

PERFORMANCE OF SOLAR PHOTOVOLTAIC PLANT INSTALLED IN IIT ROORKEE CAMPUS: A CASE STUDY

Kunwar Sangram Singh Pundir¹, S.K Singal², R.P. Saini³

¹*Alternate Hydro Energy Centre, Indian Institute of Technology, Roorkee, (India)*

²*Principal Scientific Officer, Alternate Hydro Energy Centre, IIT, Roorkee, (India)*

³*Associate Professor, Alternate Hydro Energy Centre, IIT, Roorkee, (India)*

ABSTRACT

The application of renewable energy in electrical power system is growing fast. Solar Photovoltaic energy and other renewable energy are being increasingly recognized as cost-effective generation sources for different area isolated power system. Solar energy is the most clean, abundant and inexhaustible of all the renewable energy resources till date. The power from the sun intercepted by the earth is about 4.2×10^{18} Watt-hours, which is many times larger than the present rate of all the energy consumption. Photovoltaic energy systems take place as the most dominant source among renewable energy technologies. PV grid connected systems offer a wide range of both technological and commercial challenges, more so in India, which has just started a major initiative in this direction under the auspices of Jawaharlal Nehru National Solar Mission. This paper presents the performance of solar photovoltaic (SPV) system installed in IIT Roorkee Campus in Uttarakhand state of India. The different technical parameters are used to carry out the performance analysis.

Keywords: *Performance Analysis, Solar Energy, Solar Photovoltaic, Solar Power Plant, Solar Radiation Data.*

I. INTRODUCTION

The Solar Photovoltaic (PV) system installations in India have increased after the launch of Jawaharlal Nehru National Solar Mission (JNNSM) by the Ministry of New and Renewable Energy, Government of India. The main objective of the JNNSM is to achieve 20 GWp generations capacity using solar power systems by 2020 [1]. The contribution of Renewable energy sources in India's primary energy supply is about 30%. By conventional and renewable resources, the growth of electricity generation in India is increasing continuously. Renewable energy has increased the grid capacity by almost 4 times from year 2002 onwards. In April 2002, the installed capacity based on renewable energy was 3,497 MW (Mega Watt) which was 3% of the country's total installed capacity. It has become 40799 MW on 30 Nov. 2014, which is about 16% of the total installed capacity [2,3].

The energy from sun can be utilized directly or indirectly in the form of solar energy. Solar energy plays an important role to reduce the harmful gases for environment produced during the electricity generation. According to IEA report, SPV technology could stop 100 Giga tons of CO₂ emissions in the period of 2008-2050 [4]. Solar energy does not affect the cultivated land, reduces grid transmission lines propagation cost and increases the life style of people in distant areas [5]. Solar energy has three different technologies: solar

photovoltaic and concentrating solar power for providing electricity, and solar cooling and heating. Based on IEA report, in 2050, around 11% of the global energy demand could be fulfilled by the solar energy [4,6].

II. SOLAR PHOTOVOLTAIC SYSTEM

Solar radiation is a general term for electromagnetic radiation emitted by the sun. Solar radiation can be captured and turned into useful form of energy, such as heat and electricity, using a variety of technologies [7]. However, the technical feasibility and economical operation of these technologies at a specific location depends on the variable solar resources. There are following types of solar radiation:

- (i) Beam Radiation – Solar radiation received from the Sun without being scattered by the atmosphere and propagating along the line joining the receiving surface and the sun. It is also referred as direct radiation.
- (ii) Diffuse Radiation – The solar radiation received from the Sun after its direction has been changed due to scattering by the atmosphere. It does not have a unique direction and also does not follow the fundamental principles of optics.
- (ii) Total Solar Radiation – The sum of beam and diffused radiation on a surface. The most common measurements of solar radiation are total radiation on a horizontal surface often referred to as ‘global radiation’ on the surface.

It is direct conversion of sun light into electricity. Solar cell works on the photovoltaic effects. In order to get useful powers from the PV cells, which use basically semiconductor and semiconductor material as these materials having more capability of eliminating the electrons under sunshine. Following are the three conditions to get the output in form of electricity from semiconductor material: -

- (i) Solar radiation in the form of Photon must be absorbed by the active part of material and Potential Energy of the photon should transfer the electron. Further with this extra energy particular electron must be dislodged from its bond.
- (ii) The charged particle having extra energy should be carried to the edge of the material so that it may be available to carry to the load. This particular condition can be provided to the material by creating an internal electric field in the material by developing pn junction through a process known as doping.
- (iii) The charged particle available at the edges of a material should carry to the load through the external circuit.

III. SITE DETAILS

India lies in sunny regions of the world. Most parts of India receive 4–7 kWh (kilowatt-hour) of solar radiation per square meter per day with 250–300 sunny days in a year. The highest annual radiation energy is received in western Rajasthan while the north-eastern region of the country receives the lowest annual radiation [8].

Roorkee is located at 29.87°N 77.88°E. It has an average elevation of 268 meters (879 feet). Roorkee is 172 km north of the Indian capital New Delhi and located between the rivers Ganges and Yamuna, close to the foot hills of Himalayas.



Fig. 1 Location of Roorkee

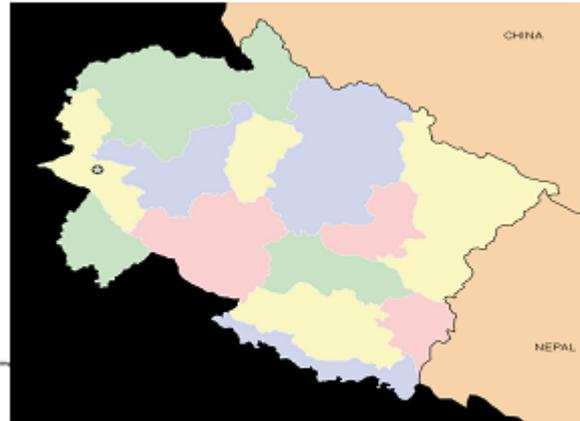


Fig. 2 Uttarakhand Map

Due to its location away from any major water body and its close proximity to the Himalayas, Roorkee has an extreme and erratic continental climate. Summers start in late March and go on until early July, with average temperatures around 28°C (83°F). The monsoon season starts in July and goes on up till October, with torrential rainfall, due to the blocking of the monsoon clouds by the Himalayas. The post monsoon season starts in October and goes on up till late November, with average temperatures sliding from 21°C (70°F) to 15°C (58°F). Winters start in December, with lows close to freezing and frequent cold waves due to the cold katabatic winds blowing from the Himalayas. The total annual rainfall is about 2600 mm (102 in).

Annual mean daily solar radiation in Roorkee is about 5.22 KWh/m²/day, and there are about 250-300 clear sunny days in a year.

Availability of land: Installation of apparatus for solar energy generation requires land, which is both economically feasible and has ample amount of sunshine. IIT Roorkee has a vast amount of unused rooftop area. It can be used for the purpose, as it receives ample sunshine for most of its part. It's about 25200 sq. mts total rooftop area.

IV. PV SYSTEM PERFORMANCE EVALUATION

An accurate evaluation of photovoltaic (PV) system performance is important for the development of PV industry. The performance evaluation helps the component manufacturers to ensure the quality of their products and to identify future industry needs. There is a need for standard parameters on the basis of which the performance of a PV system can be evaluated. Thus, in order to evaluate the performance of a PV system, International Electro-technical commission (IEC) has developed standard performance parameters for photovoltaic system performance monitoring and analysis as per IEC standard 61724 [9].

These performance parameters are developed on the basis of following considerations:

- (i) As the output of PV systems differs due to size, geographic location, season, design and technology so, it is difficult to compare various PV systems as such; the developed performance parameters should be able to provide a single base for comparing such PV systems.
- (ii) The parameters should be capable of detecting the operational problems and various losses in the PV system.
- (iii) The parameters should be able to validate the models developed for system performance estimation during the design phase.

V. PERFORMANCE EVALUATION METHODOLOGY

The performance of SPV plant is a function of climatic conditions, equipment used and system configuration [10]. The main parameters for evaluation of PV system performance as per IEC standards are as follows: -

5.1 Final Yield (Y_F)

At the standard test conditions (1000W/m² irradiance, 25⁰C ambient temperature and air mass 1.5g) the total energy generated by the PV system for a defined period (E) divided by the rated output power ($P_{PV, Rated}$) of the installed PV system is called the Final yield (Y_F).

$$Y_F = E / P_{PV, Rated} \quad (1)$$

5.2 Reference Yield (Y_R)

The ratio of total in plane solar insolation (H_t) (kWh/m²) to the reference irradiance (G) (1kW/m²) is called the Reference yield. This parameter represents equal number of hours at the reference irradiance and is given as:

$$Y_R = H_t / G \quad (2)$$

5.3 Performance Ratio (PR)

The ratio of the final yield (Y_F) to the reference yield (Y_R) is known as Performance ratio. It is a dimensionless quantity and normalized performance parameter w.r.t incident solar radiation. It depicts about the overall effect of losses. This parameter is used to evaluate the long term changes in the performance. The decreasing year wise PR values are indicative of loss in the performance.

$$PR = Y_F / Y_R \quad (3)$$

5.4 PVUSA Rating

The PVUSA rating method is a regression method to study the PV system performance. This method uses the meteorological data of the site to calculate power at PVUSA Test Conditions (PTC), where PTC are defined as 1000W/m² plane-of-array irradiance, 20⁰C ambient temperature, and 1m/s wind speed. According to PVUSA regression analysis, power is considered to be a function of irradiance, temperature and wind speed given as:

$$P = E (A + B * E + C * T_a + D * W_s) \quad (4)$$

where, P=AC power in kW at the specific test condition, E=plane of array irradiance (W/m²), T_a=ambient temperature (⁰C), W_s=wind speed (m/s), A–D = regression constants derived from operational data.

5.5 Capacity Factor (CF)

The capacity factor (CF) is defined as the ratio of actual annual energy output ($E_{AC,a}$) of the PV system to the amount of energy the PV system would generate if it operates at full rated power ($P_{PV, rated}$) for 24h per day for year and is given as:

$$CF = E_{AC,a} / P_{PV, rated} * 8760 \quad (5)$$

5.6 System Efficiency

The ratio of the energy generated ($E_{AC,D}$) to the incident irradiance (H_t) at the module area (A_a) given as:

$$\eta_{sys,m} = E_{AC,D} / (H_t * A_a) \quad (6)$$

The Efficiency of the system: -

$$\eta = P_{max} / (H_t * A_a)$$

where, P_{max}=Maximum Power generated i.e. multiple of maximum current (I_{max}), maximum voltage (V_{max}) & Fill Factor (FF), H_t = Incident irradiance, A_a =Module area, $FF = (V_{max} * I_{max}) / (I_{SC} * V_{OC})$.

These performance parameters provide the overall system performance w.r.t. energy production, solar resource, and overall effect of system losses.

VI. FACTORS AFFECTING THE PERFORMANCE OF PV MODULE

The performance of a PV module under actual outdoor conditions depends on several factors like type of PV technology used and the environmental conditions of the site where the module is deployed [11,12].

6.1 Type of PV technologies

A number of PV technologies available are mono-crystalline silicon, poly crystalline silicon, amorphous silicon and other thin film technologies like CdTe, CIS etc. Out of these, crystalline silicon PV technology is well established and shares about 85% of the world's PV installations. However, upcoming PV cell technologies like triple junction under concentrated sun are expected to take up the larger share of the PV market in near future. Extensive research is going on to improve the efficiency of PV cells for the commercial use. The efficiency of the PV cell is one of the key parameters on which the performance of a PV module and system depends, which in turn is influenced by the temperature, solar irradiance, dust etc.

6.2 Effect of Ambient Temperature

The output power of a PV module depends on the temperature at which the solar cells operate. It is important to note that module temperature is always higher than the ambient temperature. The higher temperature of the module is due to the use of glass cover, which traps the infrared radiation. The increase in temperature results in the reduction of band gap of PV cells in the module. This leads to the increase in I_{SC} but decrease in V_{OC} . The decrease in V_{OC} is more prominent than the increase in I_{SC} . Therefore, over all power output and efficiency of the PV cells decreases with the increase in its operating temperature.

6.3 Effect of Solar Irradiation

The output power of the PV module strongly depends upon the solar irradiation falling on it. The power output of a module increases linearly with the increase in the incident solar radiation. With the increase in the incident solar radiation, more number of photons will be available to move the electrons from balance band to conduction band resulting into the production of more current.

6.4 Effect of Tilt Angle of PV Module

The performance of PV module depends on the amount of solar radiation received by a PV module which in turn depends on the orientation and tilt angle. The orientation of modules is generally south in northern hemisphere and north in southern hemisphere. The tilt angle is site dependent and has to be optimized to maximize the incident solar radiation on the surface of PV module. It is very helpful to have a solar site locator to determine the potential shading.

Distance from object to array= Object Height * Spacing Factor

6.5 Other Factors

In addition, there are several factors like dust accumulation, humidity and air velocity, which affect the performance of PV module.

VII. DATA COLLECTION AND ANALYSIS

In order to estimate the solar radiation, data were collected from the different sources.

7.1 Insolation Data

The average insolation data for Roorkee is presented in the table below. Since the peak power output of solar modules is delivered at STC of 1000 W/m^2 insolation, the actual power output depends upon the insolation at the place [13].

Table 1: Insolation Data of Roorkee

Month	Insolation ($\text{kWh/m}^2/\text{day}$)
1	3.16
2	4.43
3	5.86
4	6.83
5	7.37
6	6.47
7	5.63
8	5.38
9	5.29
10	5.13
11	3.83
12	3.21
Yearly average	5.22

The average insolation value is 217.5 W/m^2 for evaluating power output of modules.

7.2 Solar Devices

In Solar PV systems, there are various devices, which are connected in order to generate the required energy. These devices should have some common and standard parameters so as to allow the parameters to be interconnected to each other. In this works, some of devices and its parameters used are as follows:

(i) Modules

PV system is long life plants in which those modules are used which have higher efficiencies in order to obtain the desired power outputs. In these works, the modules from Tata Power solar system Ltd. manufacturer have been using with preference ranges.

Electrical rating under STC (1000 W/m^2 , A.M. 1.5, Cell temperature= 25°C) [14].

Table 2: Module Details

Manufacturer	Tata Power solar system Ltd.
Model	TS230MBT
P_m (W)	230
V_m (V)	29.1
I_m (A)	7.9
V_{oc} (V)	36.7
I_{sc} (A)	8.4

(ii) Inverters

IIT Roorkee is connected to grid having 3 phase system. Therefore, Inverter of three phases with the following parameters from Delta 30 kW, 20 kW, 15 kW and 11 kW series are recommended. However, the systems are flexible to use any type of inverter regardless of /independent of the efficiency and compatibility with the system.

7.3 Number of Modules, Peak Power Output and Module Area

Table 3: Number of Modules, Peak Power Output and Module Area

S.No	Site (Department)	No. of PV Modules	Peak Power Output (kWp)	Module Area (m ²)
1	AHEC	184	42.32	306.7
2	Archite. & Plan.	289	66.00	481.8
3	Biotech	261	60.26	436.8
4	Civil	870	200.0	1450.1
5	Chemistry	267	61.00	445.1
6	Chemical	518	119.0	863.5
7	DOMS	174	40.03	290.1
8	Earthquake	289	66.00	481.8
9	Earth Science	218	50.05	363.4
10	ICC	140	32.20	233.4
11	WRDM	188	43.24	313.4
12	E&C	496	114.0	826.8
13	Electrical	741	170.0	1235.3
14	HS	154	35.42	256.7
15	Hydrology	115	26.00	191.7
16	Maths & Physics	261	60.26	436.8
17	Metallurgy	692	159.06	1153.6
18	MCA Block	066	15.18	110.0
19	IIC	096	22.08	160.0
20	Mechanical	436	100.0	726.8
21	Library	184	42.32	306.7
22	LH-1, -2	131	30.28	218.4
23	New LH	368	84.00	613.5
24	Mandi Cell	267	61.00	445.1
25	Industrial	210	48.30	350.1
26	OP Jain Audi	092	21.16	153.4
27	RS Wing	201	46.23	335.1
Total		7910	1816	13186

7.4 Calculation and Analysis

The Performance indices of solar photovoltaic system installed in IIT Roorkee campus for six months i.e.

(i) Final Yield, $Y_F = E / P_{PV, Rated}$

where, E= total energy generated by the PV system, for six months in IITR i.e. 1227419 kWh

P= the rated output power of the installed PV system i.e. 1816 kW

Then, $Y_F = 1227419 \text{ (kWh)} / 1816 \text{ (kW)} = 675.89 \text{ (h/d)}$

(ii) Reference yield, $Y_R = H_t / G$

where, H_t = total in plane solar insolation in (kWh/m²) i.e. 6.16 kWh/m²/day (Average)

G = the reference irradiance i.e. 1kW/m²

Then, $Y_R = (6.16 * 183) / 1 = 1127.59 \text{ (h/d)}$ (for 6 months)

(iii) Performance Ratio, $PR = Y_F / Y_R$

Then, $PR = (675.89 / 1127.59) = 0.5994$

Hence, The Performance Ratio of IITR Campus for six months is 59.94%.

(iv) Capacity Factor, $CF = E_{AC,a} / (P_{PV, rated} * 8760)$

But we can measure the CF for six months (i.e. 183 days).

Then, $CF = 1227419 / (1816 * 183) = 0.1539$

Hence, The Capacity Factor of IITR Campus for six months is 15.39%.

(v) System efficiency, $\eta_{sys,m} = E_{AC} / (H_t * A_a)$

where, E_{AC} = total energy generated by the PV system, for six months in IITR i.e. 1227419 kWh

H_t = total in plane solar insolation in (kWh/m²) i.e. 6.16 kWh/m²/day = 1127.59 kWh/m²

A_a = Module area in (m²) i.e. 13186 m². Then, $\eta_{sys,m} = 1227419 / (1127.59 * 13186) = 0.0826$

Hence, The System efficiency of IITR Campus in the month of April is 8.26%.

7.5 Economical Analysis

The cost analysis is based upon the following factors:

(i) Cost of the system (in rupees) = Rs. 14.14 crore

(ii) First 5 year O&M cost = Rs. 13.75 lacs

(iii) O&M cost 6 to 25 year = Rs. 3.49 to 15.55 lacs per year

According to the Actual cost and O&M cost, the Unit generation cost is as follows: -

Unit generation cost = Rs. 8.5 per unit (without subsidy)

= Rs. 0.85 per unit (with subsidy)

Electricity Generation = 30.8 lacs units annual and The CO₂ Reduction = 2464 ton p.a.

According to the given data of Cost, O&M and Electricity Generation, the energy saving is shown: -

Table 4: Economical Analysis

Capital Cost of the system (Rs.)	14.14 crore or 14,14,00,000
Subsidy (Rs.)	12.72 crore or 12,72,60,000
Actual Capital Cost (Rs.)	1.41 crore or 1,41,40,000
Saving per annum (Rs.)	26.18 lacs or 26,18,000
Payback Period (Year)	5.4 years or 5 years 4 months

Note: - Capital subsidy of 90% of the benchmark cost would be available for special category states, viz. NE, Sikkim, J&K, Himachal Pradesh and Uttarakhand.

VIII. CONCLUSIONS

Detailed investigation on Performance Evaluation of Solar Photovoltaic system Installed in IIT Roorkee Campus leads to following conclusion: The solar radiation data from National Aeronautics and Space Administration (NASA) and NREL are collected and found that the minimum sunshine hour for the site is 3.16 for the month of January 2014. Collected data of energy generation, solar radiation were analyzed and Performance indices is Performance ratio, Capacity Factor & efficiency were found to be 59.94%, 15.39%, 8.26% respectively. During the analysis, Shading effect, inclination angle etc. were assumed to be fixed as no arrangement is made/provided (in the installed system) to vary these parameters. Through detailed analysis of the data, it has been found that the system is viable, efficient and cost effective. As a result, due to JNNSM subsidies, the financial viability of the project is extremely good. The Payback period of the PV system installed in IIT Roorkee Campus is 5.4 Years. The CO₂ Reduction 2464 ton p.a. shows the solar PV system installed in IIT Roorkee Campus is Eco-friendly and good for Environment.

REFERENCES

- [1] Jawaharlal Nehru National Solar Mission. Guidelines for selection of new grid connected solar power projects www.mnre.gov.in; July 2010.
- [2] Parida B, Iniyani S, Goic R. A review of solar photovoltaic technologies. *Renewable and Sustainable Energy Reviews* 2011; 15: 1625-1636.
- [3] Ministry of Power, Government of India, Central Electricity Authority, http://www.cea.nic.in/reports/monthly/executive_rep/Nov14.pdf.
- [4] Zhang X, Zhao X, Smith S, Xu J and Yu X, —Review of R&D progress and practical application of the solar photovoltaic/thermal (PV/T) technologies, *Renewable & Sustainable Energy Reviews*, 16(1), (2012), 599–617.
- [5] Bahadori A and Nwaoha C, —A review on solar energy utilization in Australia, *Renewable & Sustainable Energy Reviews*, 18(0), (2013), 1–5.
- [6] Dincer F., —The analysis on photovoltaic electricity generation status, potential and policies of the leading countries in solar energy, *Renewable & Sustainable Energy Reviews*, 15(1), (2011), 713–20.
- [7] Saini R.P, *Solar photovoltaic Design and Application*, AHEC IIT Roorkee, 2014.
- [8] *Solarification of IIT Roorkee Campus*, AHEC IIT Roorkee 2010.
- [9] *Photovoltaic system performance monitoring—guidelines for measurement, data exchange and analysis*. IEC standard 61724. Geneva, Switzerland; 1998.
- [10] Sharma V, Chandel SS. Performance analysis of a 190kWp grid interactive solar photovoltaic power plant in India. *Energy* 2013; 55:476–85.
- [11] *PV Solar Home System Qualification Testing Procedure*, June 2011 Instituto De Energia Solar Universidad Politecnica De Madrid.
- [12] Carr AJ, Pryor TL. A comparison of the performance of different PV module types in temperate climates. *Solar Energy* 2004; 76:285–94.
- [13] Synergy Enviro Engineers, source NREL.
- [14] <http://www.tatapowersolution.com>

QUEUING THEORY IN WORKSHOP

Dr. Saloni Srivastava

Assistant Professor, Faculty of Engineering and Technology, Agra College, Agra, (India)

ABSTRACT



When we are out of the home, we see a huge number of vehicles in the street. It is observed that numbers of vehicles are increasing very rapidly. However, number of vehicles for repairing also increasing in the workshop. Now, there is a tough competition held between the workshops. When there is a huge waiting line in one workshop then a customer withdraw and go to the competitor's door; the service time may need to be improved. In this paper, we show that a queuing theory satisfies the model when tested with a real case scenario. A workshop in Arthoni provide us a data and also we derive the arrival rate, service rate, utilization rate, waiting time in queue and the probability of potential customers to balk based on the data using Little's theorem and $M/M/1/GD/\infty/\infty$ queuing model. The mean arrival rate at Kavisha during its busiest period of the day is 2.22 customers per minute (cpm) while the service rate is 2.24 cpm. The average number of customers in the workshop is 133 and the utilization period is 0.991. Our result involved the benefits of performing queuing analysis to a busy workshop.

