoid using mobile phones not only for one's own safety but for others too.

(vi) Free Nights: Wastage of time

Nights are supposed to be the best time for the students to study in the past. Many mobile operators nowadays are offering cheapest call rates at night; some are even offering free nights. The time that young generation should spend at night for their work, they waste up by talking to friends or doing online dating. Although operators cannot alone be blamed for this as this service can be used in a positive or negative way both.

- QUALITY OF SERVICE

As the call rates are coming down, people now look for other then just the prices. Unfortunately many mobile users are not satisfied with the Quality of Service. In order to increase sales, there was and still is a trend among mobile operators to sell SIMs beyond the capacity of their networks. However many operators now have their optimization teams working on increasing

their capacity and call quality. Figure 9 shows the results of the question, asking people about Quality of Service (QOS).
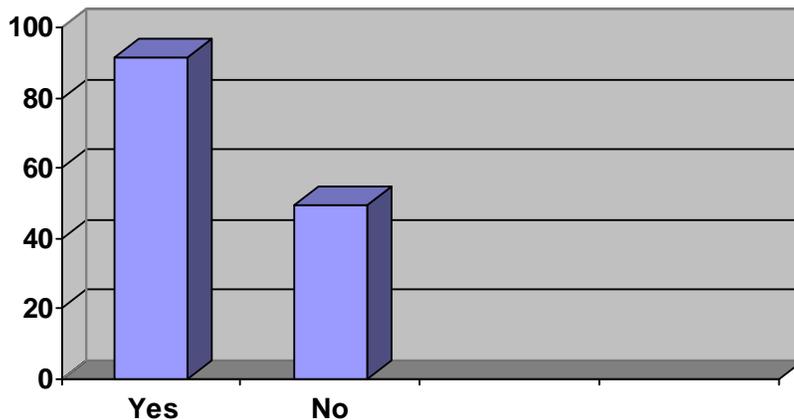
Figure 9: Are you satisfied with QOS

This Graph may not represent the true picture as it greatly depends on the usage patterns of the individual users. e.g. a person makes on average 20 calls daily out of which 18 calls are made in first attempt. He may be satisfied with QOS. However another person making only 2 calls daily and out of which only one gets connected on the first attempt, he will definitely not be satisfied with QOS.

CONCLUSION AND FUTURE TRENDS

The mobile services prices are already too low and people are no more opting for low price; now they want more than that. The most important of all is coverage. Most of the people in Pakistan generally migrate to big cities for jobs and when they select an operator they select the one that has coverage in their village too. Many mobile operators now are concentrating on this aspect. All the five mobile operators are planning and executing huge expansion projects to cater for users demand. The important thing is that now they are concentrating on small towns, villages and far flung areas so that people can enjoy "True Mobility".

Quality of Service is another major issue. The unsatisfied customer's percentage is too high. PTA is pressing hard and directing the operators to improve their quality of service. Many operators are working on it and now have their dedicated optimization teams in place for improving capacity and QOS. It is hoped that the situation will improve soon as PTA has allowed MNP (Mobile Number Portability) whereas the customers who are not satisfied with their current operator will switch to other one.

As the educated class of Pakistan is growing, people now not only use the mobile phones for just making calls but are looking more towards value added services.

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PERFORMANCE OF PARALLEL CONCATENATED CONVOLUTIONAL CODES (PCCC) ON CHANNELS

Sajjad Ahmed Ghauri, Hannan Adeel
National University of Modern Langauges

Abstract— The performance of Parallel Concatenated Convolutional Codes on AWGN channel and Raleigh Frequency non Selective (Flat) slow & fast fading channel is evaluated in this paper. In digital communication system the PCCC are used for error protection. PCCC encoder comprises of recursive systematic convolutional codes (RSCC) encoder. The iterative decoding is the main aspect of PCCC. The PCCC decoding algorithms used in paper are BCJR algorithm and PCCC decoding algorithm. Binary phase shift keying (BPSK) modulation technique is used in the paper. The performance is evolved on different fading channels i.e. AWGN, Rayleigh Flat Slow Fading Channel and Rayleigh Flat Fast Fading Channel. Bit error rate (BER) versus Signal to noise ratio (SNR) plots are used as performance measurement throughout the simulations.

Index Terms—SNR, PCCC, RSCC, BER

INTRODUCTION

In Digital Communication system design channel coding improves the error performance by inserting redundancy, memory and mapping message sequences into code sequences to transmission. From Shannon theory, better performances are achieved while increasing constraint length or memory in case of convolutional codes or codeword length in block codes. However, increasing constraint memory or codeword length the complexity of maximum likelihood (ML) decoding algorithms increases. Therefore, a question for coding theory scientists to design codes whose performance near the Shannon capacity limit.

Research in error correcting coding is aimed at the construction of such powerful codes that has larger block length while break ML decoding into simpler decoding steps, and obtaining a powerful suboptimum decoding strategy. Using channel coding there are two approaches to decrease the bit error probability (BEP).

Increase in minimum Hamming distance of the codeword, reduces BEP and word.

With low Hamming weights the goal is rather to reduce the multiplicity of codeword's. For design of parallel concatenated convolutional codes (PCCC) this approach is applied [4]. To quote Dave Forney [8]: "Rather than attacking error exponents, they attack multiplicities, turning conventional wisdom on its head."

"PCCC" with their performance have raised interest in the coding theory. They are also termed as Parallel Concatenated Convolutional Codes (PCCC). The PCCC encoder constitutes of two recursive systematic convolutional codes (RSCC) encoders. The information sequence is fed to the first RSCC encoder and, after interleaving the information sequence, these interleaved information sequence fed in to the second RSCC encoder. The PCCC codeword's consists of the information sequence followed by the parity sequence of both RSCC encoders.

Fading degrades the transmission performance on many real links so we use powerful error-control coding techniques. PCCC have low bit-error rate (BER) using iterative decoding process, and also approaches close to the Shannon capacity limit theorem in terms of signal to noise ratio (SNR).

In PCCC Decoding Algorithm the main development is its Iterative Decoding Process. In PCCC Decoding Algorithm two decoders are used, each produces an estimate of received symbol. These two decoders exchange soft information from one to another while operating in soft input soft output mode. Extrinsic probabilities are probabilities of the symbols from one decoder which are passed to the second decoder where these probabilities are used as prior probabilities

for the second decoder. So these decoders thus pass probabilities back and forth. After reasonable number of iterations, the decoders converge and produce an estimate of the transmitted codeword. Since the output probabilities of first decoder are fed to the input of the second decoder, the decoding algorithm is called an Iterative Decoding Process.