Keywords — Queue, Little's Theorem, Workshop, Waiting Lines

I. INTRODUCTION

1.1 Workshop (A Repair Shop)

The basic purpose of the workshop is to offer paintwork repairs to scratches, scuffs and dents to vehicle damage as well as damage caused by collisions and major accidents. Repair shops often can be specialty shops specializing in certain parts such as brakes, mufflers and exhaust systems, transmissions, body parts, tires,

automobile electrification, automotive air conditioner repairs, automotive glass repairs and installation, and wheel alignment or those who only work on certain brands of vehicle or vehicles from certain continents of the world. There are also automotive repair shops that specialize in vehicle modifications and customization.



1.2 Need of the Queuing Theory in a Repair Shop

As the number of vehicles increases, number of workshop are not increasing as a result service time decreasing and customer became impatient and went to the competitor's shop. There are several determining factors for a workshop to be considered a good or a bad one. Paint, Crash Parts, Refinishing Materials, Repair Materials, Tools, Capital Equipment, Mechanical Parts etc. are some of the most important factors. These factors, when managed carefully, will be able to attract plenty of customers. However, there is also another factor that needs to be considered especially when the workshop has already succeeded in attracting customers. This factor is the customers queuing time. Queuing theory is the study of queue or waiting lines. Some of the analysis that can be derived using queuing theory include the expected waiting time in the queue, the average time in the system, the expected queue length, the expected number of customers served at one time, the probability of balking customers, as well as the probability of the system to be in certain states, such as empty or full.

Waiting lines are a common sight in workshops especially during day and evening time. Hence queuing theory is suitable to be applied in a workshop setting since it has an associated queue or waiting line where customers who cannot be served immediately have to queue (wait) for service. Researchers have previously used queuing theory to model the restaurant operation [2], reduce cycle time in a busy fast food restaurant [3], as well as to increase throughput and efficiency [5].

This paper uses queuing theory to study the waiting lines in Kavisha Workshop in Arthoni, Agra. The workshop provides three workers per customer. There are 20 to 25 workers working at any one time. On a daily basis, it serves over 600 customers during weekdays, and over 2000 customers during weekends. This paper seeks to illustrate the usefulness of applying queuing theory in a real case simulation.

1.3 QUEUING THEORY

In 1908, Copenhagen Telephone Company requested Agner K. Erlang to work on the holding times in a telephone switch. He identified that the number of telephone holding time fit into Poisson distribution and exponentially distributed. This was the beginning of the study of queuing theory. In this section we will discuss two common concepts in queuing theory.

1.3.1 Little's Theorem

Little's theorem [7] describes the relationship between throughput rate (i.e. arrival and service rate), cycle time and work in process (i.e. number of customers/jobs in the system). This relationship has been shown to be valid for a wide class of queuing models. The theorem states that the expected number of customers (N) for a system in steady state can be determined using the following equation:

$$L = \lambda T \quad (1)$$

Here, λ is the average customer arrival rate and T is the average service time for a customer. Consider the example of a workshop where the customer's arrival rate (λ) doubles but the customers still spend the same amount of time in the workshop (T). These facts will double the number of customers in the workshop (L). By the same logic, if the customer arrival rate (λ) remains the same but the customers service time doubles this will also double the total number of

customers in the workshop. This indicates that in order to control the three variables, managerial decisions are only required for any two of the three variables.

Three fundamental relationships can be derived from Little's theorem [6]:

- Ø L increases if λ or T increases
- Ø λ increases if L increases or T decreases
- Ø T increases if L increases or λ decreases

Rust [8] said that the Little's theorem can be useful in quantifying the maximum achievable operational improvements and also to estimate the performance change when the system is modified.

1.3.2 Queuing Models and Kendall's Notation

In most cases, queuing models can be characterized by the following factors:

1. **Arrival time distribution:** Inter-arrival times most commonly fall into one of the following distribution patterns: a Poisson distribution, a Deterministic distribution, or a General distribution. However, inter-arrival times are most often assumed to be independent and memory less, which is the attributes of a Poisson distribution.
2. **Service time distribution:** The service time distribution can be constant, exponential, hyper-exponential, hypo-exponential or general. The service time is independent of the inter-arrival time.
3. **Number of servers:** The queuing calculations change depends on whether there is a single server or multiple servers for the queue. A single server queue has one server for the queue. This is the situation normally found in a grocery store where there is a line for each cashier. A multiple server queue corresponds to the situation in a bank in which a single line waits for the first of several tellers to become available.
4. **Queue Lengths (optional):** The queue in a system can be modeled as having infinite or finite queue length.
5. **System capacity (optional):** The maximum number of customers in a system can be from 1 up to infinity. This includes the customers waiting in the queue.
6. **Queuing discipline (optional):** There are several possibilities in terms of the sequence of customers to be served such as FIFO (First In First Out, i.e. in order of arrival), random order, LIFO (Last In First Out, i.e. the last one to come will be the first to be served), or priorities.

Kendall, in 1953, proposed a notation system to represent the six characteristics discussed above. The notation of a queue is written as:

$$A/B/P/Q/R/Z$$

where A, B, P, Q, R and Z describe the queuing system properties.

- § A describes the distribution type of the inter arrival times.
- § B describes the distribution type of the service times.
- § P describes the number of servers in the system.
- § Q (optional) describes the maximum length of the queue.
- § R (optional) describes the size of the system population.
- § Z (optional) describes the queuing discipline.

1.3.3 Maruti Workshop Queuing Model

The data were obtained from Kavisha workshop through interview with the workshop manager as well as data collections through observations at the restaurant. The daily number of visitors was obtained from the workshop itself. The workshop has been recording the data as part of its end of day routine. We also interviewed the workshop manager to find out about the capacity of the workshop, the number of workers, as well as the number of machines in the workshop. Based on the interview with the workshop manager, we concluded that the queuing model that best illustrate the operation of Kavisha is M/M/1.

This means that the arrival and service time are exponentially distributed (Poisson process). The workshop system consists of only one server. In our observation the workshop has several workers but in the actual waiting queue, they only have one machine to serve all of the customers.

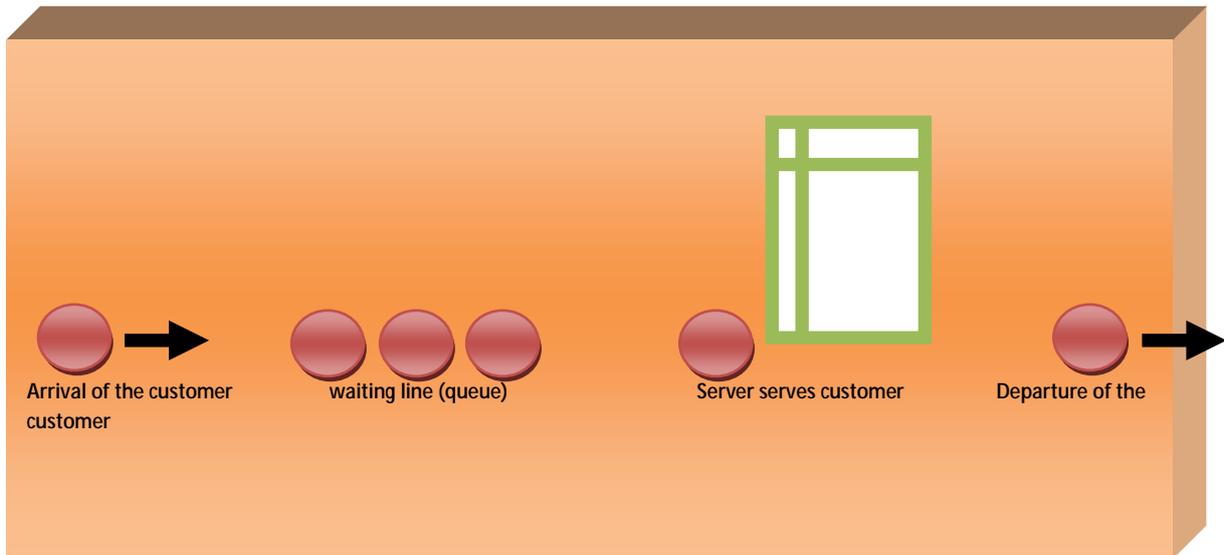


Figure 1: M/M/1 Queuing Model

For the analysis of the Kavisha M/M/1 queuing model, the following variables will be investigated [6]:

- ✓ **The mean customers arrival rate:** λ
- ✓ **The mean service rate:** μ
- ✓ **Utilization factor:** $\rho = \lambda/\mu$ (1)
- ✓ **Probability of zero customers in the workshop:** $P_0 = 1 - \rho$ (2)
- ✓ **Probability of having n customers in the workshop:** $P_n = P_0\rho^n = (1 - \rho)\rho^n$ (3)

Avera

ge number of customers served in the workshop: $L = \frac{\rho}{1-\rho} = \frac{\lambda}{\mu-\lambda}$ (4)

✓ **Average number in the queue:** $L_q = L \times \rho = \frac{\rho^2}{1-\rho} = \frac{\rho\lambda}{\mu-\lambda}$ (5)

✓ **Average time spent in Kavisha, including the waiting time:** $W = \frac{L}{\lambda} = \frac{1}{\mu-\lambda}$ (6)

Avera

ge waiting time in the queue: $W_q = \frac{L_q}{\lambda} = \frac{\rho}{\mu-\lambda}$ (7)

II. RESULT AND DISCUSSION

The one month daily customer data were shared by the workshop manager as shown in Table I.

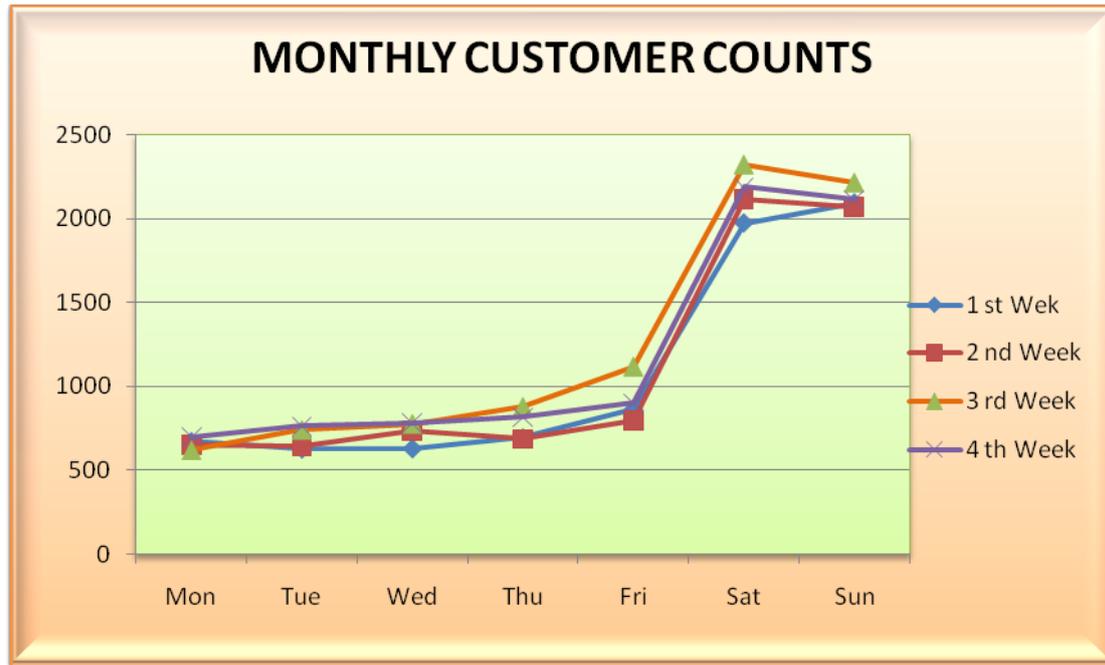


Figure 2: One Month daily customer counts

As can be seen in Figure 2, the number of customers on Saturdays and Sundays are double the number of customers during weekdays. The busiest period for the workshop is on weekend during day time. Hence, we will focus our analysis in this time window.

2.1 . Calculation

Our teams conducted the research at dinner time. There are on average 600 people are coming to the workshop in every 270 minutes time window of day time. From this we can derive the arrival rate as:

$$\lambda = \frac{600}{270} = 2.22 \text{ customers /minute (cpm)}$$

We also found out from observation and discussion with manager that each customer spends one hour on average in the workshop (W), the queue length is around 40 people (Lq) on average and the waiting time is around 18 minutes.

It can be shown using (7) that the observed actual waiting time does not differ by much when compared to the theoretical waiting time as shown below.

$$W_q = \frac{40 \text{ customers}}{2.22 \text{ cpm}} = 18.02 \text{ minutes}$$

Next, we will calculate the average number of people in the workshop using (1).

$$L = 2.22 \text{ cpm} \times 60 \text{ mins.} = 133.2 \text{ customers}$$

Having calculated the average number of customers in the workshop, we can also derive the utilization rate and the service rate using (4).

$$\mu = \frac{\lambda(1 + L)}{L} = \frac{2.22(1 + 133.2)}{133.2} = 2.24 \text{ cpm}$$

$$\text{Hence, } \rho = \frac{\lambda}{\mu} = \frac{2.22 \text{ cpm}}{2.24 \text{ cpm}} = 0.991$$

With the very high utilization rate of 0.991 during day time, the probability of zero customers in the workshop is very small as can be derived using (2).

$$P_0 = 1 - \rho = 0.019$$

The generic formula that can be used to calculate the probability of having n customers in the workshop is as follows:

$$P_n = (1 - 0.991)0.991^n = 0.019(0.991)^n$$

We assume that potential customers will start to balk when they see more than 10 people are already queuing for the workshop. We also assume that the maximum queue length that a potential customer can tolerate is 45 people. As the capacity of the workshop when fully occupied is 130 people, we can calculate the probability of 10 people in the queue as the probability when there are 140 people in the system (i.e. 130 in the restaurant and 10 or more queuing) as follows:

Probability of customers going away = P (more than 15 people in the queue) = P (more than 140 people in the workshop)

2.2. Evaluation

1. The utilization is directly proportional with the mean number of customers. It means that the mean number of customers will increase as the utilization increases.
2. The utilization rate at the workshop is very high at 0.991. This, however, is only the utilization rate during day time on Saturdays and Sundays. On weekday, the utilization rate is almost half of it. This is because the number of visitors on weekdays is only half of the number of visitors on weekends. In addition, the number of workers or machines remains the same regardless whether it is peak hours or off-peak hours.
3. In case the customers waiting time is lower or in other words we waited for less than 15 minutes, the number of customers that are able to be served per minute will increase. When the service rate is higher the utilization will be lower, which makes the probability of the customers going away decreases.

2.3 Benefits

1. This research can help Kavisha to increase their QOS (Quality Of Service), by anticipating if there are many customers in the queue.
2. The result of this paper work may become the reference to analyze the current system and improve the next system. Because the workshop can now estimate of how many customers will wait in the queue and the number of customers that will go away each day.
3. By anticipating the huge number of customers coming and going in a day, the workshop can set a target profit that should be achieved daily.
4. The formulas that were used during the completion of the research is applicable for future research and also could be use to develop more complex theories.
5. The formulas provide mechanism to model the workshop queue that is simpler than the creation of simulation model in [9,4].

III. CONCLUSION

This research paper has discussed the application of queuing theory of Kavisha Workshop. Here we have focused on two particularly common decision variables (as a vehicle for introducing and illustrating all the concepts. From the result we have obtained that the rate at which customers arrive in the queuing system is 2.22 customers per minute and the service rate is 2.24 customers per minute. The probability of buffer flow if there are 10 or more customers in the queue is 15 out of 100 potential customers. The probability of buffer overflow is the probability that customers will run away, because may be they are impatient to wait in the queue. This theory is also applicable for the workshop if they want to calculate all the data daily. It can be concluded that the arrival rate will be lesser and the service rate will be greater if it is on weekdays since the average number of customers is less as compared to those on weekends. The constraints that were faced for the completion of this research were the inaccuracy of result since some of the data that we use was just based on assumption or approximation. We hope that this research can contribute to the betterment of Kavisha Workshop in terms of its way of dealing with customers.

REFERENCES

- [1] T. Altiok and B. Melamed, *Simulation Modeling and Analysis with ARENA*. ISBN 0-12- 370523-1. Academic Press, 2007.
- [2] D.M. Brann and B.C. Kulick, "Simulation of restaurant operations using the Restaurant Modeling Studio," Proceedings of the 2002 Winter Simulation Conference, IEEE Press, Dec. 2002, pp. 1448-1453.
- [3] S. A. Curin, J. S. Vosko, E. W. Chan, and O. Tsimhoni, "Reducing Service Time at a Busy Fast Food Restaurant on Campus," Proceedings of the 2005 Winter Simulation Conference, IEEE Press, Dec. 2005.
- [4] K. Farahmand and A. F. G. Martinez, "Simulation and Animation of the Operation of a Fast Food Restaurant," Proceedings of the 1996 Winter Simulation Conference, IEEE Press, Dec. 1996, pp. 1264-1271.
- [5] A. K. Kharwat, "Computer Simulation: an Important Tool in The Fast-Food Industry," Proceedings of the 1991 Winter Simulation Conference, IEEE Press, Dec. 1991, pp. 811-815.
- [6] M.Laguna and J. Marklund, *Business Process Modeling, Simulation and Design*. ISBN 0-13- 091519-X. Pearson Prentice Hall, 2005.
- [7] J. D. C. Little, "A Proof for the Queuing Formula: $L = \lambda W$," Operations Research, vol. 9(3), 1961, pp. 383-387, doi: 10.2307/167570.
- [8] K. Rust, "Using Little's Law to Estimate Cycle Time and Cost," Proceedings of the 2008 Winter Simulation Conference, IEEE Press, Dec. 2008, doi: 10.1109/WSC.2008.4736323.
- [9] T. C. Whyte and D. W. Starks, "ACE: A Decision Tool for Restaurant Managers," Proceedings of the 1996 Winter Simulation Conference, IEEE Press, Dec. 1996, pp. 1257- 1263.

THE POSITIVE POWER OF PRIVATE EQUITY: A STUDY ON THE INFRASTRUCTURE SECTOR OF INDIA

Dr. Renu Verma¹, Dr. Harsh Purohit², Ms. Prapti Paul³

¹Faculty Member, IBS Business School Gurgaon (India)

²Dean, Faculty of Management Studies

- WISDOM Chair-ICICI Bank and Chair for BFSI Banasthali Vidyapith (India)

³Faculty Member, IBS Business School (India)

ABSTRACT

India is one of the fast growing economies of the world. Infrastructure plays a crucial role in the development of an economy. As infrastructure requires huge capital investment, Government of India opened up this field for private sector participation which resulted in private capital inflows of various forms in this sector. Private equity emerged as an important class of investment in infrastructure to reap the benefits in an economy like India.

The present study analyzes the trends of private equity inflows in terms of number of deals and value of deals during 2001-2010 in the field of infrastructure. From the view point of analysis, infrastructure sector has been divided in seven subsectors but the main focus has been on major three sectors i.e.. Telecom, Oil & Gas and Power & allied which have attracted the maximum private equity investments in terms of value and volume during the period of the study. The present study is based on secondary data collected from specific database – Venture Intelligence and EMIS. Besides bar charts, Pie charts, percentage, arithmetic mean, coefficients of correlation have also been estimated to check the association between these sub sectors in terms of private equity inflows. The paper also investigates the issues, challenges, government policy and regulatory support concerning these sub sectors. Based on the findings of the study, an attempt has been made to suggest certain measures that India would need to sustain the same level of or attract even higher private equity investments in the coming decade.

Keywords: Asset Class, Coefficient of Correlation, Financial System, Infrastructure, Private Equity

I INTRODUCTION

The Indian economy has been on growth trajectory in all fields as a planned economy thus becoming a safe and attractive destination for foreign investment. Ever since Indian economy underwent series of reforms from 1991, there have been progressive steps in banking, finance, industry, investment climate, incomes, employment, legal environment, etc. India has enjoyed an average growth rate of 9% p.a in GDP growth in the recent years and investments from FIIs, increased FDI in several sectors, surging Foreign Exchange reserves, deregulation of interest rates, etc., have all been witnessed in recent years. Capital Market has undergone dramatic changes, with

SEBI as regulator, yielding returns to all segments of investors – retail or wholesale .If Indian continues to grow at this pace, according to experts, the share of the India in world GDP is expected to rise from the present 6 to 11 per cent by 2025, and emerge as the third major force in the global economy after the US and China. High growth rates in Industry and Services sector and the changing world economic environment has provided a conducive backdrop to the Indian economy.

One of the reasons for this high growth that could be achieved in the last decade was due to availability of private financial capital for expansion and the positive influence of these private equity houses on Indian management practices. There has been phenomenal growth in the value of private equity investment in India over the past decade. With an expanding domestic market and additional opportunities brought by globalization, the impact of private equity on Indian business is likely to increase further in the coming yearsGOI also recognizes the key role of foreign capital for economic development and as an important source of technology and global best practices. In this context the role of private equity as an important component of foreign capital has been very crucial for the development of Indian economy and particularly in the field of infrastructure of the country.

With an expanding domestic market and additional opportunities brought by globalization, the impact of private equity on Indian business is likely to increase in the coming years. It is crucial therefore, to undertake a review of the private equity investment that took place in the last decade and assess if there is any important trend which could be observed and analyze the underlying policy framework for the same. Also, as investments in the Infrastructure sector would be crucial for claiming the country's future growth as projected, an attempt herehas been madeto study the private equity investments in the various sub sectors of the Infrastructure Sector.The core infrastructure sectors are likely to see continued private equity deal activity.The study so reviews the deal trends, developments, issues and challenges in the Infrastructure sector and highlights the underlying policy and regulatory support that India would need to sustain the same level of or attract even higher investments in the coming decade.

II PRIVATE EQUITY

Alternative investment asset classes which were traditionally not considered as a part of an investment portfolio have become importantsources of capital in the global financial system today. Private Equity is a broad term that refers to any type of equity investment in an asset in which the equity is not freely tradable on a public stock market. Categories of Private Equity investment include leveraged buyout, venture capital, growth capital, angel investing, mezzanine capital and others as can be seen in the table below:

Table I: Different Categories of Private Equity

Leveraged Buyout:	The private equity funds provide capital for acquiring the controlling stake or purchasing the company using debt and equity capital. The term leverage depicts that it involves using more of debt than equity. The buyout can be referred to as Management Buy In (MBI) or Management Buy Out (MBO) type of transaction.
Management buy-in (MBI)	When a management team buys into a firm from outside, taking a majority stake, it is most likely to need private equity financing. A Management Buy-In most is

	<p>likely to happen if the internal management lacks the required expertise or the funding needed to 'buy out' the firm from within. This situation can also occur if there are succession issues - in family businesses; for example, there may be nobody suitable to take over the management of the company. It is important to note that an MBI can be more risky than a MBO because the new management might not be familiar with the way the company works.</p>
Management buy-out (MBO)	<p>This is form of investment wherein a private equity firm provides finance to current operating management to enable them to acquire or to buy at least 50 per cent of the business they manage. In return, the private equity firm normally seeks a stake in the business. This is amongst the least risky types of private equity investment as the firm is well established and the managers managing it know the business - and the market it operates in - extremely well.</p>
Angel Investing:	<p>This refers to private equity investment in small closely held firms by high net worth individuals, in which they usually have some operational experience. They may have significant ownership stakes in the company and may be active in guiding the company, but they usually are not as active as professional managers in supervising the company and rarely exercise control.</p>
Venture Capital:	<p>It refers to long term investment in innovative technology based projects which display potential for substantial financial returns and growth. It provides seed, start up and first stage financing to these industrial enterprises.</p>
Growth Capital:	<p>Growth capital is one of the most flexible types of financing. The money borrowed under this line of credit can be used for any corporate purposes. The administration under this type of facility is also fairly simplified as the firm need not provide for invoices or other backup material. This type of capital can be a useful way to extend a company's runway between various rounds of financing. The time saved can be utilized to complete additional milestones that will help to raise the valuation of the company, or as a buffer to ensure that all the intended milestones are successfully achieved.</p>
Mezzanine Capital:	<p>It refers to the investment to be made in companies which have already proven their financial viability but still have to raise some funds from the market. It is related with the middle layer of financing in case of leveraged buy-outs.</p>

The process of a private equity fund raising involves arranging large pools of equity capital from various investors. The fund then bids for and acquires stakes in the operating firms using the said capital, supplemented by borrowings equal to around three or four times the equity capital they invest. Generally, they bring about a change in the company's management incentive scheme so as to give the management team a much larger share of the shareholder's wealth that is successfully created. Thereafter, the operating company's board of directors is sometimes supplemented /replaced by the general partners of the private equity firms who have a huge stake in the success of the business. The private equity firm then manages the acquired firm for optimum cash flow generation.

III REVIEW OF LITERATURE

This area has attracted the attention of many researchers after the 1980s. Some major studies which have been undertaken in this area nationally and internationally can be quoted here. A large literature investigating the economic effects of buyouts, mainly focused on the U.S in the 80's and 90's, have generally demonstrated a positive impact of this new form of corporate organization, measured by increased profitability and productivity of the investee company. **Kaplan [1] (1989); Lichtenberg and Siegel [2] (1990); Muscarella and Vetsuypens [3] (1990); Palepu [4] (1990); Smith [5] (1990); Wright et al [6] (1992)]**

A central hypothesis since **Jensen [7] (1989)** has been that private equity has the ability to improve the operations of firms. Beginning from monitoring of the day to day operations to reviewing performance of the staff and managers closely, keeping a check on free cash flows and incentivizing employees with equity / stock options, sthe private equity-backed firms are able to enhance operations in the firms they invest in. Jensen also suggested that the impact of the leveraged buyouts (LBOs) may not only influence the behavior and management performance of the acquired firm but raise competitive pressure which may leadto improved operations. Multiple empirical studies have been conducted in this regard and several of them conclude that the all the private equity-backed companies have considerably improved their operationssince PE investment has taken place. The changes in accounting and financial performance for 76 of the large management buyouts of public companies between 1980 and 1986 was investigated by **Kaplan (1989)** andthe findings includethere has been a considerable improvement noticed in the operating income, cash flow and market value in all these firms post three years the transaction took place. He also claimed that these improvements were actually due to the impact of employees getting motivated and incentivized rather than layoffs. **Muscarella and Vetsuypens (1990)** examined 72 "reverse LBOs" (RLBOs) and concluded that thesefirms experienced a remarkable increase in profitability, the argument for which is may be due to the impact of cost reductions. There have been examples of more recent studies where large sample size of companies from countries other than U.S. have been studied and a variety of performance measures were evaluated to analyse whether private equity makes a difference in the management of the firms in which they invest. **Cumming and Walz [8] (2004)** assessed the returns generated by the investors from the buyouts in an international context. The authors compared buyout returns to the returns of other stages of venture capital and private equity investments and the study is based on an international sample of 5,114 investments across 39 countries. For the subset of the buyout data from the U.S. and the U.K. which covering the 1984-2001 period, they found an average return of 26.1% to LBOs and an average return of 21.5% to MBOs based on a sample of 259 buyouts. A significant finding of this

study was that the average returns to earlier stage venture capital investments were greater than the average returns to buyouts, whereas the median returns to buyouts were greater than the median returns to earlier stage venture capital investments. They showed that cross-sectional differences in returns for all types of venture capital private equity investments largely depend on corporate governance mechanisms.

A study conducted by **Kaushal Shah and Associates [9] (2007)** indicated that private equity and venture capital are becoming a major instrument for fostering innovation and entrepreneurial growth. In India, this has been catalyzed by the rapid growth in information technology. An exhaustive research study of 6 markets in Asia: Australia/ New Zealand, Greater China, India, Japan, Korea and Southeast Asia was conducted on deal sizes, fund raising and exits, comparisons of size, growth and potential among these very different economies was brought out in a report on **Private Equity and Principal Investing[10] (2010)**.

From 2003 to 2008, the growth of private equity investments in dollar terms in the above mentioned markets averaged nearly 22% compounded annually. And, this is mainly spearheaded by Greater China (47% compounded annual growth rate) and India (59% compounded annual growth rate).

India soared with private equity investments at a CAGR of more than 100 percent between 2004 and 2008 making it the fastest growing private equity market in Asia. The principal factors responsible for such performance included: low barriers to entry for private equity firms, well developed legal and regulatory system, widespread use and acceptance of English as the language of business, capable investment banks and active equity capital market.

The private equity market in India is led by expansion deals that associate well with exceedingly consistent macroeconomic factors, such as GDP growth and exports of IT and business process outsourcing services. The government is likely to spend over USD 500 billion on fresh infrastructure- rails, roads, ports and power plants, amongst other investments over the next five years during the 12th plan period.

Several private equity houses have introduced funds set aside for infrastructure or solely evaluating renewable and green assets. Blackstone's investment in Nagarjuna Construction, Goldman Sach's investment in Sudhir Gensets and 3i's investment in Adani Power are all minority stake holdings headed to take advantage of the growth in demand for infrastructure.

IV RESEARCH OBJECTIVES

India has witnessed a behemoth rise in Private Equity and Venture Capital financing as the country has opened its doors to foreign funding. The Indian companies have ventured out in creating strategic partnerships with various private equity funds and venture capital firms on a scale which was never witnessed earlier. The assessment carried out shall also indicate the sub-sector of Energy and infrastructure sector which has received the maximum private equity investments in terms of volume and value. The main objectives of the study are listed below:

- a. To study the private equity inflow in India from 2001-2010.
- b. To study the private equity trends in Indian Energy and Infrastructure sector from 2001-2010 and identify which sub sector/s are playing a dominant role in attracting private equity investments in India.

- c. To analyze the role of government policy and regulatory support aiming at development of identified sub sectors of Energy and Infrastructure sector and its impact on the inflows of private equity investments in these sub sectors.
- d. To suggest the policy makers the initiatives that could be taken to enhance economic growth via private equity.

V METHODOLOGY

The study has been divided into two main sections.

1. The first section will examine the private equity inflow in India from 2001-2010 and particularly compare the private equity investments in seven sub sectors of Energy and Infrastructure namely:
 - i. Power & Allied (Power)
 - ii. Oil & Gas (O&G)
 - iii. Heavy Construction (HC),
 - iv. Transportation and Logistics (Logistics),
 - v. Water and Waste Treatment (W&W),
 - vi. Cement, and
 - vii. Telecommunication & Wires (Telecom)
2. The second section would examine the policy decisions that have contributed to this difference in volume and value of private equity in the different sub sectors of Energy and Infrastructure sector of India.

The present study is primarily based on secondary data collected from specific database such as Emerging Markets Information System (EMIS) and Venture Intelligence, as the data related to private equity is not easily accessible in public domains. Besides, the secondary data has also been collected from other sources like business journals, research papers, consulting companies' publications and thought leadership papers for the purpose of the data analysis.

The data has been collected for the period from 2001-2010 on two major aspects of private equity which are volume and value of deals in the sub sectors of Energy and Infrastructure sector of India. This period has deliberately been chosen as it includes an upward and downward cycle in the economy and maximizes the number of companies taken for comparison.

The collected data has been analyzed with the help of tables, bar diagrams, graphs and simple arithmetic mean. Besides, coefficient of correlation has also been estimated to check whether there is any relation between the various sub sectors which have attracted the highest value of private equity investments in the last decade.

VI LIMITATIONS

Though private equity investments now span across numerous sectors and are rapidly rising, for the purpose of this study, focus is only on the 7 subsectors of the India's Infrastructure sector. Also, the industry specialization of private equity firms and buyout specialization impact has not been considered in the study.

6.1 Private Equity in India- story of last decade

PE funding in India has been observed to have grown at a rapid rate in the last few years, though the major growth was experienced post year 2003 when the global markets started responding back from the consequences of the dot com bust and the subsequent US economic slowdown. One cannot deny the fact that the inflow of private equity investments has not been consistent throughout the period of study. The value of PE investments which was US \$865 Mn in 2003 had gone up to US\$ 1.3 Billion in 2004, US \$2.3 Billion in 2005 and US \$6.0 Billion in 2006. In early 2004, the US market which constitutes almost 60 per cent of the world’s PE market, had begun to stabilize and started showing signs of recovery. The total number and value of PE / VC investments had gone down between the years 2000 to 2003 whereas the trend is upwards during the years 2004-06. The growing confidence in the Indian economy, noteworthy progress in global perception of India, optimism in the Capital markets, and enriched performance of the previous cross border transactions resulted in the country’s total Mergers and Acquisitions (M&A) and PE activity register an incredible growth in the second half of the last decade as shown below.



Figure I: Trends in Private Equity in India

Opportunities across the sectors in India continued to fuel M&A activity. With an expanding domestic market and further opportunities brought by globalization, the impact of private equity on Indian business is likely to increase further in the coming years.

Table II: Infrastructure sub-sectors Deal Analysis 2001-2010

Sub-sectors	Deal Value (USD Mn)	Percentage (%)
Cement	5331.01	4.20%
Heavy Construction	170.15	0.13%
Oil & Gas	24521.12	19.31%
Power & Allied	20112.49	15.84%
Telecom	71145.21	56.03%
Logistics	5515.95	4.34%
W & W	170.29	0.13%
Total	126966.22	100.00%

During the period of study, private equity inflows have taken place in energy and infrastructure sector but all the sectors have not witnessed the same growth. No doubt, some sub-sectors have been lagging behind while others have performed exceedingly well. For example cement, logistics and heavy construction have witnessed low growth whereas the infrastructure sectors – Telecom, Power and Oil & Gas have been consistently amongst the top sectors to receive PE investments as is seen in the Fig below. This clearly depicts that Telecom, Power and O&G are the three sub-sectors which dominated the Infrastructure space in terms of attracting private investments during the last decade.

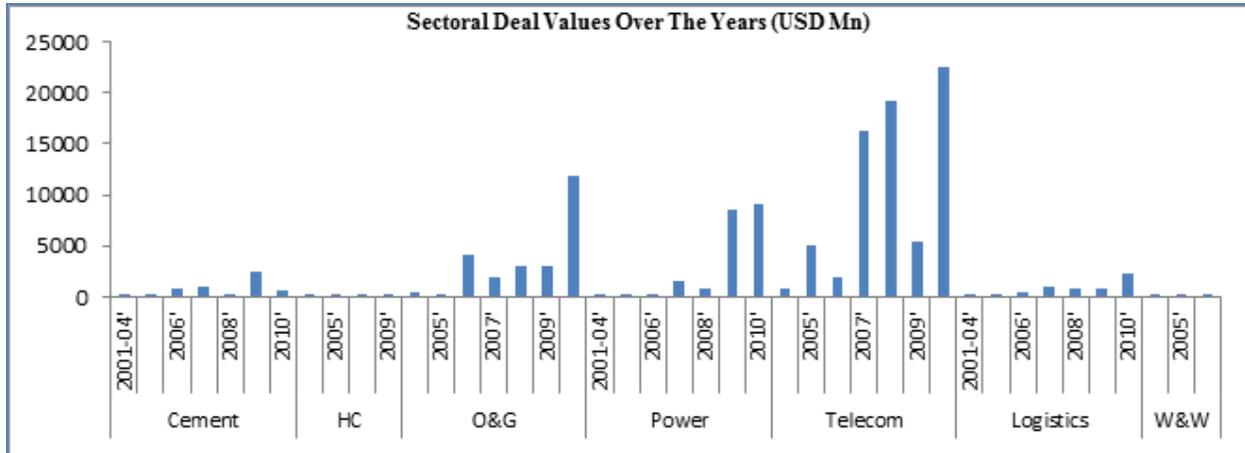


Figure II: Sectoral investment trend

(Source: EMIS Deal Watch Analysis)

Indian Infrastructure sector has continued to attract significant private equity investments, accounting for approximately 28 per cent of total private equity deal value in the year 2010. The increasing need for telecom infrastructure and energy demand of the country ensured both growth and consolidation within these sectors.

The core infrastructure sectors - power, roads and highways, and construction are likely to see continued private equity deal activity. Furthermore, private equity houses are also likely to pursue investment opportunities in the domestic demand-driven sectors including education, healthcare retail and consumer products. The Table below outlines the investments that took place in these three sub-sectors in the evaluation period.

Table III: Top 3 Infrastructure Sub-Sector Deal Values 2001-2010 (USD Mn)

Subsector	2001-04	2005	2006	2007	2008	2009	2010	Average
O&G	521	11	4,207	1,929	3,017	3,036	11,801	3,503
Power & Allied	55	61	195	1,492	738	8,453	9,119	2,873
Telecom	787	5,096	1,962	16,350	19,155	5,364	22,430	10,164

(Source: EMIS Deal Watch)

The following paragraph examines the relationship between the 3 top performing sub sectors i.e. Power and Allied, Telecom and Oil and Gas. The coefficient of correlation has been estimated and results have been shown in the Table below.

Table IV: Calculation of Correlation Coefficient

Subsector	R	R ²	DF	T Value
O&G	521	0.508	8	5.801
Power & Allied	55	0.380	8	3.985
Telecom	787	0.152	8	1.839

The table above shows the results of the linearity checks which were conducted for the investments in the above sub-subsectors. A correlation coefficient of 0.713 was observed between investments in Oil & Gas and Power which means a high correlation exists between investments in these two sectors. This is precisely because both these subsectors are guided by the overall energy security plans of the country and would depend on the energy supply position, the unrestricted demand scenario and the country's policies and regulations to meet the projected demand. A correlation coefficient of 0.617 is observed between O&G and Telecom which probably indicates the country's policies for both these sub-sectors have been progressive and investors perceived similar opportunities. A correlation coefficient of 0.390 is observed between Power and Telecom showing a weak linearity trend and probably unrelated investments over the years during the evaluation period.

The correlation coefficient (R) computed above measures the strength and direction of a linear relationship between the investments in the sectors. We have also carried out the significance of such correlation by using 2 sided t-test with degrees of freedom (df) equal to 8. Assuming a level of significance ($\alpha = 0.05$) and a critical value of 3.72 for two tailed t-test, it is found that the test value falls in the critical region for both O&G, Power and O&G, Telecom indicating there is a significant relationship between the variables under consideration and that null hypothesis of no relationship can be rejected. The test value for Power, Telecom lies below the critical value indicating the null hypothesis of no relationship in population cannot be rejected.

It is with this understanding, we move to the following section to study the underlying factors / reasons which led to such trend and surge in investments.

6.2 Government Policy and Regulative Framework

Long-run economic growth is swayed by availability of infrastructure services. However, insufficient public investment and snowballing consumer demand has necessitated large scaled private participation in developing countries. The economic crisis faced by India in 1990-91 provided an opportunity for unleashing the economy by de-licensing a number of sectors and reducing the role of the Indian Government to run businesses. This led to opening up of infrastructure sectors like power, oil & gas and telecommunication from the shackles of the Government for heightened private participation.

6.3 Indian Telecom Sector

The telecom services have always been acknowledged globally as one important instrument for socio-economic development for a nation. Indian telecommunication sector has endured a major process of makeover through noteworthy policy reforms, mostly beginning with the proclamation of NTP 1994 which was consequently re-emphasized and made progressive under NTP 1999. Compelled by various policy initiatives, the Indian telecom sector beheld a complete makeover in the last decade.

The advent of liberalization in the country got initiated with the proclamation of the New Economic Policy in July 1991. The Telecom equipment manufacturing was de-licensed in 1991 and value added services were professed to the private sector in 1992, following which investments from the private sector were seen progressively in the areas of radio paging, cellular mobile and other value added services. This occasioned in large number of manufacturing units been set up in various parts of the country. Consequently, as a result, most of the equipment found in telecom industry is being manufactured within the country. A major breakthrough was the assertion of the government's intent of liberalizing the telecom sector in the National Telecom Policy resolution of 13th May 1994.

There was a predictable need for independent regulation with the entry of private service providers. With effect from 20th February, 1997, the Telecom Regulatory Authority of India (TRAI) was, thus, established by an Act of Parliament, called the Telecom Regulatory Authority of India Act, 1997. The TRAI was given a mandate to regulate telecom services, including fixation and revision of tariffs for telecom services which were earlier conferred with the Central Government.

The most significant milestone and instrument of telecom reforms in India is the New Telecom Policy 1999 (NTP 99). The NTP-99 laid down a distinct roadmap for future reforms, envisioning the opening up of all the segments of the telecom sector for private sector participation. The Government pronounced on 13.08.2000 the guiding principle for entry of private sector in National Long Distance Services without any restriction on the number of operators. In the field of international telephony, India had agreed under the GATS to review its opening up in 2004. Conversely, competition in this sector was allowed with effect from April 2002 itself.

Another important step was to set up the Universal Service Obligation Fund with effect from April 1, 2002. An administrator was appointed and consequently, the Indian Telegraph (Amendment) Act, 2003 giving statutory status to the Universal Service Obligation Fund (USOF) was approved by both Houses of Parliament in December 2003. The Unified access license regime was announced in November 2003. Under the regime, the service operators were free to provide, within their respective areas of operations, services which cover collection, carriage, transmission and delivery of voice and/or non-voice messages over Licensee's network by deploying circuit, and/or packet switched equipment.

The Internet service was introduced for private participation in 1998 with a view to reassure growth and increasing its penetration. Identifying the prospects for universal Broadband service in the growth of GDP, and also its potential to enrich the quality of life through societal applications including entertainment, e-governance, education, and employment generation by providing access to high-speed information, the Government came out with the Broadband Policy in October 2004. This led to the sudden surge in Private Equity funds in the year 2005 as noted above (Figure 2). The year 2009 was an unfortunate year in terms of new investments due to global recession and this is uniformly being reflected in the sectoral investment trend graph, Figure 5.

Foreign Direct Investment (FDI) has been permitted to the extent of 74% in most of the Telecom services and manufacturing and in some cases even up to 100% has been allowed starting 2010. Additionally, an attractive trade and investment policy, the rewarding incentives for overseas collaborations made India globally one of the world's most attractive markets for the telecom equipment suppliers and service providers.

Unlike Indian Power sector and Oil & Gas sector, the Indian Telecom sector started with the reforms process earlier way back in 1990s and with the introduction of NTP 1994, it opened the doors to the private sector entry without any restriction in the number of operators. Along with de-licensing the trade, what the Telecom sector could manage was to provide an ambient environment for the private investors to participate and stay invested for a longer time.

6.4 Indian Power Sector

The economic planning in India for decades following the country's independence in the year 1947 placed noteworthy importance on the development of the power sector. The premature phase of power sector reform, which began in the early 1990s was aimed at improving the policy climate for private investment. Nonetheless, the Indian power sector has not been able to fascinate any considerable private investment. This is perhaps attributed to an inadequate legal and commercial framework, delays in obtaining regulatory approvals and statutory clearances. Consequently, as a result, entire emphasis was laid on bringing in regulatory reforms leading to the establishment of independent regulatory commissions. The chronology of the policy and regulatory developments are further discussed below.

In 1991, the Government amended the Electricity Supply (Act) 1948 to sanction the entry of private investors in power generation and distribution followed by a tariff notification issued in 1992 which provided for a two-part tariff structure covering fixed and variable costs.

The Ministry of Power (GoI), in 1995, came out with a Mega Power Policy for power generation projects of size over 1000 MW. These power plants, which would supply electricity to multiple states, were termed as Mega power projects. The policy envisioned to introduce a competitive bidding framework for awarding the projects, but did not propose any fiscal concessions. There were shortcomings reported in the policy by various stakeholders which were further addressed through the revised Mega Power Policy of 1998. The Government announced tax concessions and exemption from customs duty on import of capital equipment for such projects. The projects which would qualify as Mega Power Projects were granted an income tax holiday for 10 years. This tax holiday could further be claimed in a block of 10 years within the first 15 years of operations of the power plant. The policy was further liberalized by conferring mega project status to all inter-state thermal projects of 1000 MW and above and thereby enabling these projects to secure duty free import of capital goods.