In this thesis we design the PCCC encoder and decoder using BCJR algorithm & PCCC Decoding Algorithm. Also investigates the performance of PCCC on AWGN channel and Rayleigh Flat Fast & Slow Fading Channel.
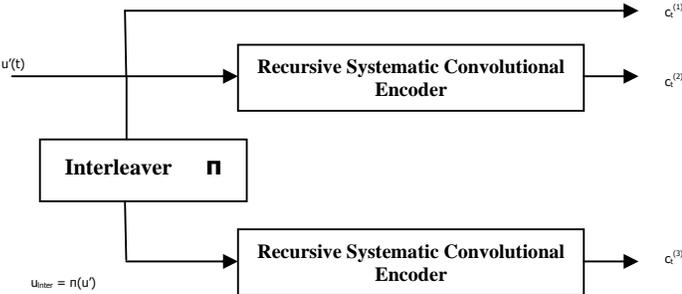
METHODOLOGY

A. PCCC Encoder

Schematic diagram of PCCCencoder is shown in figure. The input bits are coded using two component codes. Component codes are RSCC.
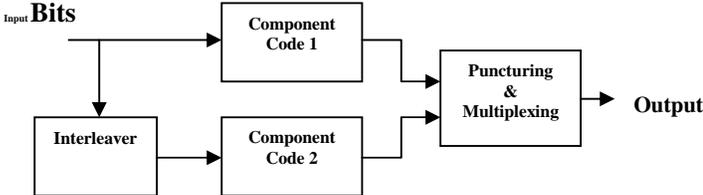
RSCC encoders are separated by an interleaver are shown in Figure below.
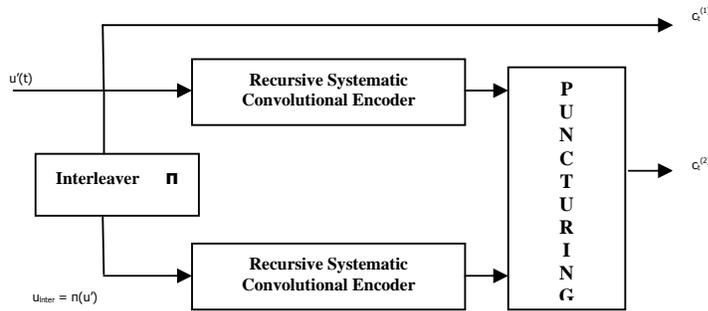
The second RSCC encoder works on a permuted version of the input frame while using Interleaver.

The input symbols block are at the input of encoder is $u' = \{ u'_0, u'_1, \ldots, u'_{n-1}\}$, where each u'_i belongs to alphabet   A ε {0, 1}. After appending zeros the message sequence becomes $u = \{u_0, u_1, \ldots, u_{N-1}\}$. In the encoder block diagram, the input sequence u' is used in three ways.

First, coded sequence is exactly equal to the message sequence. $c_t^{(1)} = u'_t$, t = 0 , 1, . . . , N - 1. Second, the input sequence fed in to the first RSCC encoder, resulting in a coded plus parity sequence $\{c_0^{(2)}, c_1^{(2)}, \ldots, c_{N-1}^{(2)} \}$. Third, the message sequence u' is first passed through the interleaver which permutes the message sequence as $u_{Inter} = \pi$ (u'). This interleaved sequence u_{Inter} is passed through RSCC encoder, which produces the output sequences $c_t^{(3)} = \{c_0^{(3)}, c_1^{(3)}, \ldots, c_{N-1}^{(3)} \}$. The outputs of PCCCencoder are multiplex together, resulting code rate Rc =1/3.
$C = \{(c_0^{(1)}, c_0^{(2)}, c_0^{(3)}), (c_1^{(1)}, c_1^{(2)}, c_1^{(3)}), \ldots \ldots \ldots \ldots \ldots, (c_{N-1}^{(1)}, c_{N-1}^{(2)}, c_{N-1}^{(3)})\}$
Because of interleaving the codes have two sets of parity information $c^{(2)}$ and $c^{(3)}$, which are fairly independent. Using puncturing before multiplexing we obtain the higher data rates, as shown in Figure.

u'(t)

Recursive Systematic Convolutional Encoder

Interleaver   Π

$U_{inter} = Π(u')$

Recursive Systematic Convolutional Encoder

P U N C T U R I N G

$c^{(1)}$

$c^{(2)}$

B.   PCCC Decoding

1.   BCJR Algorithm

In 1974 by Bahl was presented by symbol-by-symbol maximum a posteriori (MAP) algorithm, as an alternative for decoding convolutional codes [2] i.e. Viterbi algorithm (VA). While the MAP algorithm minimizes the error probability of symbol, where as the VA minimizes the error probability of sequence.

Processing Stages of BCJR Algorithm

The encoder consists information/message symbols u_i coming from an alphabet A ε {0, 1} which are grouped into k-tuples $u_i = [u_j^{(0)}, \ldots, u_j^{(k-1)}]$.. The information/message sequence   u $= [u_o, u_1, \ldots, u_{L-1}]$ is passed through system that appends a sequence of zero are $u'_L, u'_{L+1} \ldots u'_{L+m+1}$, where m is the memory or constraint length of the convolutional encoder. The need for appending zero is to derive the state of encoder at 0.

Now the information sequence $u' = [u, u'_L, u'_{L+1} \ldots u'_{L+m+1}]$ are fed in to the **CHANN** ᵈᵉʳ. The actual length of the information sequence is denoted by N, so N   if there   ) y f appended zero sequence or N = L + m if the appended zero sequence iₛ ᵤₛed The ᵥ ⁿ ₁ᵗ = ₑ RSCC encoder is   v

$c = [c_0, c_1, \ldots c_{N-1}]$, where for the ith input, each c_i contains the n-output bits, $c_i = [c_i^{(o)}, c + $ . . $c_i^{(n-1)}]$.   **n**

The coded sequence c_i are modulated using binary phase shift keying (BPSK) which prᵤᵤᵤₑₛ modulated sequence $v_i = [v_i^{(0)}, v_i^{(1)}, \ldots, v_i^{(n-1)}]$ and BPSK response is ±1 modulated signals which is given in eq 1

$$v_i^{(j)} = 2 * v_i^{(j)} - 1$$

 (1)

The output symbols sequence $v = [v_0, v_1, \ldots, v_{n-1}]$ are passed through different channel to produce received symbol sequence $y = [y_o, y_1, \ldots, y_{n-1}]$ where $y_i = v_i + n_i$. n_i is zero mean white gaussian noise with variance No/2.