Complementing the augmentation in the generation capacity, the sector also necessitates substantial investment requirement in the associated transmission and distribution network of the country. The Electricity Laws (Amendment) Act 1998 was enacted to encourage private investments in power transmission networks. Transmission licenses were granted and this aided the infusion of private sector investments. This was followed by introduction of the guidelines for private sector participation in the transmission sector in the year January 2000. The guidelines envisaged two routes: 1) the Joint Venture (JV) route and 2) the Independent Private Transmission Company (IPTC) Route. In the JV route, the Central Transmission Utility / State Transmission Utility own at least 26% equity and the balance are contributed by the Joint Venture Partner. In the IPTC Route, 100% of the equity is owned by the private entity.

An appropriate policy framework is a sufficient but not an adequate measure to improve the climate for private investment in the power sector. Ministry of Power soon realized that in order to attract the much-needed private

investment, the unbundling of the distribution business from the integrated power sector operations undertaken by erstwhile State Electricity Boards should be carried out. Led by similar developments globally in a number of countries, a process of reform was first introduced in the state of Orissa. Orissa became the first state to unbundle the state electricity board (SEB) into five corporatized entities—one each for generation and transmission, and one each for the three distribution zones in the state. An independent regulatory Commission, the Orissa Electricity Regulatory Commission was established to oversee the functioning of these independent companies. Orissa later privatized its power distribution companies to bring in more efficiency and reduce losses in the network and its commercial operations. Successively, the Electricity Act, 2003 endorsed the concept of the unbundling of the State Electricity Boards and provided directive for all other states to follow the reform process within a specified time period.

The enactment of the Electricity Act 2003 deepened the process of reform by introducing competitive bidding framework in the Indian power sector enabling competition in bulk electricity supply, through license-free thermal generation and open access in transmission. It aimed to end all regulatory uncertainties through introduction of multi-year tariff principles to be adopted by every state in their tariff determination process.

Phased competition in the retail electricity supply were also introduced in the form of appointing private distribution franchise operations within the license area and also by the introduction of open access regulations issued by the respective SERCs for access to electricity by the Industrial consumers directly from the power generators. Impending competition in the distribution segment by envisaging the segregation of the wires and supply business further highlights the need for improving efficiency in this segment of the power sector.

The Electricity Act, 2003 sufficiently personifies policy and regulatory framework in support of encouraging private investment in the power sector. Moreover, an amendment to the Act stipulates open access to all consumers with an electricity demand load of more than 1 MW by 27th January, 2009. The Act recommends that the applicable cross subsidy surcharge to be progressively reduced and ultimately eliminated by the SERCs. It is then when the market for electricity will open up greater avenues for prospective Independent Power Producers (IPPs) by means of direct sale to consumers bypassing the distribution licensees.

Ensuing to the enactment of the Act, the National Electricity Policy (NEP), 2005 and the National Tariff Policy (NTP), 2006 were issued by the Ministry of Power. The NEP has re-emphasized the role of private investment in generation, transmission and distribution while, the NTP specifies financial norms associated with the determination of reasonable tariffs to ensure financial viability and attract investments.

6.5 Indian Oil & Gas Sector

The oil and gas sector is one of the most critical components of the country's economy as the economic growth of every country is directly linked with the energy demand. A 8 per cent growth year on year is expected to double India's per capita energy consumption from 560 kilograms of oil equivalent (kgoe) in FY10 to 1,124 kilograms of kgoe by FY32 as reported by many experts. The oil and gas is recognized to be the primary source of fuel meeting the country's demand for energy. Therefore, the Indian Government, to increase efficiency and bringing in the best technologies applied in the developed countries, has recently adopted policies such as allowing 100% FDI in many segments of the sector such as refineries, pipelines, petroleum products, natural gas and infrastructure related to the

marketing of petroleum products. This has led to showering of interests from the private investors. The year 2011 has experienced one of the biggest FDI deals in the country in the oil and gas sector with British Petroleum (BP) entering a US \$ 72 billion deal with Reliance Industries for exploration of offshore oil and gas.

One of the other policy initiatives which led to promoting private investments over the last decade included New Exploration Licensing Policy (NELP), to aid both public and private sector companies in bidding for exploration rights. Over two hundred and forty six blocks were up for bidding over eight bidding rounds through this initiative during the last decade alone, resulting in the discovery of 68 oil and gas fields. The policy allows 100 per cent FDI in small to medium sized oil fields. Nevertheless, the NELP may soon be replaced by the Open Acreage Licensing Policy (OALP), which invites bids all year round unlike NELP that invites bids on an annual basis.

Along with other initiatives in the sector, the Petroleum and Natural Gas Regulatory Board was also established to ensure seamless supply of petroleum and petroleum products throughout the country at regulated prices. Having a role in defining the country's overall energy security and being one of the most precious natural resources, the Indian Oil & Gas sector is still highly regulated, largely state controlled and likely to remain the same in near future.

VII CONCLUSIONS

Along with de-licensing the trade, the Telecom sector managed to provide an ambient environment for the private investors to participate and stay invested for a longer time. Despite having investor friendly policies in the Indian Power sector, there was a lack in participation from private investors due to the deficiency in support from Government in acquiring the various clearances required for the project, the responsibility of which was essentially passed on to the private investors.

It is therefore necessary for the Government to take a note that policy alone is not the single most important factor for furthering private investment and welcoming private capital, but the public administration also needs to move along-with by tying up the loose ends and providing a completely stress free environment for the business to operate.

Also, as we have seen that investments in Power & Allied and Oil & Gas have a positive correlation coefficient, policymakers should have a view of the overall energy security of the country and while developing policies and regulations governing each of these sectors. For e.g. availability of Natural Gas and Natural Gas Distribution policy would have a direct impact on the power generation potential of the country, thereby, linking it to sale of power to Power Distribution utilities from the gas based generation plants and tariff charged to the consumers of electricity. Therefore, any such policy affecting one end of the value chain has an impact on the entire value chain of investments and has to be carefully designed.

With rising competition and margins becoming thinner day by day, and introduction of best class technology applications driving down operational efficiencies, the next phase of developmental growth and flowing of private funds shall begin with consolidations expected in the Indian Telecom industry. Policymakers shall have to make India a fantasy destination for all investments by global players such that the next level of growth could be achieved through global consolidation by means of acquisition, JVs, and partnerships.

With growth in the European markets almost becoming stagnant and other countries in the globe in equally tight economic conditions, India and parts of Asia and Africa are believed to be experiencing the next phase of the growth. PE funds are expected to be investing in Indian markets and looking for right opportunities. The increasing trends of PE investments in different growing sectors in India are welcome. However, this should not lead to bourgeoning of such funds resulting in irresponsible lending merely because of the promising economic conditions. Already in countries like UK, Australia and Gulf, the government authorities have realized the need for surveillance and taken measures to watch the PE industry closely by introducing market regulators and investment watchdogs. Also as policy makers, the Indian bureaucrats should keep in mind the interests of the private developers cum investors' vis-à-vis the interests of the consumers of India and the long term financial security and resource security of the country

VIII. ANNEXURE

8.1 Industry Categorization

Subsector	Industries
Cement	Cement & Glass and Other Nonmetallic Mineral Products
	Cement and Concrete Product Manufacturing
Heavy Construction	Bridge and Tunnel Construction
	Heavy Construction
	Highway and Street Construction
	Highway, Street, Bridge, and Tunnel Construction
	Commercial and Institutional Building Construction
	Engineering Services
	Highway and Street Construction
	Support Activities for Road Transportation
Oil & Gas	Crude Petroleum and Natural Gas Extraction
	Drilling Oil and Gas Wells
	Oil and Gas Extraction
	Support Activities for Oil and Gas Operations
	Industrial Gas Manufacturing
	Petroleum and Coal Products Manufacturing
	Petroleum Lubricating Oil and Grease Manufacturing
	Petroleum Refineries
Power & Allied	Electric Power Generation
	Electric Power Generation, Transmission and Distribution
	Electric Power Transmission, Control, and Distribution
	Nuclear Electric Power
	Fossil Fuel Electric Power Generation
	Other Electric Power Generation
	Turbine and Turbine Generator Set Units Manufacturing
	Utilities
	Hydroelectric Power Generation
	Power Boiler and Heat Exchanger Manufacturing
	Power and Communication Transmission Line Construction
	Cable and Other Program Distribution

Subsector	Industries
	Coal Mining
	Support Activities for Coal Mining
Telecom	Telecommunications
	Wired Telecommunications Carriers
	Other Telecommunication
	Satellite Telecommunication
	Telecommunications Resellers
	Wireless Telecommunications Carriers (except Satellite)
Transport & Logistics	Air Transportation
	Scheduled Freight Air Transportation
	Airport Operations
	Boiler, Tank, and Shipping Container Manufacturing
	Deep Sea Freight Transportation
	Deep Sea Passenger Transportation
	Transportation and Warehousing
	Deep Sea, Coastal, and Great Lakes Water Transportation
	Marine Cargo Handling
	Support Activities for Water Transportation
	Freight Transportation Arrangement
	Process, Physical Distribution, and Logistics Consulting Services
	Port and Harbor Operations
	Water Transportation
	Support Activities for Road Transportation
	Support Activities for Transportation
	Passenger Car Rental and Leasing
	Ship and Boat Building
	Scenic and Sightseeing Transportation
	Support Activities for Rail Transportation
Truck Transportation	
Water Transportation	
Water & Waste Treatment	Waste Treatment and Disposal
	Water Supply and Irrigation System
	Water, Sewage and Other Systems
	Water, Sewer, and Pipeline Construction

REFERENCES

Books

- [1]Kaplan The effects of management buyouts on operating performance and value. Journal of Financial Economics (1989)
- [2] Lichtenberg, F. Siegel The effects of leveraged buyouts on productivity and related aspects of firm behavior. Journal of Financial Economics (1990)
- [3] Muscarella, C. and Vetsuypens, M. Efficiency and Organizational Structure: A study of Reverse LBOs. Journal of Finance (1990)
- [4]Palepu, K.G. Consequences of leveraged buyouts. Journal of Financial Economics (1990)

- [5]Smith, A.J., corporate ownership structure and performance: the case of management buyouts. Journal of Financial Economics (1990)
- [6] Wright, M., Thompson, S., Robbie, K. Venture Capital and Management led Leveraged Buyouts: European evidence. Journal of Business Venturing(1992).
- [7]Jensen, M., Agency cost of free cash flow, corporate finance and takeovers. American Economic Review ((1986)
- [8]Cumming, D., Walz, U., Private equity returns and disclosure around the world. Working Paper, Centre for Financial Studies ((2004).
- [9] Kaushal Shah and Associates Impact of Private Equity and Venture Capital on Indian Economy ((2007),
- [10] Mckinsey and Company, Report on Private Equity and Principal Investing (2010),
- [11] Cochrane, J. H., The risk and return of venture capital. Journal of Financial Economics, 75(1), January, 3-52 (2005).
- [12]Amit, R., Glosten L., Muller E., (1990). Entrepreneurial ability, venture investments and risk sharing, Management Science, 36(10).
- [13]Cressy, R., Determinants of small firm survival and growth. The Oxford Handbook of Entrepreneurship, Oxford University Press, edited Casson, M., Yeung, B., Basu, A., Wadeson, N., 161-193 (2006),
- [14] Smith, A. J., .Corporate ownership structure and performance: the case of management buyouts. Journal of Financial Economics, 27(1), 143-164 (1990).

Journal Papers

- [15] Armour, J., Cumming, D., (2006), The legislative road to Silicon Valley, Oxford Economic Papers 58(4).
- [16]Alemany, L., Marti, J. (2005). Unbiased estimation of economic impact of venture capital backed firms, (Paper presented at the European Financial Management Association 2006 Annual Meetings, Jun28-Jul 1, 2006, Madrid)

Industry Reports and Websites:

- [17] Globalization of Alternative Working Papers Volume 2, World Economic Forum, Report on 'The Global Economic Impact of Private Equity, (2009). http://www.weforum.org/pdf/cgi/pe/Full_Report2.pdf
- [18]Grant Thornton Report on "Top Trends in Middlemarket Private Equity"(2008). www.grantthornton.com.
- [19]SEBI, Dr. Ashok Lahiri, November (2003), Report on Venture Capital in India.
- [20]Bain & Company, (2010), The India Private Equity Report: An inflection point for private equity in India
- [21]Venture Intelligence, (2007), report on Private Equity Impact- impact of private equity and venture capital on Indian economy.
- [22]SEBI October (2000), Report of K.B Chandrashekhar on Venture Capital.
- [23]SpencerStuart, (2007), Report on , Private Equity in India- An executive roundtable
- [24]The Economist, (2004). King of Capitalism. A survey of Private Equity. November,1-15.
- [25]Harper, N., Schneider, A., (2004). Private Equity new Challenge. The Mckinsey Quarterly, summer. www.mckinseyquarterly.com
- [26]KPMG and Confederation of Indian Industries, (2010), Report, Enabling Growth In Promising Indian Companies- The Positive Power of Private Equity. www.kpmg.com

[27]KPMG and Stanford University's Shorenstein Asia-Pacific Research Centre, (2009), report on, reshaping for future success- what's next for private equity in India. www.kpmg.com

[28]McKinsey & Company (2010), Report on Private Equity & Principal Investing. www.mckinseyquarterly.com

Other websites:

[29] www.indiape.com

[30]www.bain.com

[31]www.ssrn.com

[32]www.wikipedia.com

[33]www.ventureintelligence.com

[34]www.spencerstuart.com

[35]www.planningcommission.nic.in

A SURVEY ON OPINION MINING APPROACHES

¹Bijal Shah, ²Nikita P. Desai

^{1,2}Information Technology Department, Dharmsinh Desai University,
Nadiad, Gujarat, (India).

ABSTRACT

Opinion mining tasks involve opinion word identification, classification (positive, negative or neutral) and identifying strength of opinion (positive (strong or weak), negative (strong or weak)), target identification on which opinion is given, opinion source identification and opinion summarization. Hence, Opinion Mining tasks require techniques from the field of natural language processing, information retrieval (IR), and text mining. The main concern is how to automatically identify opinion components from unstructured text and summarize the opinion about an entity from a huge volume of unstructured text.

This study presents a systematic literature survey that contains a comprehensive overview of different approaches of opinion mining. The aim of this study is to provide researchers and students access to the works in opinion mining as they frame new ideas and further develop the practice.

Keywords: *Aspect Mining, Opinion Classification, Opinion Mining, Opinion Polarity, Opinion Word*

I. INTRODUCTION

Opinion Mining needs use of natural language processing tasks for tracking the mood of the public about a particular product or topic. Opinion mining, which involves in building a system to collect and examine and categorize opinions about the product made in blog posts, comments, reviews or tweets. [31]

Opinion mining is the computational treatment of people's opinions, emotions and attitudes toward entities, individuals, events, topics and their attributes. The opinion mining task is technically very challenging and practically very useful. For example, businesses always want to know public or consumer opinions about their products and services. People also want to know the opinions of existing customers before they use a service or purchase a product.

An opinion is the private state of an individual and it represents the individual's ideas, beliefs, judgments and evaluations about a specific subject, topic or item.

Opinion Mining is a procedure used to extract opinion from text. "opinion mining is a recent discipline at the crossroads of information retrieval, text mining and computational linguistics which tries to detect the opinions expressed in natural language texts" [22].

An opinion has three main components, i.e., the opinion holder or source of the opinion, the object (aspect or entity) about which the opinion is expressed and the evaluation, view or appraisal, that is, opinion. For opinion identification, all of these components are important.

Opinion mining tasks involve opinion identification, opinion classification (positive, negative, and neutral), opinion target identification, opinion source identification and opinion summarization. Hence, opinion mining

tasks require techniques from the field of natural language processing, information retrieval (IR), and text mining.

II. OPINION MINING TASKS

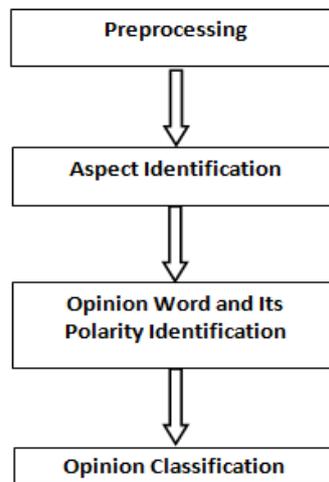


Figure -1 Aspect Based Opinion Mining

2.1 Preprocessing

Preprocessing the text is the process of cleaning text and preparing the text for classification. User-generated reviews require preprocessing to remove noise before the mining process can be performed. This is because these reviews are usually written by non experts and frequently contain mistakes in spelling, grammar, use of non dictionary words such as abbreviations or acronyms of common terms (domain specific), punctuation mistakes, incorrect capitalization, and so forth. The preprocessing involves several steps: spelling check, online text cleaning, white space removal, expanding abbreviation, stemming, stop words removal, tokenization, and sentence boundary detection.

2.2 Aspect Identification

Mining aspect and opinion of products or services commented by customers. Aspects are also called features that are features of some entity or service. In aspect extraction, product or service features (aspects) are extracted from each sentence. Aspects can be frequent or infrequent. Frequent aspects are those which are commented by many people which are most talked about. Infrequent Aspects are not talked by many people. In review, features may be mentioned explicit or implicit. Features which are mentioned in a sentence directly are called as explicit features and features which are not mentioned directly are called implicit features.

For example, “Hotel room was very clean and spacious”

In this sentence reviewer has mentioned about room directly. So it is explicit feature. It is easy to extract such features. Now consider following sentence,

“The elevator was slow”

In this sentence reviewer is talking about speed of elevator but it is not mentioned directly in the sentence. So here speed is implicit feature. It is difficult to understand and extract such features from sentence.

2.3 Opinion word extraction

In opinion word extraction, opinion words mentioned on its related aspect or entity or target are identified. If a sentence contains one or more opinion words and its related targets then the sentence is called an opinion sentence. Opinion words are generally identified by adjectives.

2.3.1 Opinion Word Polarity Identification

In opinion word polarity identification, semantic orientation or polarity (positive or negative) of each opinion word is identified.

2.4 Opinion Classification

The Classification task aims to determine the opinions' polarity (positive, negative or neutral) regarding the features being commented on.

Identifying opinion words in each review and deciding whether each opinion word is positive, negative or neutral.

An opinion is simply a positive or negative view, attitude, emotion or appraisal about an entity or an aspect of the entity from an opinion holder. Positive, negative and neutral are called opinion orientations. Other names for opinion orientation are sentiment orientation, semantic orientation, or polarity. In practice, neutral is often interpreted as no opinion.

It also aims to determine the strength and polarity of the opinions regarding the product's features. Opinion strength may be inferred from adjective choice (e.g., "disappointing" is milder than "awful") or from qualifiers (e.g., "very good" is stronger than "good").

III DIFFERENT APPROACHES FOR OPINION MINING

3.1 Opinion Mining using Machine Learning Approach

Pang et al. [23] tested Naïve Bayes Classifiers, Maximum Entropy, and Support Vector Machines (SVM) to see which would best classify the movie reviews in an earlier 1400 text version of the Polarity Dataset. The answer was fairly conclusive: SVMs outperformed the other two algorithms with most combinations of features, and had the highest scores overall. Based on this result, most of the sentiment analysis research based on machine learning has made use of SVMs. Pang et al. [23] also tested a number of feature types like (one-word) unigrams and (two-word) bigrams, with or without appended part of speech tags or indicators of their position in the text. The optimal SVM classifier did best with only unigram features.

Dave et al. [6] examines product reviews from C|net for classification. The studied corpus consists of reviews from 4 largest categories of C|net (in total, 448 reviews). A review is mentioned as Positive if it is rated in C|net with three or more stars, and as negative for one and two stars. Before aspect extraction, reviews' texts get preprocessed. Preprocessing contains POS tagging, negation words like not and never are identified. The approach also extracts N-grams (unigrams, bigrams and trigrams). The SVM classifier is used for classification and yields the accuracy value of 85.8% using ten-fold cross-validation without stratification. Dave et al. [6] classifier did much better when bigram and trigram features were used instead of Unigrams.

Using the Appraisal Theory of Martin and White (2005), Whitelaw et al. (2005)[33] used features that not only took into account the Orientation (positive or negative) of adjectives in the text, but also their Attitude Type (appraisal, judgment, or affect) and Force (low, neutral, or high). They tested a number of combinations, and got the best results (better than all preceding studies) from a SVM trained on a bag of words plus a set of features that reflected the frequency of “appraisal groups” (adjectives and their modifiers) grouped according to their Attitude Type and Orientation. Not surprisingly, appreciation was the Attitude Type most relevant for predicting sentiment in the movie review corpus. The inclusion of Force features, however, degraded performance.

Esuli and Sebastiani [8] note that this task can be divided into three interrelated subtasks: determining whether a certain unit of language is subjective, determining the orientation or polarity of subjective language, and determining the strength of that orientation. Esuli and Sebastiani [8] use machine learning techniques to classify individual words as positive or negative using their WordNet glosses. The first step is to derive a set of features (positive and negative words) with enough coverage to train a classifier. This is accomplished using two small sets of seed words (e.g., good, nice, etc. and bad, mean, etc., from (Turney and Littman, [27]) that are expanded iteratively using the WordNet synonym, antonym, hyponym, and hypernym relations. When the set of terms was sufficiently large, the glosses and sample sentences were used to train the classifier. The hypernym relation proved too general, and the hyponym relation was only somewhat helpful; the best results were achieved when the synonyms and antonyms of adjectives alone were used to expand the term sets. Having separate features for negated items (e.g., not good) also improved accuracy as compared to the GI lexicon.

Kennedy and Inkpen (2006) [16] used the entire Polarity dataset (2000 reviews) for both semantic and machine learning testing. They tested a number of combinations of options, finding that the use of contextual valence shifters (Polanyi and Zaenen, 2006) boosted the performance of both models (particularly the semantic model), and that, while the semantic model was very sensitive to the dictionary chosen (adding Google PMI dictionaries decreased performance, for instance), the SVM classifier always did best with lemma unigrams and bigrams; limiting unigrams to the ones in previously existing polarity dictionaries (e.g., the GI) was counterproductive. Overall, the SVM classifier outperformed the term-counting (semantic) method by a large margin: the best term-counting model had an accuracy of only 67.8%, as compared to 85.9% for the SVM classifier. A hybrid SVM classifier trained on the output from each model (comparable to Mullen and Collier 2004) did the best of all, reaching 86.2% accuracy. The authors note that this last performance increase was possible in part because the classifiers seems to make different mistakes; the term-counting model is far better at classifying positive reviews correctly, while the SVM classifier does better on average with negative reviews.

Li et al. [17] proposed a machine learning approach to incorporate polarity shifting information into document level sentiment classification. Pang et al. [19] proposed a word between a negation trigger word/phrase. Li et al. used binary classifier to divide sentences in a document into two parts: sentences which contain polarity shifting structure and sentences without polarity shifting structure. They first proposed a machine learning based classifier to detect polarity shifting and then apply two classifier combination methods to perform polarity classification.

Wilson, Wiebe and Hwa [34] used Supervised Machine Learning techniques to classification of intensity of opinions and emotions being expressed in text. Intensity classification detects the absence of opinion and detects strength of opinion. Authors presented promising results in identifying opinions in deeply nested clauses and classifying their intensities.

3.2 Opinion Mining using unsupervised Approach

Turney [30], which not only attempts to classify full texts, but eschews a unigram (single word) approach in favor of two-word bigrams, extracted according to their part of speech (i.e., adjective/noun pairs, adverb/verb pairs, etc.). The SO values of these bigrams are derived by calculating their Pointwise Mutual Information (PMI).

Another unsupervised approach is the lexicon based method, which uses a dictionary of sentiment words and phrases with their associated orientations and strength, and incorporates intensification and negation to compute a sentiment score for each document (Taboada et al., [29]).

Polanyi and Zaenen [24] focused on how context affects the polarity of a valence (polar) term. They assumed a numerical +2/-2 value (a valence) on positive/negative words in the lexicon (including adjectives, nouns, verbs, and adverbs), and then suggested how this numerical value should change based on the surrounding context. Negation is the case of a contextual valence shifter; the authors proposed that the presence of a negating word (such as not) should switch the sign on the valence, +2 for clever becomes -2 for not clever. The presence of an intensifier (very) or a downtoner (somewhat) affects the valence by increasing or decreasing the absolute value; if good is +2, somewhat good is +1, whereas bad (-2) becomes very bad (-3). Valence shifters, for instance, are probably less useful to an SVM classifier because they require an increase in the number of features, with each feature requiring further independent examples.

3.3 Subjectivity Classification

Subjectivity classification classifies sentences into two classes, subjective and objective (Wiebe, Bruce and O'Hara, 1999). An objective sentence expresses some factual information, while a subjective sentence usually gives personal views and opinions which might not be fact.

In (Wiebe, 2000), Wiebe proposed an unsupervised method for subjectivity classification, which simply used the presence of subjective expressions in a sentence to determine the subjectivity of a sentence. Since there was not a complete set of such expressions, it provided some seeds and then used distributional similarity (Lin, 1998) to find similar words, which were also likely to be subjectivity indicators. However, words found this way had low precision and high recall.

In (Pang and Lee, 2004), a mincut-based algorithm was proposed to classify each sentence as being subjective or objective. The algorithm works on a sentence graph of an opinion document, e.g., a review. The graph is first built based on local labeling consistencies (which produces an association score of two sentences) and individual sentence subjectivity score computed based on the probability produced by a traditional classification method (which produces a score for each sentence). Local labeling consistency means that sentences close to each other are more likely to have the same class label (subjective or objective). The mincut approach is able to improve individual sentence based subjectivity classification because of the local labeling consistencies. The purpose of this work was actually to remove objective sentences from reviews to improve document level sentiment classification.

Wilson, Wiebe and Hwa [34] pointed out that a single sentence may contain both subjective and objective clauses. It is useful to pinpoint such clauses. It is also useful to identify the strength of subjectivity. A study of automatic subjectivity classification was presented to classify clauses of a sentence by the strength of subjectivity expressed in individual clauses, down to four levels deep (neutral, low, medium, and high). Neutral

indicates the absence of subjectivity. Strength classification thus subsumes the task of classifying a sentence as subjective or objective. The authors used supervised learning. Their features included subjectivity indicating words and phrases, and syntactic clues generated from the dependency parse tree.

Benamara et al. (2011)[3] performed subjectivity classification with four classes, S, OO, O and SN, where S means subjective and evaluative (their sentiment can be positive or negative), OO means positive or negative opinion implied in an objective sentence or sentence segment, O means objective with no opinion, and SN means subjective but non-evaluative (no positive or negative sentiment).

3.4 Aspect Extraction Approaches

Lein Zhang and Bing Liu [35] had focused on mining features of an entity. They used unsupervised method “Double Propagation” for feature extraction. It mainly extracts noun features. Dependency Parser was used to find relations between opinion words and features.

Double propagation works well for medium sized corpora. For large and small corpora, it can result in low precision and low recall. Then author introduced “part whole” and “no” patterns to increase the recall. And feature ranking applied to improve precision.

Jorge Carrilo and Laura Plaza has focused on measuring the polarity and strength of opinions. Their approach discovers feature automatically from reviews using unsupervised model. The set of discovered features are small and meaningful enough for the user. And lastly, system estimates the weight of each product feature in the overall user opinion to predict a more precise rating.

Hu and Liu [12] proposed a technique based on association rule mining to extract product features. The idea can be summarized briefly by two points: (1) finding frequent nouns and noun phrases as frequent aspects. (2) Using relations between aspects and opinion words to identify infrequent aspects. The idea is as follows: The same opinion word might be used to describe or modify different aspects. Opinion words that modify frequent aspects may modify infrequent aspects, and thus can be used to extract infrequent aspects.

Jakob and Gurevych (2010) used CRF. They trained CRF on review sentences from different domains for a more domain independent extraction. They also used domain independent features e.g. tokens, POS tag, syntactic dependency, word distance, and opinion sentences.

Li et al [17] used and integrated two CRF variations, i.e., Skip- CRF and Tree-CRF, to extract aspects and opinions. Original CRF, which can only use word sequences in learning, Skip-CRF and Tree- CRF enable CRF to exploit structure features. However, a limitation of CRF is that it only captures local patterns rather than long range patterns. It has been shown in (Qiu et al., [25]) that many feature and opinion word pairs have long range dependencies. Experimental results in (Qiu et al., [25]) indicate that CRF does not perform well.

3.5 Opinion Mining Using Fuzzy Logic

Mita Dalal and Mukesh Zaveri (2014) [5] used fuzzy functions for classification of online user reviews. They proposed an approach to perform fine-grained sentiment classification of online product reviews by incorporating the effect of fuzzy linguistic hedges on opinion descriptors.

Animesh Kar and Deba Mandal [15] introduced fuzzy opinion miner (FOM) a fuzzy approximation system to determine the strength of opinion about product in reviews. FOM outputs a set of opinion phrases which are ranked based on strength and the overall intensity of the product.

Pratik N. Kalamkar and Anupama G. Phakatkar [14] used fuzzy logic algorithmic approach to classify opinion words into different category. Their Proposed approach used conditional random field for aspect extraction. Classification of opinion related to aspect word is done using fuzzy logic algorithmic approach. Ranks Entities based on desired aspect of entities. Their Fuzzy Logic system follows steps like fuzzification and defuzzification. Fuzzification is the process where special degree is associated with each opinion word. Finally, fuzzy results are converted into crisp values using Memdani's defuzzification function.

Nadali and Kadir [27] used fuzzy Logic for classification of reviews. At first fuzzification of inputs is done. Then membership function is defined for finding membership value for each input. Defuzzification is used to get final output.

Shaidah Jusoh and Hejab M. Alfawareh [13] used approach which evaluate sentiment word and sentiment word modifier. Their opinion fuzzy set contains only two types of linguistic variables first is sentiment word and second is sentiment word modifier. Lexicon of sentiment word of positive sentiment, lexicon of negative sentiment word and lexicon of sentiment word modifier are developed. Each word in the list of token are matched with developed lexicons. If they are matched then sentiment word has been recognized and then word in token list is labeled as SenWord Assigns Fuzzy values to fuzzy sets opinion. Fuzzy set operation is conducted on the opinion fuzzy sets to determine sentiment either it is positive or neutral.

IV RESEARCH ISSUES AND CHALLENGES

Despite number of research efforts, the current opinion mining studies and applications still have limitations and margins for improvement. Accordingly, opinion mining suffers from a number of problems, such as accuracy, scalability, quality, standard of data, natural language understanding comprehension, among others.

Some of the major challenges related to natural language processing, such as context dependency, semantic relatedness and ambiguity, have made opinion mining difficult. As practical applications require high accuracy, some of the work must be performed manually because of the challenging problems with the natural language processing.

Most of the existing research regarding opinion mining is domain dependent, which limits the scope generalization of the information. Machine-learning systems, which are domain dependent, require that data be manually labeled; it is very a difficult task to manage. Hence, there is need for generalized domain independent for the automatic identification and classification of opinion components.

One of the important problems of opinion mining is the identification of opinion targets from unstructured text. The opinion target is defined as the entity or features of an entity about which an opinion is expressed.

Another problem is domain dependency, which can be a problem when the target features that are relevant to a specific domain take on different meanings or interpretations when in a different domain. Accordingly, creating a knowledge base for each domain with relevant features and attributes is a difficult but real concern. Hence, generalized procedures are used to identify and disregard the domain dependency of features (Qiu et al., 2009).

V CONCLUSION

This paper discusses about techniques used by other authors for opinion mining. Opinion mining is the mining of opinions from the text. It can be of document level, sentence level or aspect level. There are different approaches for mining opinions from the text. Supervised techniques need training and testing data. It takes

more time in labeling data. Unsupervised Techniques learn from examples. Labeling data is not needed in unsupervised techniques.

REFERENCES

- [1] Al-maimani, maqbool, naomie salim, and Ahmed m. al-namani. "Semantic and fuzzy aspect of opinion mining." *Journal of Theoretical and Applied Information Technology* 63.2 (2014).
- [2] Arora, Piyush. *Sentiment Analysis for Hindi Language*. Diss. International Institute of Information Technology Hyderabad, 2013.
- [3] Benamara, Farah, Baptiste Chardon, Yannick Mathieu, and Vladimir Popescu. *Towards Context-Based Subjectivity Analysis*. in *Proceedings of the 5th International Joint Conference on Natural Language Processing (IJCNLP-2011)*. 2011.
- [4] Brooke, Julian. *A semantic approach to automated text sentiment analysis*. Diss. Simon Fraser University, 2009.
- [5] Dalal, Mita K., and Mukesh A. Zaveri. "Opinion Mining from Online User Reviews Using Fuzzy Linguistic Hedges." *Applied Computational Intelligence and Soft Computing* 2014 (2014).
- [6] Dave, Kushal, Lawrence, Steve, and Pennock, David M. 2003. Mining the peanut gallery: Opinion extraction and semantic classification of product reviews. In *Proceedings of the Twelfth International World Wide Web Conference (WWW 2003)*.
- [7] De Albornoz, Jorge Carrillo, et al. "A joint model of feature mining and sentiment analysis for product review rating." *Advances in information retrieval*. Springer Berlin Heidelberg, 2011. 55-66.
- [8] Esuli, Andrea and Fabrizio Sebastiani. Determining term subjectivity and term orientation for opinion mining. in *Proceedings of Conf. of the European Chapter of the Association for Computational Linguistics (EACL-2006)*. 2006.
- [9] Guohong Fu, Xin Wang (2010), 'Chinese Sentence-Level Sentiment Classification Based on Fuzzy Sets', *Coling 2010: Poster Volume*, Pages 312-319, Beijing, August 2010.
- [10] Gupta, Narendra, Giuseppe Di Fabbrizio, and Patrick Haffner. "Capturing the stars: predicting ratings for service and product reviews." *Proceedings of the NAACL HLT 2010 Workshop on Semantic Search*. Association for Computational Linguistics, 2010.
- [11] Haddi, Emma, Xiaohui Liu, and Yong Shi. "The role of text pre-processing in sentiment analysis." *Procedia Computer Science* 17 (2013): 26-32.
- [12] Hu, Mingqing, and Bing Liu. "Mining and summarizing customer reviews." *Proceedings of the tenth ACM SIGKDD international conference on Knowledge discovery and data mining*. ACM, 2004.
- [13] Jusoh, Shaidah, and Hejab M. Alfawareh. "Applying Information Extraction and Fuzzy Sets for Opinion Mining."
- [14] Kalamkar, Pratik N., and Anupama G. Phakatkar. "Review Based Entity Ranking using Fuzzy Logic Algorithmic Approach: Analysis."
- [15] Kar, Animesh, and Deba Prasad Mandal. "Finding opinion strength using fuzzy logic on web reviews." *International Journal of Engineering and Industries* 2.1 (2011): 37-43.
- [16] Kennedy, Alistair, and Diana Inkpen. - "Sentiment classification of movie reviews using contextual valence shifters." *Computational Intelligence* 22.2 (2006): 110-125.

- [17] Li, Shoushan, et al. "Sentiment classification and polarity shifting." Proceedings of the 23rd International Conference on Computational Linguistics. Association for Computational Linguistics, 2010.
- [18] Liu, Bing. "Sentiment analysis and opinion mining." Synthesis Lectures on Human Language Technologies 5.1 (2012): 1-167.
- [19] Mattosinho, Felipe Jordão Almeida Prado. "Mining Product Opinions and Reviews on the Web." (2010).
- [20] Momtazi, Saeedeh. "Fine-grained German Sentiment Analysis on Social Media." LREC. 2012.
- [21] Nilesh M. Shelke, Shriniwas Deshpande, Vilas Thakre (2012), Survey of techniques for opinion mining, International Journal of Computer Applications, 57, 13, pp 0975-8887.
- [22] Pang B. And Lee L. (2008), "Using very simple statistics for review search: An exploration," in Proceedings of the International Conference on Computational Linguistics (COLING), (Poster paper).
- [23] Pang, Bo, Lee, Lillian, and Vaithyanathan, Shivakumar. 2002. Thumbs up? Sentiment classification using Machine learning techniques. In Proceedings of Conference on Empirical Methods in NLP, 79-86.
- [24] Polanyi, Livia, and Annie Zaenen. "Contextual valence shifters." Computing attitude and affect in text: Theory and applications. Springer Netherlands, 2006. 1-10.
- [25] Qiu, Guang, et al. "Expanding Domain Sentiment Lexicon through Double Propagation." IJCAI. Vol. 9. 2009.
- [26] Qu, Lizhen, Georgiana Ifrim, and Gerhard Weikum. "The bag-of-opinions method for review rating prediction from sparse text patterns." Proceedings of the 23rd International Conference on Computational Linguistics. Association for Computational Linguistics, 2010.
- [27] Samaneh N., Masrah A. Murad, Rabiah Abdul Kadir (2010), 'Sentiment Classification of Customer Reviews Based on Fuzzy Logic', Information Technology (ITSim), 2010 International Symposium, pp. 1037-1040.
- [28] T. Wilson, J. Wiebe, and P. Hoffmann. Recognizing contextual polarity in phrase-level sentiment analysis. In Proc. EMNLP, 2005.
- [29] Taboada, Maite, et al. "Lexicon-based methods for sentiment analysis." Computational linguistics 37.2 (2011): 267-307.
- [30] Turney, Peter D. "Thumbs up or thumbs down? Semantic orientation applied to unsupervised classification of reviews." Proceedings of the 40th annual meeting on association for computational linguistics. Association for Computational Linguistics, 2002.
- [31] Vinodhini, G., and R. M. Chandrasekaran. "Sentiment analysis and opinion mining: a survey." International Journal 2.6 (2012).
- [32] VO, Anh-Dung, and Cheol-Young Ock. "Sentiment classification: a combination of PMI, sentiwordnet and fuzzy function." Computational Collective Intelligence. Technologies and Applications. Springer Berlin Heidelberg, 2012. 373-382.
- [33] Whitelaw, Casey, Navendu Garg, and Shlomo Argamon. "Using appraisal groups for sentiment analysis." Proceedings of the 14th ACM international conference on Information and knowledge management. ACM, 2005.
- [34] Wilson, Theresa, Janyce Wiebe, and Rebecca Hwa. "Just how mad are you? Finding strong and weak opinion clauses." aaai. Vol. 4. 2004.

- [35] Zhang, Lei, et al. "Extracting and ranking product features in opinion documents." Proceedings of the 23rd international conference on computational linguistics: Posters. Association for Computational Linguistics, 2010.
- [36] Zhang, Wen, Taketoshi Yoshida, and Xijin Tang. "Text classification using multi-word features." Systems, Man and Cybernetics, 2007. ISIC. IEEE International Conference on. IEEE, 2007.

MORAL AND STRATEGIC ISSUES IN SOCIAL NETWORK ANALYSIS

¹Kamlesh , ²Usha, ³Priyanka

^{1,2,3}Computer Science & Engineering Department, M.D.U,(India),

ABSTRACT

Notwithstanding all the normal moral issues that can emerge with any sort of request, system investigations, by their exceptionally nature, present uncommon moral issues that ought to be perceived. This paper portrays some of these issues, recognizing issues that emerge in absolutely scholastic studies and those that emerge in managerial practice settings. Furthermore, the paper brings up the long haul issue of whether the utilization of system investigation for settling on managerial choices will make gathering legitimate system unthinkable later on, truly hurting the scholarly field of informal organization research. The paper finishes up with a short set of standards expected to structure the premise for a set of rules intended to defend members in informal community considers and ensure the long haul practicality of the system research venture

Keywords: *Case Study, Degrees Of Separation, Hierarchical System Research , Moral Responsibility, Sociology*

I INTRODUCTION

Informal community examination is expanding quickly in fame, both in scholastic exploration and in administration counseling. The idea of system has turned into the representation for comprehension associations. Scholastics see the system ideal model as an approach to escape from the atomism of conventional sociology in which singular conduct –, for example, selection of an advancement – is broke down exclusively as far as the characteristics of the individual (e.g., openness to change, stake in the result, and so forth.) and not regarding interpersonal transmission, impact forms and other social variables. Administration professionals are keen on system technique in light of the fact that it gives an approach to make the imperceptible unmistakable and the impalpable substantial (Cross, Parker and Borgatti, 2002). That is, they can utilize it to evaluate and guide such "delicate" phenomena as information streams and communication. The system lens has likewise caught the creative energy of people in general, as seen in diversions, for example, the Kevin Bacon diversion, plays like John Guare's Six Degrees of Separation, and innumerable famous books, for example, Malcolm Gladwell's The Tipping Point.

As the volume of system studies increments (whether scholastic or professional), so does the requirement for tending to moral issues. On the scholastic side, human subject panels or institutional audit sheets (IRBs) have officially paid heed to system mulls over and have had fiercely distinctive responses to system research – not amazing, given that every board settles on its choices autonomously and that no composed set of benchmarks exists that would give direction. On the managerial side, the very adequacy of interpersonal organization

examination makes thought of moral issues progressively basic as associations begin basing staff and revamping choices on system examinations.

It is likewise critical to note that the two circles of authoritative system research – scholastic and administration counseling – are not entirely autonomous. Scholastics need associations as locales for their examination, and they require respondents to round out system study surveys genuinely. On the off chance that administrators utilization system mulls over as the premise for work force and authoritative choices, and especially on the off chance that they do as such in an unscrupulous way, scholastics will be not able to discover respondents who will answer their overviews sincerely, possibly crushing a lot of hierarchical system research.

Thus, the time it now, time that the field consider the moral difficulties postured by system research, and start creating rules to ensure its examination subjects. The issue is both moral, in the feeling of securing people, and vital, in the feeling of shielding the field from progressively rare or invalid information. The destination of this paper is to lay out a portion of the moral and vital issues postured by system based counseling for specialists and scholastic scientists, and to propose a few rules that could in the end lead to a code of morals. We expect that without holding fast to a few rules, the hurry to do system investigations could make system examinations unimaginable in .

II NEED FOR EXTRA CARE IN SOCIAL NETWORK

There are numerous routes in which arrange studies vary from customary studies that make them all the more in need of additional consideration. Maybe the most clear contrast is that in a system study namelessness at the information gathering stage is unrealistic. In place for the information to be important, the scientist must know who the respondent was with a specific end goal to record a connection from that respondent to the persons they show having associations with. This instantly puts a unique load on both the advisor and the scholastic analyst to be clear to the respondent about who will see the information and what can sensibly be anticipated to happen to the respondent as a consequence of somebody seeing what they have reacted.

System examines additionally vary from routine studies in that missing information is especially troublesome. A system guide may be exceptionally deceptive if the most focal individual is not envisioned , or if the scaffold between two gatherings is not demonstrated. Subsequently, arrange specialists have a personal stake in not letting hierarchical individuals quit of a study. This may lead them, intentionally or unwittingly, to neglect to bring up the genuine repercussions of taking an interest in the overview.

An alternate fascinating issue that is exceptional to the system setting is that non-interest by a respondent does not so much imply that they are excluded in the study. Case in point, if Mary picks not to answer the review, this does not prevent different respondents from posting Mary as a companion, a wellspring of guidance, an individual whom they have clashes with, etc. It will in any case be uncovered that numerous individuals recorded Mary as somebody who was hard to work with. A simple arrangement, in any event for scholastic analysts, is to dispose of all non-respondents from the investigation by and large. Un-fortunately, as examined over, this prompts system maps and measurements that may be very deceptive, destroying the nature of the information. Moreover, utilization of such information presents another moral issue, especially in the counseling setting, as avoidably wrong choices can be taken as an aftereffect of the contorted information. All in all, it won't be conceivable to demonstrate to the chief exactly how the picture is deluding without uncovering the very data that the scientist is compelled by a solemn obligation to smother.

The non-investment issue focuses to a more unpretentious basic contrast. While in routine sociology mulls over the respondent reports on themselves, in system thinks about the respondent reports on other individuals who may not wish to be named. This is the thing that has concerned a few IRBs, as the individuals being accounted for on are not so much piece of the study and along these lines have not marked assent structures. To be reasonable, what the respondent is regularly writing about is their view of their association with an alternate, which is obviously something the respondent has a privilege to do: each respondent claims their own recognitions. On the other hand, if the respondent distinguishes somebody as an individual with whom they take part in illicit exercises (e.g., medications, replicating programming), there is a reasonable ramifications that the named party does actually do unlawful things: it is not "simply" an observation. Regardless, while it might be clear that individual possesses their observations, it is not clear that an individual claims the connections they are in and it is at any rate conceivable to contend that not one or the other party can morally investigate it without assent of the other. Along these lines this here is that the study may be obliging or urging respondents to do untrustworthy things.

A related issue concerns the sorts of connections being contemplated. It is by and large comprehended that the conduct of workers of an association is interested in investigation by administration. Most clearly, raises and advancements are controlled by how well individuals are seen by administration to carry out their employments. How workers identify with others, for example, clients, subordinates, and different representatives is liable to both checking and regulation (e.g., inappropriate behavior rules). It is additionally regularly comprehended that there are things that representatives may do that are considered outside the association's purview, for example, what they do in their own rooms. Anyway what of worker companionships? As a rule, system analysts concentrate on the casual association inside an association, the part not represented by the formal association. A not phenomenal question on system studies is 'With whom do you standardize with outside of work?'. It appears conceivable to contend that these sorts of inquiries fall into a hazy area that is between plainly satisfactory investigation and obviously unseemly spying.