The discrete time index is denoted by i. State of encoder at time i are denoted by Si. Possible states of encoder are $Q = 2^a$, where a is the memory or constraint length. We suppose that encoder starts in state 0, $S_i = 0$. When appended zero sequence is added to information or message sequence the encoder terminates also in state 0.The sequence of states is $(S_o, S_1, \ldots \ldots \ldots, S_{N-1})$.

Posteriori Probability

The convolutional code presents addictions to symbols {A}. The decoder produces the estimate of bits after examining the whole sequence by exploiting these addictions. Thus decoder's goal to determine the a posteriori probabilities of the input $P(u'_t = u' / y)$. The BCJR algorithm is used

to determine these probabilities efficiently. BCJR algorithm first compute probabilities of state transitions and then computes probabilities of input bits.

Probability of State Transition

In convolutional code there exists a Markovity in probability structure. Markovity is if we have cognition of state at time i+1 depicts besides the point knowledge of state at time i or previous times. Using above point, we divide the observation sequence into three different sets, $y = y_{<i} \cup \{y_i\} \cup y_{>i}$ where $y_{<i} = \{y_k: k<i\}$ set of "prior" observations, y_i set of "current" observation, and $y_{>i} = \{y_k: k>i\}$ set of the "future" observations. Thus posterior probability of the state transition $(S_i=p, S_{i+1}=q)$ is give by following relation.

$$P(S_i = p, S_{i+1} = q / y) = \frac{p(S_i - p, S_{i+1} - q, y)}{p(y)} \quad (2)$$

$$P(S_i = p, S_{i+1} = q / y) = \frac{p(S_i = p, S_{i+1} = q, y_{<i}, y_i, y_{>i})}{p(y)}$$

Now employing the conditioning factorization

$$P(S_i = p, S_{i+1} = q / y)$$
$$= \frac{p(S_i = p, S_{i+1} = q, y_{<i}, y_i) p(y_{>i} / S_i = p, S_{i+1} = q, y_{<i}, y_i)}{p(y)}$$

Using Markovity definition,

$$P(S_i - p, S_{i+1} - q / y) - \frac{p(S_{i+1} = q, y_i / S_i = p, y_{<i}) p(S_i = p, y_{<i}) p(y_{>i} / S_{i+1} = q)}{p(y)}$$

In above equation again exploiting Markovity the first factor can be written as

$$P(S_i = p, S_{i+1} = q / y)$$
$$= \frac{p(S_i = p, y_{<i}) p(S_{i+1} = q, y_i / S_i = p) p(y_{>i} / S_{i+1} = q)}{p(y)} \quad (3)$$

In 3 the three factors can defined as:

$\alpha_i(p) = p(S_i = p, y_{<i})$, shows the probability of the observation sequence up to time i-1, with the state p at time i

$\gamma_i(p,q) = p(S_{i+1} = q, y_i / S_i = p)$, represents the state transition probability, with the observation at time i.

$\beta_{i+1}(q) = p(y_{>i} / S_{i+1} = q)$, shows probability of the future observed sequence y>i, which starts at state q at time i+1.

Thus posterior probability of the state transition:-

$$P(S_i = p, S_{i+1} = q / y) = \frac{\alpha_i(p) \gamma_i(p,q) \beta_{i+1}(q)}{p(y)} \quad (4)$$

Probability of Input

BCJR easily determine the probability of input bits $P(u'_i = u'/y)$, if given the probability of state transitions. For input value $u'_i = u'$, let us denote state transitions sets by (p,q) which correspond to the input: $S_{u'} = \{(p,q): u'^{(p,q)} = u'\}$.

The posterior probability is found by summing over all state transitions for which $u'_i = u'$ is the input:

$$P(u'_i = u'/y) = \sum_{(p,q) \subset Su'} P(S_i = p, S_{i+1} = q / y)$$

$$P(u'_i = u'/y) = \sum_{(p,q) \subset Su'} \frac{\alpha_i(p) \gamma_i(p,q) \beta_{i+1}(q)}{p(y)} \quad (5)$$

Recursive techniques for Computing α_i

The values of $\alpha_{i+1}(q)$ can be determined using supposition that $\alpha_i(p)$ are given for all states i.e. $p \quad \{0, \ldots, Q-1\}$.

$\alpha_{i+1}(q) = p(S_{i+1} = q, y_{<i+1})$
$\alpha_{i+1}(q) = p(S_{i+1} = q, y_i, y_{<i})$, using definition of y

Computing marginal from joint probability distribution.

$$\alpha_{i+1}(q) = \sum_{p=0}^{Q-1} p(S_{i+1} = q, y_i, S_i = p, y_{<i})$$

Utilizing conditioning factorization

$$\alpha_{i+1}(q) = \sum_{p=0}^{Q-1} p(S_i = p, y_{<i}) \, p(S_{i+1} = q, y_i / S_i = p, y_{<i})$$

Using definition of $\alpha_i(p)$, $\gamma_i(p,q)$ and Markovity

$$\alpha_{i+1}(q) = \sum_{p=0}^{Q-1} p(S_i = p, y_{<i}) \, p(S_{i+1} = q, y_i / y_{<i})$$

$$\alpha_{i+1}(q) = \sum_{p=0}^{Q-1} \alpha_i(p) \, \gamma_i(p,q) \tag{6}$$

The α probabilities working forward through the trellis and are computed at start of trellis with set $\alpha_0(p)$, p=0, 1, . . . , Q − 1. The computation is referred as forward pass.

Recursive techniques for Computing β_i

The values of $\beta_i(p)$ can be determined using supposition that $\beta_{i+1}(q)$ are given for all states.

$\beta_i(p) = p(y_{>i-1} / S_i = p)$

$\beta_i(p) = p(y_{>i}, y_i / S_i = p)$, using definition of y

Computing marginal from joint probability distribution.

$$\beta_i(p) = \sum_{q=0}^{Q-1} p(y_{>i}, y_i, S_{i+1} = q / S_i = p)$$

Applying conditioning factorization

$$\beta_i(p) = \sum_{q=0}^{Q-1} p(y_i, S_{i+1} = q / S_i = p) \, p(y_{>i} / y_i, S_{i+1} = q, S_i = p)$$

Using definition of $\beta_{i+1}(q)$, $\gamma_i(p,q)$ & Markovity

$$\beta_i(p) = \sum_{q=0}^{Q-1} p(y_i, S_{i+1} = q / S_i = p) \, p(y_{>i} / S_{i+1} = q)$$

$$\beta_i(p) = \sum_{q=0}^{Q-1} \gamma_i(p,q) \, \beta_{i+1}(q) \tag{7}$$

The β probabilities are working backward through trellis and it is determined at end of trellis with set $\beta_N(p)$, p = 0, 1, . . . , Q-1. The computation of such type is referred as backward pass.

Computing γ_i

The transition probability $\gamma_i(p,q)$ can be computed as

$\gamma_i(p,q) = p(S_{i+1} = q, y_i / S_i = p)$

$\gamma_i(p,q) = p(y_i / S_i = p, S_{i+1} = q) p(S_{i+1} = q / S_i = p)$

Knowing the beginning (Si=p) and ending (Si+1=q) of a state transition, completely determined output $v^{(p,q)}$ and corresponding input $u'^{(p,q)}$. The probability of state transition is equivalent to probability of input bit associated with it:

$$p(S_{i+1} = q / S_i = p) = p(u_i = u'^{(p,q)}) \tag{8}$$

$p(u_i = u'^{(p,q)})$ is a priori probability. For binary coding $p(u_i = u'^{(p,q)}) = $ ½. For n-dimensional AWGN channel,

$$p(y_i / v^{(p,q)}) = \frac{1}{(2\pi\sigma^2)^{n/2}} \exp\left[-\frac{1}{2\sigma^2} \|y_i - v^{(p,q)}\|^2\right] \tag{9}$$

For BPSK modulation,

$$\gamma_i(p,q) = \frac{1}{(2\pi\sigma^2)^{\frac{n}{2}}} \exp\left[-\frac{1}{2\sigma^2}\|y_i - v^{(p,q)}\|^2\right] p(u_i = u^{(p,q)}) \qquad (10)$$

Initialization

The forward and backward recursions (6) and (7) are initialized as follows. Since encoder begin & terminate its known state, also known that encoder can terminate with a uniform probability.

$$[\alpha_0(0), \alpha_0(1), \alpha_0(2), \dots, \alpha_0(Q-1)] = [1,0,0,\dots 0]$$
$$[\beta_N(0), \beta_N(1), \beta_N(2), \dots, \beta_N(Q)] = [1,0,0,\dots 0]$$

Summary of BCJR Algorithm

Initialize:

Compute α:

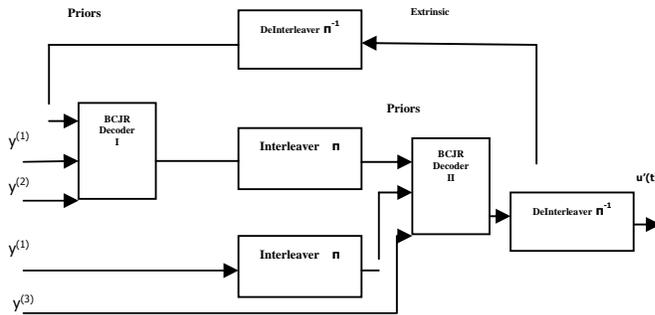$$\alpha_{i+1}(q) = \sum_{p=0}^{Q-1} \alpha_i(p)\gamma_i(p,q)$$

Compute β:

$$\beta_i(p) = \sum_{q=0}^{Q-1} \gamma_i(p,q)\beta_{i+1}(q)$$

Compute the posterior probability:

$$P(u'_i = u'/y) = \sum_{(p,q)\square Su'} \frac{\alpha_i(p)\gamma_i(p,q)\beta_{i+1}(q)}{p(y)}$$

2. PCCC Decoding Algorithm

The coded sequence which is punctured is transmitted over a noisy channel (AWGN & Rayleigh Fading). The received sequence y is de-multiplexed into sequences $y^{(1)}$ corresponding to $c^{(1)}$, $y^{(2)}$ corresponding to $c^{(2)}$ and $y^{(3)}$ corresponding to $c^{(3)}$.

The PCCC decoding algorithm operation is shown in Figure. The received sequence $y^{(1)}$, $y^{(2)}$ (consociated with the first encoder) are fed into decoder-I. The decoder-I produces probabilities of bits which are conditioned on the observed data, probabilities of bits are referred as extrinsic probabilities. The interleaved version of output of decoder-I are fed in to the decoder-II, where output of decoder-I are used as "prior" probabilities, along which is $y^{(1)}$ (interleaved) and $y^{(2)}$ are as an input to decoder-II. The extrinsic probabilities of decoder-II are deinterleaved and passed back to become prior probabilities to decoder-I. The process of communicating information probability back and forth continues until maximum number of iterations is accomplished or till the decoder specifies that decoding process is converged.

3. **Channel Models**

Channel refers as medium that is used to bring information from transmitter to a receiver. Channels which are utilized in this paper is
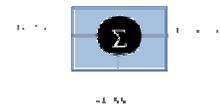
1. AWGN Channel
2. Rayleigh Frequency Non Selective (Flat) Slow Fading Channel
3. Rayleigh Frequency Non Selective (Flat) Fast Fading Channel
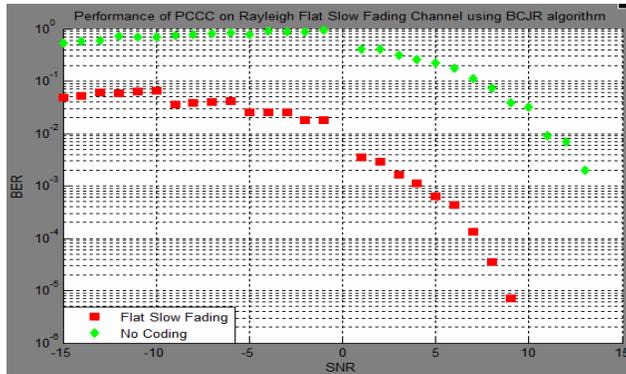
AWGN Channel

$y(t) = x(t) + n(t)$

where n(t) is Additive white Guassian noise which has a mean zero and variance is constant

Frequency Non Selective

Frequency range over which channel fading process is correlated i.e. all spectral components of transmitted signal are subject to same fading attenuation. Signal bandwidth is less than the coherence bandwidth B.W $<< (\Delta f)c$.