An alternate issue needs to do with information show. In most sociology exploration, it is the variables that are of investment. Respondents give information, yet they are unacknowledged replications, the as much as possible. Basically, they are dealt with as groups of trait qualities. Hence, it is seldom helpful to express the consequences of quantitative research by giving showcases of individual information with names connected. Yet in system investigation, the most authoritative showcase is a system chart that shows who is associated with whom. A long way from being exceptionally processed yields of investigation, system charts are low-level shows that speak to the crude information. As a rule, friendly bolts from any hub have a 1-to-1 correspondence with that individual's rounded out poll, minimally uncovering each individual's reactions. Such shows are especially significant in managerial/counseling settings. Undoubtedly, as Cross et al (2002) show, setting an outline, for example, that demonstrated in Figure 1a before the members themselves – with names recognized - can have a significantly transformational impact. Obviously, one can forego this force and limit oneself to charts in which hubs are recognized just by qualities, for example, office, office or residency in the association. This can work when the investment is in bigger examples and not people. Yet even this methodology can run into moral issues on the grounds that regularly hierarchical individuals can find the character of one individual – e.g., the main high-positioning lady in the Boston office – and once that individual has been recognized, their known partners can be now and then be found too, inevitably unwinding the entire system. Actually when no

recognizing attributes are given, members can regularly distinguish themselves – for instance, when they recall posting precisely seven companions and no other hub in the chart has precisely seven ties.

A last purpose of contrast needs to don't with the principal way of system investigation yet with its relative youth. Respondents today have significant experience rounding out study surveys in a mixture of settings from advertising examination to employment applications. Individuals as of now have a natural feel for the potential outcomes of unveiling individual data in reviews. Coupled with unequivocal assent structures that framework a percentage of the dangers, respondents' ability to think gives satisfactory security. Yet system studies are generally new. Most respondents in a study have not beforehand rounded one out, and directors getting system data have not already done as such. Subsequently, it is not as clear to respondents what the outcomes may be of ticking off who they converse with. Regardless of the possibility that the overview unmistakably expresses that the information won't be kept classified and will be accounted for again to the gathering, numerous respondents are not able to envision how they will feel and what others will think when they are distinguished in the examination as fringe players. Indeed, the system report will present various ideas, for example, hub centrality which the respondents were beforehand uninformed of yet will soon placed them in their spot as far as system position inside the gathering. Chiefs perspectives of their subordinates will be significantly influenced by the consequences of the system examination. Thus, the contention can be made that current principles for assent structures may not be satisfactory for securing respondents in system research

III A TOPOLOGY OF RISK

In the exchange above we have implied that a few issues apply more to specific settings (scholastic versus managerial practice) than others. The complexity between the scholastic and the practice settings is in a general sense about who sees the information and what they will be utilized for. In the scholastic setting, the stream of data is from the association to the institute, eventually being distributed in scholarly diaries. In the managerial work on setting, the data streams from the association, is prepared by the specialist (e.g., administration expert) and afterward streams once more to the association in handled structure. In any case, numerous studies are mixtures of the two. Case in point, most scholastic studies incorporate a compensation in which the analyst gives an examination again to administration consequently for being permitted to gather the information. An alternate, less basic, variety is the place the scholarly analyst gives criticism, (for example, an assessment of system position) straightforwardly to every respondent as an impetus to take part.

Notwithstanding the scholastic/professional refinement, we have made reference to two various types of dangers: a more impending danger to our exploration subjects, and a more drawn out term key danger to the system research endeavor.

3.1 Dangers to Research Subjects

3.1.1 Scholastic Context: The key concerns to research subjects in the unadulterated scholastic setting are absence of obscurity, absence of assent from persons named by respondents, and the likelihood of recognizing people by consolidating insurance data. Recounted proof proposes that college IRBs have hailed both the secrecy and assent issues. Secrecy can be taken care of by offering classifiedness – all examinations and reports produced from the information will utilize camouflaged names or untraceable id numbers. Where secrecy is vital, as in investigations of slandered conditions like AIDS or unlawful exercises like medications, scientists

can utilize an outsider that holds the main codebook connecting names to id numbers, so that even the specialists don't know who will be who. In the great situation where the information are sensibly subject to government subpoena (e.g., a system investigation of a bookkeeping firm under criminal examination), the outsider holding the codebook can be spotted in an alternate nation, outside legitimate locale.

The absence of assent issue has two perspectives. To begin with there is the matter of gathering information on persons from whom unequivocal assent has not been gotten. This happens most clearly when the review uses open-finished inquiries like 'Whom did you look for counsel from in settling on this choice?' and a respondent notice somebody not in the study. In fact, it likewise happens in studies utilizing shut finished surveys on the grounds that an individual may give insights about their association with persons who at last choose not to take an interest in the review. We don't feel this ought to be an issue, since we accept that an individual's impression of their colleagues and their associations with them are their own particular and they can decide to give those information to analysts. Nonetheless, IRB's will need to be taught on this point, since most IRB rules detail that "outsiders" (individuals whom examination subjects give information about) ought to be considered exploration subjects.

All the more in a broad sense, we propose that gathering information around an individual without their consent is not ipso facto dishonest. In the event that we remain on an open road and watch the stream of walker movement, do we need assent from every individual we watch? A sort of system information that makes this point clear is affiliations/participation information. In such datasets we record the investment of people in undertaking groups, organization occasions, listservs, vested parties, and so forth. Case in point, in counseling associations, workers bill time to customer ventures. We can build a cooperation arrange by analyzing who has charged time to the same undertakings. Regularly the information are gotten not from the people however from open postings, perception, and authoritative records. In the event that it is moral to utilize open records without asking people's consent, why would it be exploitative to get the same information by asking different people?

In the long haul, IRBs need to be taught on this issue to allow this sort of information. In the short term, be that as it may, to fulfill an IRB on this issue, one conceivable methodology is to convey agree structures to the populace being referred to first. Strictly when the assent structures have been returned is the poll (with list of members installed) drawn up. This keeps information from being gathered on persons not partaking. Obviously, marking an assent structure does not ensure that when the time it now, time to round out the poll everybody really does it, which implies that the outcome can at present be that some individuals investigate associations with individuals who did not take part. Be that as it may, since they marked assent structures, this is most likely adequate.

The second part of the absence of agree issue needs to do with information trustworthiness. In the event that we make moves to incorporate in the examination just individuals who were ready to partake in the study, then the subsequent system will be a mutilation of the "genuine" system (i.e., the one we would have acquired on the off chance that we had not dispensed with non-members). Obviously, all information are blemished impressions of what is "truly" going on. What makes this a moral issue is that for this situation we really realize that the information are mutilated and we know in what way. Assume, for instance, that we had disposed of hubs 7 and 10 in the system in Figure 1a on the grounds that they didn't wish to take an interest. The story we would be compelled to tell in light of the information (Figure 1b) future altogether different from what we knew to be the

situation. To present the system as though it were a legitimate representation of reality would be insincere most definitely, regardless of the fact that disclaimers are appended.

3.2 Managerial Practice Setting

The stakes are higher in the work on setting than in the scholarly setting, since the reason for the system examine in this setting is expressly to settle on choices which, specifically or in a roundabout way, will influence the lives of representatives. For instance, supervisors may utilize the measured centrality of people as info to a choice to flame somebody. Given that system examinations can have genuine positive and negative results for people, one essential issue is whether it is moral for, say, an administration expert to perform a system examination for an association. As we would see it, the answer is plainly 'yes'. That there are outcomes to the system examination (or substance investigation, or mental testing, or whatever other investigation) does not itself make it deceptive – it simply implies that shields are required.

One contrast between settling on faculty choices, for example, terminating a subordinate in light of an administrator's instinct or involvement with that individual and utilizing system examination is that the information for the system investigation are normally gathered by means of review from a set of respondents that incorporate the subordinate. On the off chance that the subordinate does not comprehend that their answers on the overview could focus their destiny, this could be seen as beguiling and constitute a deceptive utilization of system investigation. To keep away from this, an overview in the work on setting ought to be willful and greatly unequivocal about what the results of replying (and not replying) may be. From this thin viewpoint it would be ideal to depend on non-review information accumulation, for example, venture coordinated effort or email logs, to abstain from asking a representative to implicate themselves.

An alternate issue in the work on defining is the limit between the expert (the association's locale) and the private (the singular's purview). At the point when a system scientist makes inquiries like 'Who do you like?', 'Who do you converse with about political occasions?', 'Who are your companions?', and 'Who do you standardize with outside of work?', have the scientists acted unbecomingly into a region that is not their concern? Some system information can be seen as formalized babble about who's hot and who has been seen with whom. For illustrations, Krackhardt's CSS strategy (Krackhardt, 1987), asks every respondent to report all alone ties, as well as ties among all others in the gathering. It appears real to ask whether it is suitable to gather this data in administration of settling on staff choices.

There is no acceptable response to this inquiry. One methodology is to ask whether the system connection boats being measured relate specifically to employment execution. In the event that they are, then the connections can be esteemed a proper object of managerial investigation. Social capital examination has abundantly exhibited the significance of connections in employment execution (e.g., Burt, 1992) proposing that making companions at work is as much an occupation expertise as giving reasonable presentations. This appears to be especially solid in present day information based associations with level, liquid hierarchical structures where learning creating connections yield focused edge. It might be less faultless in a formal Weberian organization with sharp qualifications saw between the individual and the position they possess. A second approach may be to ask whether the people included are engaged or debilitated by the investigation. On the off chance that the members feel that they have picked up experiences as an aftereffect of rounding out the polls or getting criticism from the specialists (and no negative reactions), then it is difficult to contend that the study has been dishonest.

IV RISKS TO THE FIELD

In the past segment it was declared that the utilization of system investigation to settle on choices that have significant results for people in an association can't in itself be blamed on moral grounds. Be that as it may, there are more vital explanations behind concern. Consider the accompanying case (in view of a counseling engagement of one of the creators). A human services association has a part called "case organizer", and the people assuming this part are relied upon to keep up wide contacts all through the association keeping in mind the end goal to carry out the employment adequately. A system examination rapidly uncovers that two of the case organizers don't have about the number and differences of associations that are thought to be required, even after 18 months at work. The supervisor examines the outcomes with the facilitators and prescribes that they begin making more contacts. Regardless of how pleasantly this is carried out, as a direct aftereffect of the system examination these organizers are essentially on post trial supervision and not prime contender for a raise. There is a genuine result for these people coming about because of the system investigation. The inquiry is 'what number of system reviews of this kind could be possible before workers figure out how to round out the structures deliberately'? Today we are in what could be known as the brilliant period of informal organization research, in light of the fact that most respondents appear to round out the polls innocently. In any case as associations progressively settle on choices in light of system investigations, they will get to be progressively careful. At the point when this happens, it might be difficult to do even scholarly system research, since workers can't make sure what the genuine reason for a system overview is. To be sure, as we examine in an alternate segment, even in scholastic settings, the analyst regularly consents to impart a few results to administration in return for access to the site. This circumstance is out and out excessively like that beguiling advertising system in which the business call is masked as a showcasing exploration review. The results of the circumstance later on may be altogether refusals to take an interest in system studies, or, more awful, vital reacting intended to make the respondent look great, making a legitimacy issue.

The utilization of system examination to settle on managerial choices can be seen as an introductory move that launches a sort of persuasive weapons contest. Workers respond protectively to this move by figuring out how to answer studies in a vital way. Scientists counter by utilizing a mix of information accumulation and information examination methods to minimize the impacts of key reacting. Case in point, when attempting to guide the counsel system, we can ask every respondent who they go to for guidance, as well as who goes to them for exhortation. At that point, to figure out if individual A gets exhortation from individual B, we watch that A cases to get guidance from B, and that B cases to offer counsel to A, recording a tie just if the two concur.

Respondents can crush this too by concurring heretofore to show one another on both parts of the inquiry. On the off chance that agreement gets to be widespread, analysts can change to latent systems for information gathering, for example, inspecting venture coordinated effort information and observing approaching and friendly messages. Leaving aside the extra moral issues that such checking presents, workers can react by conveying deliberately – i.e., sending incessant messages so as to seem more associated. The legitimacy winding is unending.

It merits calling attention to that the reaction of conveying deliberately to "beat the test" is not restricted to email and can bring about veritable correspondence. Correspondence for the "wrong reasons" appears to be preferred for the association over the reaction of rounding out the review dishonestly. Notwithstanding, it does imply that a sort of Heisenberg guideline applies in which measuring the system (and utilizing it for deciding)

fundamentally changes the system, which may not inconvenience the administrator however will result in genuine issues for the scholarly specialist.

V THE COMBINED ACADEMIC/CONSULTING CASE

Maybe the most risky sort of study is likewise the most widely recognized. This is the blended scholastic/counseling situation where the scholarly specialist does a scholarly study in an association however gives a report to administration consequently for access to the site. Commonly, the survey clarifies the scholarly purposes of the overview and does not say that administration will see the outcomes in undisguised structure. Actually when it does, there is seldom sufficient data given about what precisely administration will see and how the outcomes may be utilized, also what the results could be for the respondent. Without a doubt, the scrupulous scholastic analyst will need to oppose including an excessive amount of data in view of the risk to the legitimacy of the information made by key respondents. In this appreciation, the needs of scholarly research are conflicting with the needs of managerial practice, and relying upon how the scientists attempt to determine the contention, the outcomes can be a study that is either tricky or yields invalid information.

VI MOVING TO A SET OF ETHICAL GUIDELINES

An undeniable reaction to these contemplations is to build up a situated of moral (and key) rules which, if held fast to, would minimize mischief to respondents and protection the field for future specialists. This is not a simple thing to do. Despite the fact that we can undoubtedly make rules that prohibit awful studies, it is difficult to do as such without additionally barring great ones also. On the scholarly side, it is essential to remember that the motivation behind the rules is to guarantee proceeded with system research for the long haul, not stop it. We accept a set of generally upheld benchmarks will make it less demanding for college IRBs to allow system examine, and will keep a recoil in the work on setting.

As we begin, we offer two essential proposals (which contain different recommendations settled inside): keeping away from damage to innocents and giving quality to members.

6.1 Keeping away from Harm to Innocents

There are two bland approaches to evade mischief to innocents: staying away from innocents, and abstaining from doing damage. In the simply scholastic application, damage can be maintained a strategic distance from by completely masking the information (e.g., uprooting names and other recognizing qualities), so that administration can't make a move against people. This won't avert expansive scale reactions, then again, for example, shutting entire workplaces or offices that seem to have the "wrong" structure. To secure against that, scholarly scientists can clutch the outcomes until they are no more opportune.

In the managerial application, dodging damage is a great deal more troublesome. One methodology is to make an arrangement with administration, before executing the study, which confines what can happen to people as an aftereffect of the study. Now and again, it may even be conceivable to concur that administration will never see individual-level information – just information accumulated to unit level, as when researching correspondence crosswise over interior limits. Marginally less tasteful is to concur that administration will see individual-level information, yet without names. This licenses administration to see the states of systems inside gatherings. Care must be taken, in any case, to stay away from enough recognizing information to derive the characters of people,

and the issue of move being made against entire offices (raised above) is still an issue. At the point when a guarantee of no mischief can't believably be made, as in most managerial applications or scholarly studies in which there will be

administration preparation, we can take the option tack of dodging innocents. To evade innocents what we must do is give all members complete exposure and allow non-support. An individual with full learning who decides to partake can't be called a guiltless. Henceforth, in the event that we can't promise favorable results, respondents ought to be given a full comprehension of how the information will be handled (e.g., a specimen system map), what sorts of conclusions may be drawn from the information, and what outcomes may sensibly be predicted to rise up out of the study. It must be borne at the top of the priority list that respondents are not typically ready to envision what can be finished up from a set of studies in which individuals verify names of others. Despite the fact that the scholastic practice of acquiring a marked assent structure from members is once in a while utilized as a part of managerial settings, it would be a decent practice to receive with a specific end goal to flag sympathy toward respondents' welfare and to lessen the likelihood of malevolence from respondents who took an interest without the slightest hesitation and just later saw the threat.

6.2 Providing Value to Participants

Most survey data collection situations can be criticized as exploitative: the researcher receives labor from the respondent, but provides little more than a token in return. Network studies are no exception. The worst situation is the practice setting, where a respondent is asked to provide data that may be used against them. We suggest two basic approaches to address these issues.

First (and most elementary), in all studies which require active participation from the respondents (as in survey studies), participation must be voluntary. This is usually the case in academic studies, but is not always the case in the practice settings. In addition, there are grey areas where the CEO or other authority sends a note to employees encouraging their full participation. In some situations, such missives may be coercive, as when individuals will be seen as not being team players for not participating. In those cases, it may be difficult to ensure that participation is truly voluntary and to execute a study would be unethical by these guidelines. Studies that do not require active participation from the individuals being studied (as in analyses of project collaboration data or group membership data) should be exempt from the requirement of voluntary participation. Second, all studies should provide some kind of feedback directly to the respondent as payment in kind for their participation. Ideally, this consists of something tailored specifically for them, such as a network diagram indicating their position in the network. Given the absence of specialized software to create individualized evaluations, this suggestion could entail a considerable amount of work on the part of the researcher. However, we feel it is the price we have to pay in order to safeguard the future of network research. Of course, any such feedback must be handled very carefully to avoid violating the privacy of the other participants.

VII CONCLUSION

Our key reason in composing this paper is to contend for the quick advancement of moral rules for system investigate in both scholastic and managerial settings. The reasons are both essential and auxiliary. The essential reasons need to do with shielding exploration subjects from damage. With the expanding prominence of system exploration, especially in the managerial practice area, associations will progressively settle on choices educated

by system investigate that will have effective outcomes for people. The optional reasons need to do with shielding the system research endeavor from recoil by respondents as a consequence of poor treatment, and from being closed around college IRBs for deficient protections.

It ought to be noticed that any viable moral rules that are produced are unrealistic to totally end the learning process that is put into movement when supervisors routinely utilize system relations as a premise for execution assessment. We talked about two sorts of scholarly reactions: changed social conduct, and deluding poll reactions. The second is especially disturbing for both scholarly and managerial specialists since it brings about invalid information.

At last, we caution that the greatest moral and key dangers happen on account of studies that obscure the line between immaculate scholastic examination and unadulterated managerial practice. Studies that are directed by scholastic analysts for distribution purposes however which, in a quid quo professional plan additionally give a report to administration, must be especially cautious to give full divulgence to respondents about the outcomes of investment. On the off chance that what gives off an impression of being a college research exertion brings about the mischief of people, the interpersonal organization examination field in general will pay dearly.

VIII ACKNOWLEDGEMENT

My express thanks and gratitude to all the departments' personals and sponsors who give me a opportunity to express interest.

REFERENCE

- [1] CROSS, R., PARKER, A., & BORGATTI, S.P. 2002. MAKING INVISIBLE WORK VISIBLE: USING SOCIAL NETWORK ANALYSIS TO SUPPORT STRATEGIC COLLABORATION. *CALIFORNIA MANAGEMENT REVIEW*. 44(2): 25-46.
- [2] KRACKHARDT, D. 1987. COGNITIVE SOCIAL STRUCTURES. *SOCIAL NETWORKS*. 9: 109-134.

SPECIAL ECONOMIC ZONES IN INDIA: RECENT DEVELOPMENTS AND FUTURE NEW CHALLENGES

Dr.Pramod Gupta¹, Mr.Vivek Lal², Mr.Abhishek Mishra³

¹ Department of Management Studies, IET Group of Institutions, Alwar, (India)

^{2,3} Research Scholar, Sunrise University, Alwar, (India)

ABSTRACT

Designated areas in countries that possess special economic regulations that are different from other areas in the same country. Moreover, these regulations tend to contain measures that are conducive to foreign direct investment. Conducting business in a SEZ usually means that a company will receive tax incentives and the opportunity to pay lower tariffs. While many countries have set up special economic zones, China has been the most successful in using SEZ to attract foreign capital. In fact, China has even declared an entire province (Hainan) to be an SEZ, which is quite distinct, as most SEZs are cities. Special Economic Zones (SEZs) can be compared to their predecessors, Free Trade Zones and Export Processing Zones, in that they are aimed at stimulating foreign direct investment (FDI) and rapid, export-led, industrial growth. The essential characteristic of such schemes is that they allow the by-passing of particular social legislation or tax provisions which are perceived to be an impediment to progress or the competitiveness of an export-oriented activity. SEZs have shown a dramatic rate of growth with total exports of Rs. 12, 96,890 million during the financial year 2012-13, a growth of 50% over the exports for the same period of the previous year. Exports in the first three quarters of the 2013-14 financial years registered a growth rate of about 137% over the corresponding period of the previous financial year (MOCI, 2013).

Keywords: Export Promotion, Export Processing Zone, FDI, Globalization, SEZ.

I. INTRODUCTION

India was one of the first countries in Asia to recognize the effectiveness of the Export Processing Zone (EPZ) model in promoting exports, with Asia's first EPZ set up in Kandla in 1965. In order to overcome the shortcomings experienced on account of the multiplicity of controls and clearances; absence of world-class infrastructure, and an unstable fiscal regime and with a view to attract larger foreign investments in India, the Special Economic Zones (SEZs) Policy was announced in April 2000.

II. EXECUTIVE SUMMARY

This paper describes the evolution of Indian Special Economic Zones in India from EPZ time frame to till date. Indian SEZs are industrial townships with commercial units, which enjoy tax concessions for export oriented production of goods and services. The central government wanted to woo domestic and international investors towards export oriented production inspired by the success of Chinese SEZs. The tax concessions for developers and commercial units in the SEZ Act (2005) have played a vital role in attracting export oriented foreign

investment in areas such as hardware, apparel and shoes, which would have normally headed for other Asian destinations in the absence of these benefits.

The SEZ Act 2007 sought to reduce regulatory hazards by creating the Office of the Development Commissioner – which was supposed to sort out regulatory issues such as environment, power, water and labor clearances via an administrative single window. This window was supposed to reduce the transactions costs of an investor. In the absence of this single window, investors needed to knock the doors of numerous state- and central-level ministries and officials for investment approvals.

The single window in the Development Commissioner's Office has not materialized even in the aggressively investment hungry states like Tamil Nadu and Andhra Pradesh. However, the industry departments in these states provide strategic guidance to the investor. This aids a preferred investor in clearing numerous regulatory bottlenecks before making a successful investment.