Rayleigh Frequency non Selective Slow Fading Channel $y(t) = a*x(t) + n(t)$ where   a   is Fading Coefficient Constant.

Slow Fading

In slow fading, fading coefficients are constant in one frame and vary from one frame to another frame. $(\Delta t)c$ is large (symbol period is small compared to coherence time)
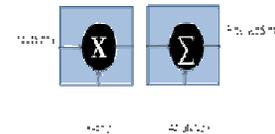
Rayleigh Frequency non Selective Fast Fading Channel

$y(t) = A*x(t) + n(t)$ where A is Fading Coefficient Matrix

Fast Fading

In fast fading, fading coefficients are constant within each symbol period and vary from one symbol to another symbol. $(\Delta t)c$ is small (symbol period is large compared to coherence time).

ANALYSIS

Simulation Results on Different channels using BCJR and PCCC Decoding Algorithm. The Graphs are shown between SNR and BER. In these graphs also show the comparison of Coding and No coding. The constraint length of the encoder is 2 that are 4 states. The interleaver which are using is Block Interleaver that is also called a random interleaver. The puncturing is used to increase the code rate or transmission rate. The puncturing is done using punctured the parity bits only of both RSCC encoders output. The first RSCC encoder even bits are punctured and second RSCC encoder odd bits are punctured. The graph shows the low probability of error at high SNR. The modulation technique used is BPSK.
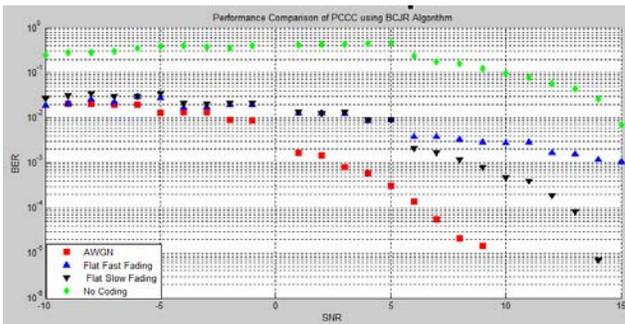
37

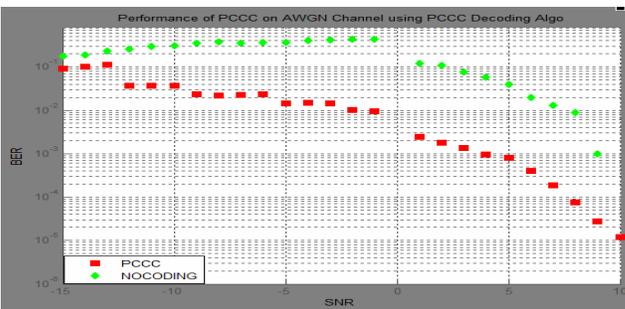1. **Performance of PCCC on AWGN using BCJR Algorithm**

Performance of PCCC on AWGN Channel using BCJR Algorithm

2. **Performance of PCCC on Rayleigh Flat Fast Fading Channel using BCJR Algorithm**
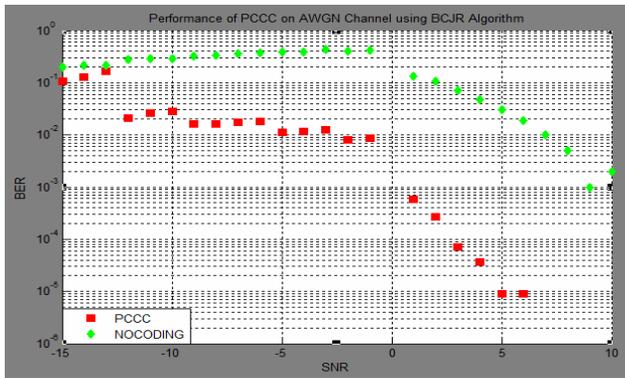
Performance of PCCC on Rayleigh Flat Fast Fading Channel using BCJR Algorithm
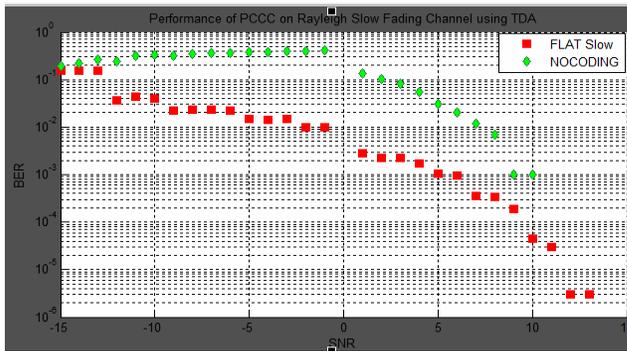
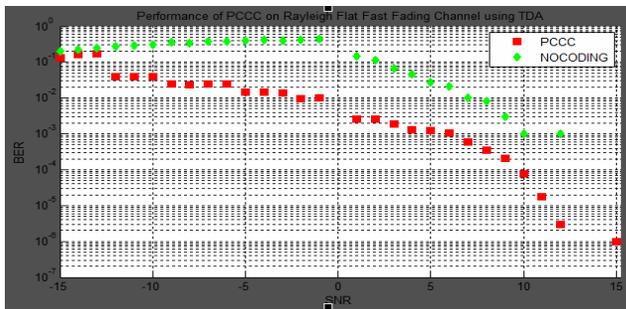3. **Performance Comparison of PCCC on Different Channel using BCJR Algorithm**
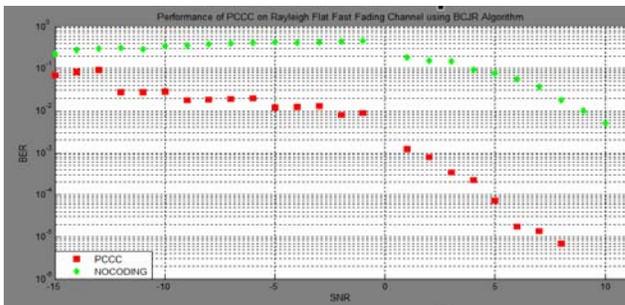
Performance Comparison of PCCC using BCJR Algorithm

4. **Performance of PCCC on AWGN Channel using PCCC Decoding Algorithm**

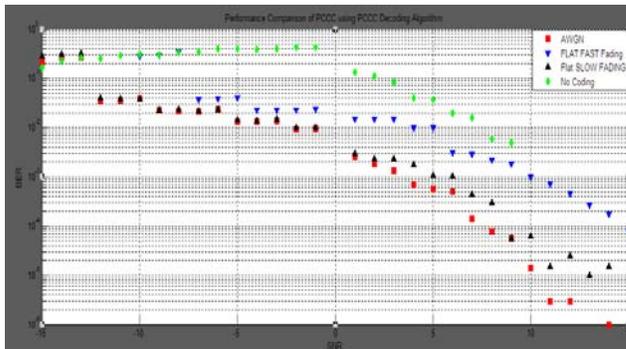Performance of PCCC on AWGN Channel using PCCC Decoding Algo

5. **Performance of PCCC on Rayleigh Flat Slow Fading Channel using PCCC Decoding Algorithm**

6. **Performance of PCCC on Rayleigh Flat Fast Fading Channel using BCJR Algorithm**

7. **Performance Comparison of PCCC on Different Channel using PCCC Decoding Algorithm**

CONCLUSION

The Simulation results show the performance of channel encoding technique PCCC. From these results the probability of error for BCJR Algorithm on different channels have $1*10^{-5}$, which means that in 100000 only 1 bit is corrupted so it approximately approaching the Shannon capacity theorem. But using PCCC decoding algorithm, provides the soft decision decoding that will overall improves the probability of error at the cost of computationally complexity. PCCC decoding algorithm gives the low BER at high SNR, which approaches the Shannon capacity theorem. So the performance of PCCC on AWGN is the best, then Rayleigh Frequency non Selective Slow fading and then Rayleigh Frequency non Selective Fast fading and worst one is No coding. If we increase the size of interleaver the performance of codes are better and increasing the constraint length of encoder and the performance of codes that means low BER but increasing the system complexity. The PCCC are now utilized in many practical applications and the codes which achieves the Shannon capacity.

SATISFACTION WITH PERFORMANCE APPRAISAL SYSTEM AND APPRAISAL DISCUSSION
(STUDY OF EDUCATIONAL SECTOR: UNIVERSITIES OPERATING IN ISLAMABAD/RAWALPINDI)

Gulfam Khan Khalid,
National University of Modern Languages

Syed Ali Abdullah Mehboob,
University of Gujrat

Dr. Syed Tahir Hijazi,
University of Central Punjab

ABSTRACT

This study was undertaken to determine the factors of satisfaction from a performance appraisal system in the educational sector. Faculty and non-faculty staff from both public and private sector universities of Islamabad and Rawalpindi was taken as a sample. Overall experience and the quality of the appraisal discussion were taken as dependent variables and were regress and correlated against a number of predicator variables. Results have shown that predicator variables were significantly explaining the dependent variables collectively but were not significant individually.

INTRODUCTION

Education is playing significant role in the development of any country. The importance of the education sector has now been recognized and acknowledged even in the developing countries like Pakistan. By exploring this sector's evolution in the local scenario of Pakistan it is evident that growth of education sector is rapid and Government is also willing to make investments in this sector. Structural reforms are under the process of implementation in the educational sector at all levels. At Primary level the provincial and local bodies have launched different schemes for the improvement of this sector and at higher level education an autonomous body named Higher Education Commission (HEC) of Pakistan is making enormous efforts. Instead of introducing different regulations and schemes for improvement, HEC has also launched a Tenure Track System for the assessment and improvement of the faculty.

Performance appraisal is an area of immense interest for researchers and many research studies have been conducted on different issues of Performance appraisal and their implications. Performance Appraisal is been defined in different ways in literature as in the words of Hidayat Ullah (1991). "Performance Appraisal is one of the scientific tools of Personnel Management. As a tool of Personnel Management, it is widely recognized as an essential base for establishing a professionalized and achievement-oriented system of Performance Management. Today, no modern organization can function effectively without establishing a proper mechanism for judging performance of employees in an objective and unbiased manner….. Performance Appraisal is a scientific tool for assessing the performance of an individual, on a given job. The ultimate objectives of appraising performance of employees are to evaluate the current performance of employees and their potentials for growth and advancement in their career."

Performance appraisal is conducted in a systematic way and is considered as an important activity in the context of Human Resource Management. Conger et al (1998) discussed its importance as "Rare is the company that does not periodically review the performance of its key contributors-whether they be individuals, work teams, business units, or senior managers." In modern day organizations Performance appraisal system is used for different purposes as described by Benton & John (1978) "Performance appraisal systems serve three basic functions: (1) to provide adequate feedback to each employee on his or her job performance; (2) to serve as a basis for modifying or changing behavior toward more effective working habits; and (3) to provide data to managers on which to base promotion, transfer, and compensation decisions. The use of performance appraisal is central to any effort to effectively manage subordinates. To date much

hard work has gone into the development of clear, stimulating, and equitable performance appraisal systems."

At times performance appraisal is mixed up with Performance Management System but these are two different things. Clear distinction was outlined by Hijazi et. Al (2005) "Performance Management System consists of the processes used to identify, encourages, measure, evaluate and improve employee performance. While performance evaluation is a process through which we calculate productivity of employees" and by Griffith and Orgera (2002) "On the performance management continuum, this is very different from the classic "performance appraisal" that typically involves an annual review of individual traits and goals tied primarily to merit increase determinations. The real objective of performance management, which is performance improvement and development, is often overlooked in the midst of completing forms and determining compensation actions."
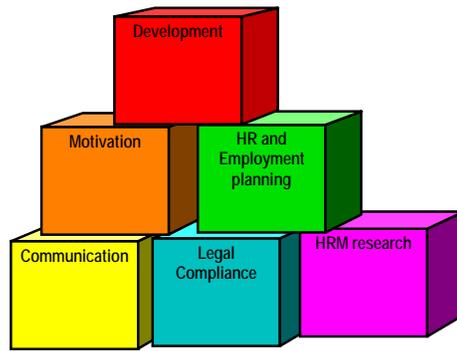
A glimpse of performance appraisal methods is reflected by the figure below
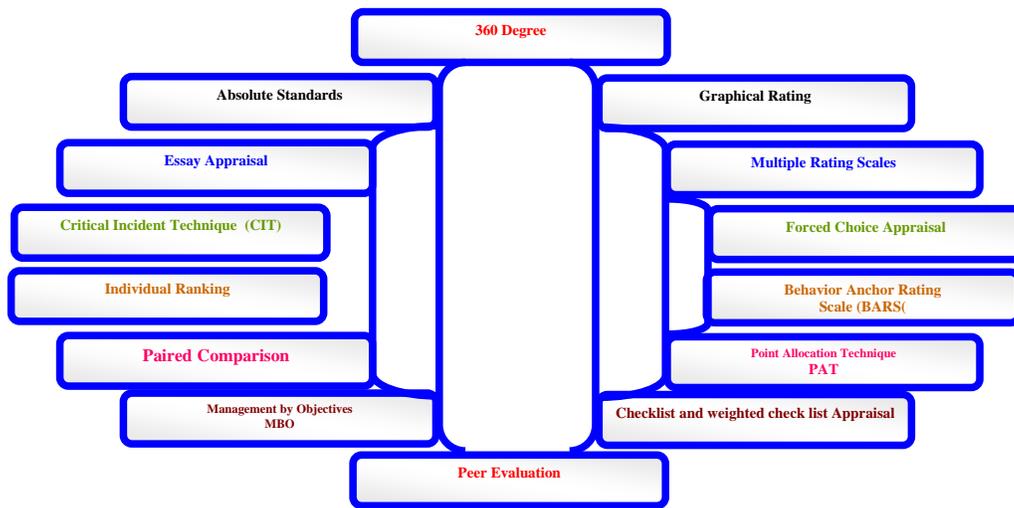
Source: Presentation of Dr. Syed Tahir Hijazi in PhD/MS-Human Resource Management class, 2006 "*Performance Evaluation Methods*"