It is important for an investor to figure out how vital its prospective investment is from the perspective of a particular state. The measure of attractiveness of an investor would depend on how big it is in terms of global operations, and its contribution to exports, employment generation and technology diffusion. If an investor is a global brand, with the ability to attract other brands, the better governed investment hungry state governments will work hard to win their confidence. State governments in Tamil Nadu, Andhra Pradesh, Gujarat, Maharashtra and Haryana realize that attracting one big player would create a positive sentiment for other investors as well.

Second, investment attractiveness would depend on the sectors that a state is interested in. For example, the government of Andhra Pradesh's push towards labor intensive textile manufacturing led to a very favorable textile policy at the state-level, which gave it an edge over other states that wished to attract SEZ investment in export oriented production of textiles and apparel.

Last but not least, an investor's attractiveness would depend on a state government's investment successes in the past. Successful states that have created a good industrial ecology in a particular sector may be willing to give fewer concessions than those that are trying to establish themselves as investment destinations.

Land acquisition for SEZs became a serious problem because state governments could legally acquire land without seeking consent of the local people. This had led to protests in a number of SEZ locations in India, where people refused to give up their residence and traditional sources of livelihood easily. Violence at a place called Nandigram in the state of West Bengal was a major setback for the development of SEZs in the rest of the country.

The Ministry of Commerce and Industry (MOCI) dealt with this problem by stressing that 100 percent consent of the local people was essential. It also stressed the need to keep SEZs out of fertile agricultural land, and to keep human displacement at a minimum level. These criteria would be invoked while judging the viability of an SEZ project by the Board of Approval headed by the Commerce Secretary.

The good news is that some SEZ developers have shown the way by providing generous relief and rehabilitation packages in poor areas where people's lives have improved as result of SEZ activity. These developers have worked with the people over a period of time to win their consent.

In other places, state governments have taken consent seriously and major clashes between the investors and local people have been averted. These governments are of the opinion that realizing the goal of 100 percent consent of the local people may be a difficult condition for most investors to fulfill. States needed to play a vital role in acquiring land for investors.

A successful SEZ investment in India would benefit by noting the following investment related issues:

- a) Relief and rehabilitation of the displaced people is a serious issue;
- b) Investors need to attract the attention of state governments, and the investors and the concerned state governments must discover synergies, which they find mutually worth pursuing;
- c) Investors should stay out of partisan politics because ruling parties frequently lose power in India; and
- d) It helps if the concerned state has ministers in central ministries who can help clear infrastructure projects such as roads, ports, airports and rail connections favorable to investors in that state.

The major incentives and facilities available to SEZ developers include:-

- Exemption from customs/excise duties for development of SEZs for authorized operations approved by the BOA.
- Income Tax exemption on income derived from the business of development of the SEZ in a block of 10 years in 15 years under Section 80-IAB of the Income Tax Act.
- Exemption from minimum alternate tax under Section 115 JB of the Income Tax Act.
- Exemption from dividend distribution tax under Section 115O of the Income Tax Act.
- Exemption from Central Sales Tax (CST).
- Exemption from Service Tax (Section 7, 26 and Second Schedule of the SEZ Act).
- Currently, there are about **143 SEZs** (as of June 2012) operating throughout India and an additional **634 SEZs** (as of June 2012) that have been formally/principally approved by the Government of India

State/Union Territory	Number of operational Economic Zones (June 2012)	Special Number of SEZs formally approved (June 2012)	Total (Operational Approved)
Andhra Pradesh	36	116	152
Tamil Nadu	28	77	105
Karnataka	20	62	82
Maharashtra	18	119	137
Gujarat	13	53	66
Kerala	7	29	36
Uttar Pradesh	6	35	41
West Bengal	5	24	29
Rajasthan	4	11	15
Haryana	3	49	52
Chandigarh	1	2	3
Madhya Pradesh	1	17	18
Odisha	1	10	11
Punjab	0	8	8
Goa	0	7	7
Chhattisgarh	0	3	3
Delhi	0	3	3
Dadra and Nagar Haveli	0	2	2
Nagaland	0	2	2
Puducherry	0	2	2
Uttarakhand	0	2	2
Jharkhand	0	1	1

III. RESEARCH METHODOLOGY

3.1 Field-Work Support

This study was based on interviews in New Delhi, Gurgaon, Jaipur, Hyderabad and Chennai with the from SEZs experts and working authorities. The views of civil servants, investors, consultants and representatives of industry organisations were sought for updating the earlier work on SEZs. Visits to operational SEZs in the neighborhood of Moradabad and Noida helped to gain first hand knowledge of SEZs in evolution.

3.2 Published Sources

The paper relied on published material such as the *Economic and Political Weekly*, *The Industrial Economist* (Observer Research Foundation), World Bank publications, news sources and papers commissioned by MOCI – Government of India, Ministry of Rural Development – Government of India, the Department of Industry – Government of Andhra Pradesh, the Industrial Guidance Bureau – Government of Tamil Nadu, Department for International Development (UK), the Indian Institute of Management (Ahmedabad), and the Department of Commerce's SEZ web site. Data on land acquisition was supplied by investors.

3.3 State-Level Focus

It was decided that the study will focus more attention on Andhra Pradesh, UP, Delhi-NCR and Tamil Nadu. These two states had the highest number of notified SEZs [Andhra Pradesh (46) and Tamil Nadu (24)] as of 30 November 2007. Moreover, the two states scored high marks in terms of attracting quality export-oriented foreign investments. Tamil Nadu is a hot foreign investment destination with Nokia, Ford, Hyundai, Foxconn and Motorola having made substantial investments in the state. Andhra Pradesh has succeeded in luring investment in areas such as textiles, leather, gems and jewelry, information technology, pharmaceuticals and biotechnology. These states have attracted the attention of Singapore investors such as Ascendas.

3.4 The Problem

An SEZ is a case of public-private partnership in building townships, which will be run and administered largely by the private sector for generating export oriented and profit-making activities. At a time when displacement, relief and rehabilitation issues were not clearly resolved for government projects such as dams, roads and bridges, SEZs posed a serious challenge to the regulatory framework governing the acquisition of land:

- a) Could such activities be defined as ones where compulsory land acquisition by government was appropriate?
- b) What should be the appropriate remuneration for those who are evicted from their places of residence and livelihood?

3.5 Violence in Nandigram

It was the protests and political violence in Nandigram in West Bengal (150 kilometers from Kolkata) in January and March 2007, which posed a substantial threat to the success of SEZs in India.² The Communist Party of India – Marxist (CPIM) government in West Bengal was working with an Indonesian foreign investor, the Salim group, to set up a petrochemical SEZ in Nandigram. Local people were infuriated by the use of force to evict people from their places of residence and agricultural livelihood. Political forces to the extreme left such as the Maoists and the more moderate Trinamool Congress helped to organise a social movement under the banner of the Bhoomi Uched Pratirodh Committee (BUPC or the Committee to Prevent Land Eviction) to prevent the setting up of the SEZ.

The Congress Party, which faced criticism on a variety of development issues from its coalition ally (CPIM), did not lose this opportunity to project this lapse in the CPIM's commitment to the rural poor. The situation in Nandigram continued to be tense till central forces were deployed to ease the situation. Land acquisition in Nandigram may have been affected by the power of absentee landlords whose interests coincided with the political opposition groups in the area. Land acquisition and SEZs earned a bad name after these incidents, and the central government needed to recalibrate its policies on land acquisition. Chief Minister Buddhadeb Bhattacharya has reassured the people of Nandigram in late December 2007 that there will be no SEZ in Nandigram and that the violence caused due to land acquisition is deeply regretted.

3.6 Janadesh 2007

Janadesh 2007, the long march of the 25,000 landless and tribal people from Gwalior in Madhya Pradesh to New Delhi in October 2007, has raised the issue of land reforms and access to common property resources, especially among the tribal and disadvantaged people. It has led to the setting up of the National Land Reforms Council with the Prime Minister as Chairman. Inequitable distribution of land and natural resources and attention to marginalised sections as part of relief and rehabilitation policy has gained attention as a result of this non-violent struggle initiated by a Gandhian non-governmental organisation called Ekta Parishad (Council of Unity).

3.7 Political Opposition

Political opposition to the Indian SEZs arose from opposition parties but the ruling parties wanted SEZs to succeed. The Congress Party, in opposition in the states of Orissa and Karnataka, opposed SEZs, and so did the opposition Bharatiya Janata Party (BJP) in the centre. The trade union wing of the BJP – the Bharataiya Mazdoor Sangh also opposed SEZs. At the level of the central government, the Ministry of Finance and the Reserve Bank of India maintained their skepticism about the possible contribution of SEZs to employment and infrastructure generation at the expense of the revenue foregone.

3.8 Policy Response

It took till the end of May 2007 to resolve some of the regulatory issues. The Ministry of Rural Development began working on a Relief and Rehabilitation policy, which had been discussed within the Cabinet.⁶ A new bill had been introduced in the Parliament, which could lead to an amendment of the LAA, 1894. Given the investment and employment opportunities that lay ahead, the SEZ policy moved faster than government legislation.

It was decided by MOCI that the processing or manufacturing area within an SEZ would be 50 percent of the total SEZ area rather than 35 percent of the same, as was the case before.

The Board of Approval headed by the Commerce Secretary was looking for 100 percent consent from the local people before approving SEZs. This provision was to ensure that another Nandigram type violent protest would not be repeated as a consequence of forced land acquisition by invoking the LAA of 1894.

The Relief and Rehabilitation Policy (2007), enunciated by the Ministry of Rural Development, discouraged investors from acquiring land that were fertile. Displacement was to be kept at a minimum. Social impact assessments based on rigorous surveys of the area and public hearings were proposed. Alternative locations for habitation, especially for the tribal people, were proposed. Land acquired for one purpose should not be used for other purposes. It was discussed within the cabinet that the government may be allowed to acquire 30 percent of the total land required by developers, especially in order to acquire contiguous land, which may be tough for private players on their own.

The economic condition of declining agriculture and poverty aided land acquisition. Whereas a mango garden would typically earn Rs.12,000 per acre every year, a cash compensation of Rs.490,000 per acre, deposited in a bank would yield an income of Rs.45,000 per annum. Absentee landlords of the mango orchards faced pilferage and monitoring problems. The plight of the marginal farmers who lacked storage facilities and the ability to invest in their land was much worse.

The presence of industry in nearby places in Tamil Nadu (Tada, Sriperumbudur, Sathyavedu, etc.) convinced the local population that industry had more to offer than land. Moreover, farm work would employ people between 90 and 120 days in a year whereas employment in industry was continuous through the year.

Social entrepreneurship created a positive sum between the entrepreneurs and the inhabitants in the Sri City area and consent was achieved within a period of one and half years. No police action was involved. In order to ensure success, it would be important make sure that people invested their wealth for long term gains rather than short term consumption. According to some reports, 50 percent to 60 percent of the amount earned was invested in neighbouring land and the living conditions of people had improved.

Positive Outlook on Land Acquisition

Emboldened by successes in land acquisition such as the Sri City experience, the Commerce Secretary announced at the India Economic Summit organized by the World Economic Forum on 3 December 2007 that the 5,000 hectare cap on SEZ size may be removed when the relief and rehabilitation policy and the amendments to the LAA, 1894 have met Parliamentary approval. Such an increase in size would benefit large projects such as the 10,000 hectare site of Reliance Industries in Jhajjar (Haryana), the 8,000 hectare DLF project in Gurgaon (Haryana), and a 10,000 hectare project of Gujarat Positra Port Infrastructure Limited in near Panvel in Maharashtra where Reliance has a stake. Moreover, foreign investors like Ascendas, interested in large multi-product SEZs, would also benefit from such policy. Infrastructure like airports and ports that could aid activity in multi-product SEZs will require land in excess of 5,000 hectares. MOCI feels that, with good planning, SEZs will not consume agricultural land for two reasons. First, the total land requirement for SEZs is 0.07 percent of India's land area and a mere 0.13 percent of agricultural land. Second, if SEZ policy emphasizes the development of dry land for SEZ use rather than wet land, this too will ensure complementarity rather competition between industry and agriculture.

IV. OTHER FACTORS AFFECTING SEZ INVESTMENT

4.1 Synergies between Investor and State Government

Investment is a relationship based on trust and the mutual fulfillment of interests. Investment-friendly states realise that as they succeed in attracting more and better quality investments, they can also demand a higher price from investors. For example, the government of Tamil Nadu may have worked very hard to attract the Ford Motor Company but once Ford had set up its plant and infrastructure, it might have been easier to attract Hyundai. The same could be said about Nokia's investment in Tamil Nadu. Once Nokia had made a success of the hardware SEZ in Sriperumbudur, Flextronics, Ericsson, Dell, Motorola, Foxconn, et al, may have been easier to convince.

4.2 Attracting the Blue Whale

An investment-friendly state government like Tamil Nadu or Andhra Pradesh goes all out to convince an iconic investor (the blue whale) like Nokia or Foxconn, with the knowledge that if they can pass a tough investment

review process with the big ticket investors, it will become easy to attract more players. Big investors conduct a serious investment review process and the state government has to satisfy the investor with infrastructure facilities such as roads, ports, airports, railways, power, water, sanitation, and high quality of human resource. The review process involves two or three independent consultant evaluations. Only when the big investor gets concurrence from all the consultants does it bet on a new location. Investors attract the attention of a state depending on the size of commercial operations, brand name, the magnitude of investment and employment potential, and the ability of the investor to contribute to the commercial ecology of the neighborhood. It is imperative for the investor to realise its attractiveness potential in terms of whether or not it is being perceived as an iconic investor or the “blue whale”.

4.3 Building Personal Trust

States have investment promotion officers who go beyond the call of duty to earn investor goodwill. There are fascinating accounts of how governments helped arrange international schools for the children of key officials of an investing firm, and, how officers belonging to investing firms who forgot their passports and travel documents were secured by government officials at times well beyond office hours.

4.4 Sectoral Compatibility

Andhra Pradesh’s textile policy yielded good results in being able to attract investors such as Brandix Apparel and MAS Holdings – Sri Lankan companies in the high end lingerie market in the West, which service brands such as Victoria’s Secrets. Textiles have traditionally been the strength of the Tirupur area in Tamil Nadu. Andhra Pradesh realised that the cotton growing region within the state did not enjoy any value addition from manufacturing. This was remedied by the Government’s Textile and Apparel Promotion Policy, 2005 - 2010. The end of Multi-Fiber Agreement quotas on 31 December 2004 and the initiation of multilateral trade in textiles under the governance of World Trade Organization was viewed as an opportunity. The aim was to employ 1.5 million people, mostly women and the literate unemployed in the handloom, textile and apparel sectors and raise exports from US\$0.08 billion to US\$5 billion. Andhra Pradesh competed with states like Gujarat, Tamil Nadu and Punjab to make it an attractive investment destination.

The government of Andhra Pradesh provided a number of incentives within in its explicit policy statements in order to attract investments. The policy encouraged investors to work with consultants such as Infrastructure Leasing and Financial Services Limited (IL&FS) by providing special incentives for this purpose. Water and power were made accessible at cheaper rates compared with neighboring Tamil Nadu. Power in Andhra Pradesh was available at Rs.2.75 per unit when the same was priced at Rs.6 per unit in neighboring Tamil Nadu. Units were exempt from zoning regulations, which had involved the administrative costs of converting agricultural zones into industrial ones. There was 100 percent reimbursement for stamp duty on land procured for setting up textile units. Textile and Apparel Parks were treated as public utility services under the Essential Services Maintenance Act for ensuring labor discipline and productivity. There were special incentives for projects employing greater than 2,500 people with an investment higher than Rs.1 billion. There were special exemptions from corporate tax and urban land ceiling regulations for textile SEZs. There was to be a one time grant of Rs.1000 per worker for spinning units, and garmenting and weaving units enjoyed an incentive of Rs.5,000 per worker for costs incurred towards training workers. Easy clearances on regulatory matters such as pollution, water, and electricity were made available via a single window located within the state government. Provision was made for health care, fire station, bank, police station, and other human and social infrastructure that could be made available via a special purpose vehicle.

4.5 Investor's Political Leanings

It helps if investors refrain from supporting political parties in a partisan way. The approaches of India's two leading entrepreneurs – Mukesh and Anil Ambani – are a study in contrast. Mukesh Ambani did not join any political party and established cordial relations with the ruling Congress Party after it came to power in 2004. This contributed to the approval of his Navi Mumbai SEZ in Maharashtra in October 2007.

His brother Anil Ambani of the Anil Dhirubhai Ambani Group, on the other hand, became a member of parliament with the support of the ruling Samajwadi Party in Uttar Pradesh (UP) in 2004. As long as the Samajwadi Party was in power in UP, his SEZ project in Noida (UP) was being supported by the Mulayam Singh Yadav government. The defeat of the Samajwadi Party and the victory of the Bahujan Samaj Party in May 2007 meant that this project now met with vehement opposition from Chief Minister Mayavati. The SEZ project was turned down by the Mayavati government on the grounds that land for the 2,500 acre SEZ project had not been acquired in an appropriate manner. Investors need to be aware that governments lose power quite frequently in India and an investor must project itself as being not so close to one government so as to be viewed as an adversary by another government.

4.6 Demand for Civil Servants in Private Sector SEZ Jobs

SEZs have created a demand for civil servants in the private sector because of regulatory uncertainties. The single window clearance on regulatory issues is not working as envisaged in the SEZ Act (2005). This window was supposed to be housed within the Office of the Development Commissioner – an official of the MOCI. Most regulatory areas are within the jurisdiction of state governments and even investment promoting states like Tamil Nadu, Andhra Pradesh, Maharashtra and Gujarat are facilitating regulatory clearance within their state-level industrial guidance bureaus rather than by ceding regulatory powers to the Office of the Development Commissioner of an SEZ. This has resulted in a situation where private sector SEZ developers are recruiting middle to senior level government servants with attractive pay packages, so that they can help the investor sort out regulatory issues. Regulatory clearances require an understanding of the way the government works at the centre and state levels, and contacts within the government.

4.7 IN SUM Challenges for Indian SEZs

This paper has described the challenges faced by those interested in investing in India's SEZs:

4.8 Regulation of Land

The manner in which land acquisition was regulated by the government (Land Acquisition Act of 1894) created complex problems when the government used the same provision to acquire land for creating profitable public-private partnerships geared towards export oriented manufacturing. Could the government invoke public purpose to acquire land for SEZs in the same manner as it had in earlier times for acquiring land for public utilities like roads, dams and public sector industrial units? The SEZ Act (2005) was silent on this issue.

4.9 Single Window Clearance

The SEZ Act tried wresting regulatory powers with an official of the central government's MOCI, the Development Commissioner. These powers such as regulatory clearances for land, labour, power, water and pollution constitutionally belonged largely with the concerned state government. The Central Act could only persuade the states to wrest these powers with the centre in the interests of speedy investment in the state. This paper demonstrates that even the most investment-friendly states were unwilling to give up their regulatory powers and cede them to the central government.

4.10 Overcoming the Challenges

4.10.1 Tax Benefits

Foreign direct investment occurred in Indian SEZs and in new areas such as hardware, textiles, and shoes, because of the combination of tax benefits provided for in the SEZ Act (2005) along with the pro-active approach of states like Tamil Nadu and Andhra Pradesh. SEZ benefits along with a new textile policy brought foreign investment in high-end apparel to Andhra Pradesh that did not exist before. MOCI was able to resist pressures from the Ministry of Finance to reduce the tax concession. The success of Indian SEZs rendered the tax concession argument arguments made by MOCI quite compelling.

4.11 Local Level Solutions to Land Acquisition

The problem of land acquisition could be solved locally in many places by winning the consent of the people. Even though there is no clear legislation around what would constitute fair and equitable acquisition, MOCI stressed three things when matters came to a head after the violence in Nandigram:

The MOCI stressed the need to obtain 100 percent consent of the people living in the local area. This meant that the relief and rehabilitation package would have to be generous, if private players were to use the benefits accorded by the SEZ Act and the State governments. The Sri City success story described above reveals how consensual land acquisition was possible in the context of a generous relief package coupled with social entrepreneurship. However, some state governments are of the view that they should be actively involved with creating the consent and acquiring land as this work will not be easy for investors.

Emphasis was laid on utilizing dry or non agricultural land. This meant that industrialization was likely to increase living standards in areas where agriculture was inhibited by poor climatic and soil conditions.

Displacement of people was to be kept to the minimum level.

State Government-Investor Synergies: Investment was aided by the pro-active nature of certain states willing to push export oriented investments in certain sectors rather than the success of the single window clearance in the Development Commissioner's office. Industrial bureaus of states governments brought out good investment packages in conjunction with SEZ benefits. This helped them attract big investors to their states. They worked hard to woo good investments, with the hope that if one major player gets convinced, it will be easy to convince others. States like Tamil Nadu and Andhra Pradesh succeeded in attracting investors who would have otherwise found a place in countries like China, Vietnam and Malaysia.

4.12 Investor Strategies

Given the aforementioned parameters affecting the success of SEZ investments in India, a typical investor needed to be concerned about the following issues:

The investor needed to understand its attractiveness given the needs of a particular state government in India. A state with high profile investments will yield fewer benefits than one, which is still trying to win big investors to the state.

Land acquisition must be preceded by a generous rehabilitation package. The people of the area must be convinced that what they are getting in return for giving up their agricultural land and traditional livelihoods will improve their economic and social conditions.

Investors should avoid becoming part of partisan politics in the state.

Large SEZs could gain by getting the government and some anchor investor involved in the equity of the special purpose vehicle running the SEZ, as in the case of the Kakinada SEZ described above. This helps build stakes between the government, the developer, and commercial units within the SEZ.

Local governments will be able to serve investors better in areas such as roads, ports, airports and railways – if the state and the central governments are working together rather than in opposition to each other's interest in a particular state.

V. CONCLUSIONS

This study as provided a brief overview of the controversies surrounding SEZs at the national level, but its main contribution is to provide an in-depth view of the history and impacts of one SEZ, the "Formulations SEZ" in Polepally, Andhra Pradesh. The aim in doing so has been to go beyond the rhetoric that surrounds the issue and to examine realities on the ground in a way that can only be done through a focused case study. To this end, this report described the process of land acquisition in Polepally, including issues of consultation, consent and compensation, before setting out the results of a detailed survey on the impacts of the land acquisition on affected households. This quantitative description is supplemented by a few selected case histories of individuals affected by the acquisition, and who took part in the resistance. The case of Polepally is not untypical. If it stands out, it is because it is one of the cases where local opposition to land acquisition has achieved wider recognition. Though no two SEZs are the same, the case of one like Polepally serves to critique any generalizations made in defense of SEZs, that disruption is minimal, compensation adequate, or that they bring net benefits of employment and new opportunities to local communities.