An effective Performance Appraisal system leads to multi-dimensional positive impacts on employee's job related behaviors and provide them with opportunities to grow. So the importance to identify or determine the features of employee satisfaction from an effective Performance Appraisal System has been increased. Mount K. (1984) have studied different determinants of the satisfaction with Performance Appraisal System. Dipboye and pontbriand (1981) listed few factors that employee feel are causing satisfaction with the Appraisal System.

This study aims to determine the features of the performance appraisal system that employees feel are important and are causing the satisfaction with system. Overall experience with the appraisal system and quality of the appraisal discussion are taken as two dependent variables and few other variables are taken as determinants of satisfaction for these dependent variables.

Source: Presentation of Dr. Syed Tahir Hijazi in PhD/MS-Human Resource Management class, 2006 "*Performance Evaluation Methods*"

METHOD

Background

Institutes, providing higher education from the cities of Islamabad and Rawalpindi are taken as the target for this research. Both public sector and private sector are given equal importance in the conduct of the study so that the factors of satisfaction from appraisal discussion and appraisal system overall can be diagnosed.

Subjects and Procedures

The subjects selected for this study are both the faculty and non-faculty members. Eight universities were selected in total, representing four from each sector (public and private). Total number of questionnaire floated was 120 (15 questionnaires per university). Only 42 questionnaires were properly filled and were considered eligible for calculations i.e. return rate of 35%. Some questionnaires were not properly filled and few were returned unanswered. (The detail of the demographics is shown in Appendix I)

For this study the procedures and methodology used by Mount K (1984), was partially used and questionnaire used to take responses was also taken from the list of important factors studied by him. Mean and Standard Deviation of each factor is calculated which is shown in table 1. Correlation coefficients of all the studied factors were calculated with each other which are shown in table 2.
Regression analysis is also undertaken for each dependent variable to determine the intensity of each predicator variable in the dependent variables.

Questionnaire content

Questionnaire was consisted of 19 questions which were taken from the research followed. Responses for each factor were taken on a five point likert scale where '1' meant not satisfied and '5' meant Very satisfied. Every factor measured in each question.

RESULTS & DISCUSSION

The regression equation of Overall experience as dependent variable and all others are as independent variables is

Overall experience = 1.64 + 0.418 Quality of discussion + 0.211 Company policy - 0.151 Separate salary discussion + 0.059 Separate forms + 0.184 providing copy - 0.095 Frame of reference + 0.441 Work planning + 0.009 Career planning - 0.212 Salary administration + 0.128 System communication - 0.342 Overall performance + 0.191 Performance factors - 0.094 Factor

definitions - 0.000 Factor examples - 0.042 Importance Ratings + 0.001 Effectiveness Ratings - 0.046 Forms and Discussion - 0.124 Development planning

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	18	13.5457	0.7525	1.92	0.071
Residual Error	23	9.0257	0.3924		
Total	41	22.5714			

Results of this equation are shown below.

Predictor	Coefficients	SE Coefficients	t	p-value
Constant	1.6355	0.5895	2.770.0	11
Overall experience	0.4178	0.1939	2.15	0.042
Quality of discussion	0.2111	0.1513	1.40	0.176
Company policy	-0.1506	0.1730	-0.87	0.393
Separate salary discussion	0.0593	0.1376	0.43	0.670
Separate forms	0.1837	0.1594	1.15	0.261
Providing copy	-0.0945	0.1788	-0.53	0.602
Frame of reference	0.4407	0.2581	1.71	0.101
Work planning	0.0088	0.2074	0.04	0.967
Career planning	-0.2119	0.1665	-1.27	0.216
Salary administration	0.1282	0.1499	0.85	0.401
System communication	-0.3416	0.2639	-1.29	0.208
Overall performance	0.1909	0.1493	1.28	0.214
Performance factors	-0.0944	0.1896	-0.50	0.623
Factor definitions	-0.0001	0.2177	-0.00	1.000
Factor Examples	-0.0422	0.1750	-0.24	0.811
Importance Ratings	0.0006	0.1769	0.00	0.997
Effective Ratings	-0.0463	0.1518	-0.30	0.763
Forms and Discussion	-0.1242	0.2502	-0.50	0.624

S.E = 0.6264   R-Sq = 60.0%   R-Sq (adj) = 28.7%

Our regression equation has a p-value of 0.071, which shows it is significance at 10% level of significance. Value of R-square indicates that the 18 predictor variables explain 60% of the variation in response variable which is quite reasonable. But on the other hand the adjusted R-square is quite below R-square, which shows its variability for every addition or subtraction of predictor variables.

The sign of regression coefficient for each independent variable shows the direction of its relationship with the dependent variables. Among all the variables the only significant coefficient is of quality of discussion. All other regression coefficients are found to be statistically insignificant. There can be many reasons for this result, which can be explored in further research.

The regression equation of Quality of discussion as dependent variable and all others are as independent variables (Except overall Experience) is

Quality of discussion = 0.254 - 0.204 Company policy + 0.153 Separate salary discussion - 0.191 Separate forms + 0.118 providing copy - 0.043 Frame of reference - 0.242 Work planning - 0.125 Career planning + 0.201 Salary administration + 0.112 System communication + 0.285 Overall performance - 0.057 Performance factors + 0.457 Factor definitions + 0.093 Factor

examples - 0.008 Importance ratings + 0.004 Effectiveness ratings + 0.342 Forms and Discussion + 0.016 Development planning

The results of this regression equation are shown and discussed below

Predictor	Coefficients	SE Coefficients	t	p-value
Constant	0.2545	0.6183	0.41	0.684
Company policy	-0.2044	0.1537	-1.33	0.196
Separate salary discussion	0.1531	0.1794	0.85	0.402
Separate forms	-0.1910	0.1395	-1.37	0.184
Providing copy	0.1185	0.1660	0.71	0.482
Frame of reference	-0.0431	0.1880	-0.23	0.821
Work planning	-0.2423	0.2671	-0.91	0.373
Career planning	-0.1252	0.2168	-0.58	0.569
Salary administration	0.2006	0.1705	1.18	0.251
System communication	0.1119	0.1562	0.72	0.481
Overall performance	0.2849	0.2717	1.05	0.305
Performance factors	-0.0566	0.1568	-0.36	0.721
Factor definitions	0.4572	0.1765	2.59	0.016
Factor Examples	0.0931	0.2284	0.41	0.687
Importance Ratings	-0.0077	0.1842	-0.04	0.967
Effective Ratings	0.0041	0.1863	0.02	0.983
Forms and Discussion	0.3422	0.1437	2.38	0.026
Development planning	0.0159	0.2634	0.06	0.952

S.E = 0.6595   R-Sq = 76.7%   R-Sq (adj) = 60.2%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	17	34.3485	2.0205	4.65	0.000
Residual Error	24	10.4372	0.4349		
Total	41	44.7857			

In the second part of our analysis we regress the quality of discussion on all 17 independent variables except "overall experience". This time results were quite different from the previous. The regression model is found to by highly significant at both 1 and 5% level of significance.

The value of coefficient of determination i.e. R-square is quite high than previous and it shows that the given 17 predictor variables explains approx. 77% of the variation in the response variable. The value of adjusted R-square is not very below and it is 60.2%.

Among regression coefficient the Factor d Forms and discussion an development planning are found to be statistically significant at 10% level of significance, where as "forms and discussion" and "factor definitions" are significant at 5% level of significant. All other regression coefficients are found to be statistically insignificant, apparently showing that none of them is explaining variation in the response variable individually.

Thus at this moment we can conclude that quality of discussion has been affected by our 17 independent variables in combine, but except for the two, all other are unable to explain the variations individually.

Limitations of the Study
1. Different performance appraisal systems in different universities may have some effects on the determinants of satisfaction factor.
2. Time and budgetary constraints have limited the scope of this study.
3. Limited sample size may also have affected the results drawn.

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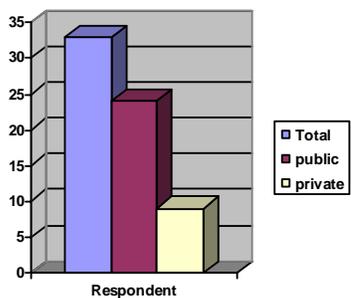GRAPHICAL REPRESENTATION OF DEMOGRAPHIC DETAILS

GENDER
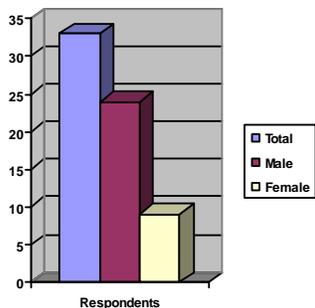
Gender	Respondents
Male	24
Female	9
Total	33

Type of Organization

Organization	Respondents
Public	24
Private	9
Total	33

Staff Type

Nature of Staff	Respondents
Faculty members	23
Non-Faculty members	10
Total	33

46
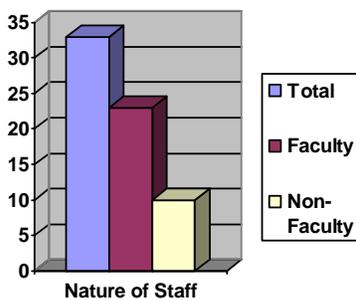
Age

Age	Respondent
Under 30	21
30-39	10
40-49	0
Above 40	2
Total	33
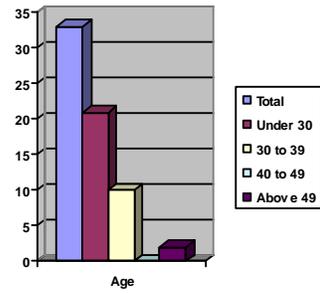
Total Experience (Years)

Experience	Demographic
Below 2 years	6
2 To 4	11
5 To 7	9
8 To 10	3
Above 10	4
Total	33
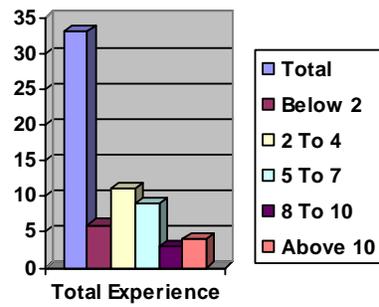
Experience with Current System

Current Experience	Respondent
Below 2 years	15
2 To 4	11
5 To 7	6
8 To 10	1
Above 10	0
Total	33
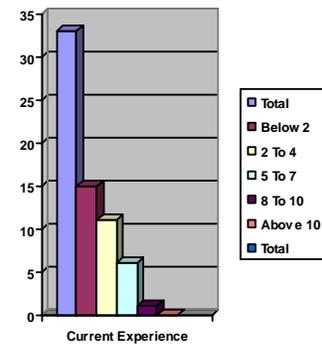
Table 1: Means and Standard Deviation of each variable.

ITEMS	Mean	Standard Error
Overall experience	3.29	0.11
Quality of discussion	2.93	0.16
Company policy	3.31	0.15
Separate salary discussion	2.90	0.16
Separate forms	2.95	0.17
Providing copy	2.76	0.19
Frame of reference	3.07	0.15
Work planning	3.17	0.14
Career planning	3.40	0.14
Salary administration	3.36	0.14
System communication	3.17	0.16
Overall performance	2.88	0.14
Performance factors	3.12	0.16
Factor definitions	3.12	0.17
Factor Examples	3.02	0.14
Importance Ratings	3.21	0.16
Effective Ratings	3.17	0.16
Forms and Discussion	3.07	0.16
Development planning	3.12	0.15