REFERENCES

- [1] Aaker, D. (1989). Managing assets and skills: the key to a sustainable competitive advantage. *California Management Review*, 31 (2), 91-106.
- [2] Agarwal, A. (2004). Performance of Export Processing Zones: A Comparative Analysis of India, Sri Lanka and Bangladesh. Retrieved February 19, 2006, from web site: <http://www.scholar.google.com>.
- [3] Ahuja, G. (2000). The duality of collaboration: inducements and opportunities in the formation of inter firm linkages. *Strategic management journal*, 21, 317-343.
- [4] Ajitabh, A. & Momaya, K. K. (2004). Challenges for Indian software firms to sustain their global competitiveness. *Singapore management review*, 26(2), 65-77
- [5] Alvarez, S.A. & Barney, J.B. (2001). How can entrepreneurial firms really benefit from alliances with large firms? *Academy of Management Executive*, 15, 139-148.
- [6] Alvarez, S.A. & Barney, J.B. (2001). How can entrepreneurial firms really benefit from alliances with large firms, *Academy of Management Executive*, 15, 139-148.
- [7] Ambastha, A. & Momaya, K., (2004). Competitiveness of firms: Review of theory, frameworks, and models. *Singapore Management Review*, 26 (1), 45-61
- [8] Bhatnagar, Rakesh, 2010, "Amend land acquisition law, says Supreme Court", *DNA*, May 8, http://www.dnaindia.com/india/report_amend-land-acquisition-law-says-supremecourt_1380052
- [9] Business Standard, 2007, "Singur land acquisition appears illegal: HC", February 24, <http://www.business-standard.com/india/news/singur-land-acquisition-appears-illegal-hc/275725>.
- [10] Ministry of Commerce and Industry (MOCI), 2010, "Press release on Approval of SEZs in India", February 25, http://commerce.nic.in/pressrelease/pressrelease_detail.asp?id=2549
- [11] Madhumanti, undated, "Analysis of the Special Economic Zones Policy with in the Governance and Globalisation Framework: a perspective from Grassroots and Marginalised", Pune, National Centre for Advocacy Studies, Globalisation Governance Grassroots Series, No 9.

ANALYSIS OF RENEL CALCULI'S ULTRASOUND IMAGE USING MATLAB

Hetal D. Chavda¹, Dhrumil.H.Sheth²

¹Student, M.tech EC, C U Shah Engineering College (India)

²Research Scholar, C U Shah University, Kothariya, Surendranagar, Gujarat.(India)

ABSTRACT

Ultrasound images are often preferred over other medical imaging modalities because it is noninvasive, non-ionizing, portable and low-cost. However, the main weakness of medical ultrasound image is the poor quality of images, which is interfere with multiplicative speckle noise. Speckle is a characteristic phenomenon in ultrasound images, which can be described as random multiplicative noise that occurrence is often undesirable, since it affects the tasks of human interpretation and diagnosis. Analysis of medical images is done using enhancement techniques. Different wavelet filters to be used into this paper. In this paper we can apply kaun and anisotropic diffusion filter. Comparison between these two parameter was done using different parameter.

Keywords: Anisotropic Diffusion, Sigmoid Weighting Factor, Wavelet Filter.

I. INTRODUCTION

DIGITAL images are subject to a wide variety of distortions during acquisition, processing, compression, storage, transmission and reproduction, any of which may result in a degradation of visual quality. For applications in which images are ultimately to be viewed by human beings, the only "correct" method of quantifying visual image quality is through subjective evaluation. In practice, however, subjective evaluation is usually too inconvenient, time-consuming and expensive. The goal of research in *objective* image quality assessment is to develop quantitative measures that can automatically predict perceived image quality. Wavelet filters are gives better result compared to regular filters. it gives in both time and frequency analysis so it is better compared with other filtering techniques.

II. FILTER INTRODUCTION

2.1. Lee Filter

Lee filter (also called Lee MMSE filter) is based on linear speckle noise model and the utilization of minimum mean square error (MMSE) criterion. Image data enhancement is then based on the filter equation:

$$\hat{R}(t) = I(t) \cdot W(t) + \bar{I}(t) \cdot [1 - W(t)], \quad \text{..(1)}$$

$\hat{R}(t)$ is the de-noised image, $I(t)$ is the image corrupted with speckle noise and $\bar{I}(t)$ is the mean image intensity within the filter window. $W(t)$ is weighted coefficient determined as:

$$W(t) = 1 - \frac{c_u^2}{c_I^2(t)}, \quad \text{..(2)}$$

where c_u and $c_I(t)$ are variation coefficients of speckle $u(t)$ and image $I(t)$ respectively:

$$c_u = \frac{\sigma_u}{u}, c_i(t) = \frac{\sigma_I(t)}{I(t)}. \quad \text{..(3)}$$

2.2. KUAN Filter

This approach transforms the multiplicative noise model into signal dependent additive noise model and then the minimum mean square error (MMSE) criterion is applied. Final equation is similar to Lee filter equation (3), but the weight factor $W(t)$ is different:

$$C(q) = \frac{1}{1 + [q^2(x, y; t) - q_0^2(t)]/[1 + q_0^2(t)]} \quad \text{..(6)}$$

2.3. Speckle Reduction Anisotropic Diffusion (SRAD)

SRAD method was tailored directly for ultrasound and radar imaging applications (both contain speckle noise). SRAD method uses instantaneous coefficient (similar to the coefficient of variation in Lee and Frost filter) that is a function of local gradient, magnitude and Laplacian operators. Yongjian et al. [8] claims, that this method is better than classical anisotropic reduction method when the image is corrupted by speckle noise. Method is based on partial differential equation (PDE) which involves the image gradient, Laplacian and image intensity. SRAD technique is based on a partial differential equation (PDE) and the MMSE, which can be related directly to the Lee and Frost window-based filters [7][8]. Thus, according to the PED, the equation of the SRAD [8] can be briefly described as follows:

$$W(t) = \frac{1 - \frac{c_u^2}{c_I^2(t)}}{1 + c_u^2}. \quad \text{..(4)}$$

where $I_0(x, y)$ represents the intensity image, $I(x, y; t)$ is the output image, 'div' the divergence operator, $\partial\Omega$ denotes the border Ω , \vec{n} is the outer normal $\partial\Omega$, and $C(q)$ is the diffusion coefficient and can be calculated as follows:

$$\begin{cases} \partial I(x, y; t) / \partial t = \text{div} [c(q) \nabla I(x, y; t)] \\ I(x, y; 0) = I_0(x, y; 0), (\partial I(x, y; t) / \vec{n}) | \partial\Omega = 0 \end{cases} \quad \text{..(5)}$$

$$q_0(t) = \frac{\sqrt{\text{var}[z(t)]}}{z(t)} \quad \text{..(7)}$$

where $q(x, y; t)$ is the instantaneous coefficient of variation determined by:

$$q(x, y, t) = \sqrt{\frac{(1/2)(\|\nabla I\|/I)^2 - (1/4^2)(\nabla^2 I/I)^2}{[1 + (1/4)(\nabla^2 I/I)^2]}} \quad \text{..(8)}$$

where ∇ is the gradient operator, $\| \cdot \|$ denotes the magnitude. The coefficient $q(t)$ is estimated below where $var[z(t)]$ and $z(t)$ are the intensity variance and mean over a homogeneous area at t , respectively.

2.4. Speckle Reduction Bilateral Filter (SRBF)

SRBF is described in equation. A brief description of the classical SRBF is described in this section, following the characterization of the speckle noise. Then the framework of the SRBF is adapted to the a priori knowledge on the speckle noise statistics and estimated speckle size. The general SRBF function can be expressed as:

$$h(p) = \Gamma^{-1}(p) \int_{\Omega(p)} f(\xi) c(\xi, p) s(f(\xi), f(p)) d\xi \quad \text{..(9)}$$

with the normalization factor:

$$\Gamma(p) = \int_{\Omega(p)} c(\xi, p) s(f(\xi), f(p)) d\xi \quad \text{..(10)}$$

where f is the original image, h is the filtered image, $\Omega(p)$ is the spatial neighborhood of the coordinate of a generic pixel p in the image and ξ is the integration variable representing pixels coordinate. In addition, $c(\xi, p)$ and $s(f(\xi), f(p))$ are represented by formulas of respectively.

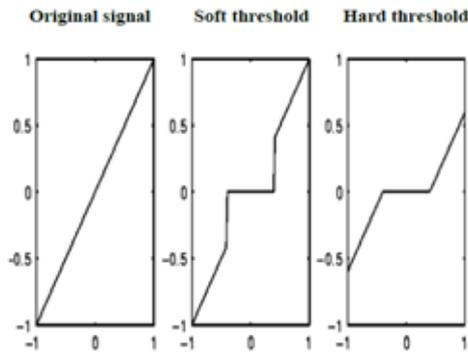
$$c(\xi, p) = \exp\left(-\frac{\|p - \xi\|^2}{2\sigma_c^2}\right)$$

$$s(f(\xi), f(p)) = \exp\left(-\frac{(f(p) - f(\xi))^2}{2\sigma_s^2}\right) \quad \text{..(11)}$$

where σ_c is the standard deviation of the Gaussian on the spatial support and σ_s is the standard deviation in the random domain Ω .

2.5. Wavelet Based Hard and Soft Thresholding

The soft and hard thresholding methods are used to estimate wavelet coefficients in wavelet threshold denoising. [1] Hard thresholding zeros out small coefficients, resulting in an efficient representation. Soft thresholding softens the coefficients exceeding the threshold by lowering them by the threshold value. When thresholding is applied, no perfect reconstruction of the original signal is possible. Hard thresholding can be described as the usual process of setting to zero the elements whose absolute values are lower than the threshold. The hard threshold signal is x if $|x| > \text{thr}$ and is 0 if $|x| \leq \text{thr}$, where „thr“ is a threshold value. Soft thresholding is an extension of hard thresholding, first setting to zero the elements whose absolute values are lower than the threshold, and then shrinking the nonzero coefficients towards 0. If $|x| > \text{thr}$, soft threshold signal is $(\text{sign}(x) \cdot (|x| - \text{thr}))$ and if $|x| \leq \text{thr}$, soft threshold signal is 0. Hard thresholding is the simplest method but soft thresholding has nice mathematical properties and gives better denoising performance. For example, as shown in figure 4, original signal has a line space with $Z = (-1, 1, 100)$. This means line space generates a row vector Z of 100 points linearly spaced between and including -1 and 1. In hard and soft thresholding, threshold value „thr“ is 0.4



$$T_{\text{Hard}}(x) = \begin{cases} x & |x| \geq \text{thr} \\ 0 & |x| < \text{thr} \end{cases} \quad \dots(12)$$

$$T_{\text{Soft}}(x) = \begin{cases} \text{Sign}(x) \cdot (x - \text{thr}) & x \geq \text{thr} \\ 0 & -\text{thr} \leq x < \text{thr} \\ \text{Sign}(x) \cdot (x + \text{thr}) & x < -\text{thr} \end{cases} \quad \dots(13)$$

III.PARAMETERS TO BE COMPARED

Following subsections describe some qualitative parameters for evaluation of quality of de-noising methods in detail.

3.1. Mean Square Error (MSE)

MSE is widely used to find the total amount of differences between the original and the de-noised image. Higher and lower MSE values indicate larger and smaller differences between the original and filtered image, respectively. MSE is equal to zero for identical images. It is 255 for completely dissimilar images. It is calculated as follows:

$$MSE = \frac{1}{MN} \sum_{i=1}^M \sum_{j=1}^N (X_{i,j} - X'_{i,j})^2 \quad \dots(14)$$

3.2. Signal-To-Noise Ratio (SNR)

SNR is a common measurement to evaluate the speckle reduction in the case of multiplicative noise by computing the ratio between the original and the de-noised image. Higher SNR values show that the filtering effect is better, and filtered image quality is much higher.

3.3. Peak Signal-To-Noise Ratio (PSNR)

PSNR is measurement of the performance of the speckle noise reduction. It is a ratio between the maximum possible power of the signal and the noise image. The PSNR can be calculated as follows:

$$PSNR = 10 \log_{10} \frac{(2^n - 1)^2}{MSE} = 10 \log_{10} \left(\frac{255^2}{MSE} \right) \quad \dots(15)$$

or

PSNR can be calculated as:

$$PSNR = 10 \cdot \log_{10} \left(\frac{I_{max}}{MSE} \right),$$

$$MSE = \frac{1}{M \cdot N \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} [R(m,n) - \hat{R}(m,n)]^2}, \quad ..(16)$$

where MSE is a Mean Square Error computed between original and de-noised image. Higher PSNR values correspond to a better image quality.

For identical images, the MSE becomes zero and the PSNR is undefined.

3.4. Average Difference (AD)

AD is the mean difference between original and filtered image divided by the size of the image. Its maximal value corresponds to dissimilar image and its minimal value corresponds to similar images. It is calculated as follows:

$$AD = \frac{1}{MN} \sum_{i=1}^M \sum_{j=1}^N |X_{i,j} - X'_{i,j}| \quad ..(17)$$

3.5. Speckle Index (SI)

SI is a measure of speckle reduction in terms of average contrast of the image. Lower value of SI corresponds to improved image quality. The SI is defined as follows:

$$SI = \frac{1}{MN} \sum_{i=1}^M \sum_{j=1}^N \frac{\sigma(i,j)}{\mu(i,j)} \quad ..(18)$$

or

The speckle index (SI) is defined as follows :

$$SI = \frac{1}{M \cdot N} \cdot \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} \frac{\sigma^2(m,n)}{\mu(m,n)}, \quad ..(19)$$

where s^2 is local variance and μ is mean value. The ratio between the speckle index of original image and the speckle index of image after filtration defines the SIR:

$$SIR = \frac{SI_{filtered}}{SI_{noisy}} \quad ..(20)$$

This parameter is useful especially for evaluation of de-noising quality for real ultrasound data. Smaller values of SIR indicate better speckle suppressing.

3.6. The Standard Deviation Of Important Regions

In both synthetic and real ultrasound images, the regions with homogenous texture can be found. The standard deviation of pixels in such regions can be also used to compare the quality of de-noising methods. Better denoising methods guarantee lower value of standard deviation in homogenous regions.

3.7. The SSIM Index

We construct a specific example of a SSIM quality measure from the perspective of image formation. A previous instantiation of this approach was made in and promising results on simple tests were achieved. In this paper, we generalize this algorithm, and provide a more extensive set of validation results. The luminance of the surface of an object being observed is the product of the illumination and the reflectance, but the structures of the objects in the scene are independent of the illumination. Consequently, to explore the structural information in an image, we wish to separate the influence of the illumination. We define the structural information in an image as those attributes that represent the structure of objects in the scene, independent of the average luminance and contrast. Since luminance

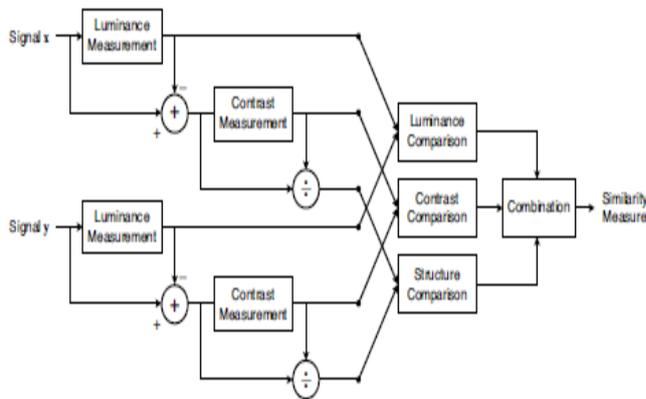


Diagram of the structural similarity (SSIM) measurement system.the three components are combined to yield an overall similarity measure

$$S(\mathbf{x}, \mathbf{y}) = f(l(\mathbf{x}, \mathbf{y}), c(\mathbf{x}, \mathbf{y}), s(\mathbf{x}, \mathbf{y})). \quad \dots(21)$$

$$l(\mathbf{x}, \mathbf{y}) = \frac{2\mu_x\mu_y + C_1}{\mu_x^2 + \mu_y^2 + C_1} \quad \dots(22)$$

$$C_1 = (K_1L)^2 \quad \dots(23)$$

$$l(\mathbf{x}, \mathbf{y}) = \frac{2(1 + R)}{1 + (1 + R)^2 + \frac{C_1}{\mu_x^2}} \quad \dots(24)$$

The contrast comparison function takes a similar form

$$c(\mathbf{x}, \mathbf{y}) = \frac{2\sigma_x\sigma_y + C_2}{\sigma_x^2 + \sigma_y^2 + C_2} \quad ..(25)$$

Structure comparison is conducted after luminance subtraction variance normalization.

$$s(\mathbf{x}, \mathbf{y}) = \frac{\sigma_{xy} + C_3}{\sigma_x\sigma_y + C_3} \quad ..(26)$$

$$\sigma_{xy} = \frac{1}{N-1} \sum_{i=1}^N (x_i - \mu_x)(y_i - \mu_y) \quad ..(27)$$

Finally, we combine the three comparisons of c and name the resulting similarity measure the SSIM index between signals x and y .

$$SSIM(\mathbf{x}, \mathbf{y}) = [l(\mathbf{x}, \mathbf{y})]^\alpha \cdot [c(\mathbf{x}, \mathbf{y})]^\beta \cdot [s(\mathbf{x}, \mathbf{y})]^\gamma \quad \dots(28)$$

where $\alpha > 0, \beta > 0$ and $\gamma > 0$.

3.8. Mean SSIM

In practice, one usually requires a single overall quality measure of the entire image. We use a mean SSIM (MSSIM) index to evaluate the overall image quality

$$MSSIM(\mathbf{X}, \mathbf{Y}) = \frac{1}{M} \sum_{j=1}^M SSIM(\mathbf{x}_j, \mathbf{y}_j) \quad ..(29)$$

where X and Y are the reference and the distorted images, respectively; X_j and Y_j are the image contents at the j th local window; and M is the number of local windows of the image. For example, region-of-interest image processing systems may give different weights to different segmented regions in the image. As another example, it has been observed that different image textures attract human fixations with varying degrees.

IV.FIGURES AND TABLES

4.1 Comparison

Filter	M_SE	SNR	PSNR	FOM	AD
Kaun	2.82e3	56.1553	13.6271	95.5667	27.5837
Anisodiff	4.4100	84.2145	41.6864	95.2023	0.0049
SRAD	0.0024	68.7906	74.3931	79.9973	-0.0025
Bilateral	5.6727e-29	373.1210	330.5929	100	3.2253e-16
Hard wavelet Threshold	148.3901	68.9449	26.4168	58.8898	-0.0070

Shoft wavelet	462.65	61.9408	21.4783	71.2664	-0.0341
---------------	--------	---------	---------	---------	---------

Table1. Metric measurement parameter of ultrasound image

Filter	SI	IQI	MSSIM	RFSIM
Kaun	0.0053	0.0322	0.4765	2.3857e-7
Anisodif	0.0049	0.0311	0.983	0.9292
SRAD	0.0041	8.7507	0.999	0.9954
Bilateral	0.0052	0.0311	1	1
Hard Thresholding	0.0047	1.4435	0.7320	0.4032
Shoft Thresholding	0.0058	0.0031	0.4752	0.2063

Table2. Metric measurement parameter of ultrasound image

All these filters are applied on renal calculi's image. Differnt parameters are to be calculated for ultrasound image. and the results are as shown in table 1 and 2. As per data result psnr should be as low as possible which are in anisotropic and hard thresholding filter. figure of merit for all the filters kaun and anisotropic diffusion filter shows good result in table 1.

4.2. FIGURES

4.2.1. Ultrasound Image with speckle noise



4.2.2. Kaun Filter



4.2.3. Anisotropic diffusion filter

4.2.4. SRAD



4.2.5. Bilateral Filter

4.2.6. Hard Thresholding



4.2.7. Soft Thresholding:



V. CONCLUSION

In this paper we can find different types of filters and different parameter are to be computed between two filters. This comparison shows that anisotropic diffusion filter gives better result than kaun filter as shown in renal calculi figure. After comparing all these filters we can conclude that anisotropic diffusion and hard wavelet thresholding filter gives better result than another filters. It reduces ultrasound noise from the medical image. It improves the quality of an ultrasound images.

REFERENCES

- [1] Deep Gupta, R.S. Anand, Barjeev Tyagi, "Enhancement of Medical Ultrasound Images using Non-Linear Filtering Based on Rational-Dilation Wavelet Transform", Proceedings of the World Congress on Engineering and Computer Science 2012 Vol I WCECS 2012, October 24-26, 2012, San Francisco, USA
- [2] D. Sasikala and M. Madheswaran, "Speckle Noise Filtering For Ultrasound Images Of Common Carotid Artery: A Review", Ictact Journal On Image And Video Processing, May 2014, Volume: 04, Issue: 04
- [3] Radek BENES1, Kamil RIHA1, "Medical Image Denoising By Improved Kuan Filter", volume: 10 | number: 1 | 2012 | march
- [4] Wen-Chien Yen, Shen-Chuan Tai, "Dual-tree Wavelet Based Algorithm for Speckle Reduction and Edge Enhancement in Ultrasound Images", 2010 3rd International Conference on Biomedical Engineering and Informatics (BMEI 2010)
- [5] Keerthivasan A, Jai jaganath babu and Gnanou Florence sudha, "Speckle noise reduction in ultrasound images using fuzzy logic based on histogram and directional differences", International conference on Communication and Signal Processing, April 3-5, 2013, India
- [6] Shibin Wu, Qingsong Zhu and Yaoqin Xie Ph.D, "Evaluation of Various Speckle Reduction Filters on Medical Ultrasound Images", 35th Annual International Conference of the IEEE EMBS Osaka, Japan, 3 - 7 July, 2013
- [7] Jappreet Kaur, Jasdeep Kaur, Manpreet Kaur "Survey of Despeckling Techniques for Medical Ultrasound Images", IJCTA | JULY-AUGUST 2011 Available online @ www.ijcta.com
- [8] Sivakumar .R and Nedumaran .D, "Implementation of Wavelet Filters for Speckle Noise Reduction in Ultrasound Medical Images: A Comparative Study", International Conference on Signals, Systems and Communication, December 21-23, 2009
- [9] Er. Simrat1, Er. Anil Sagar2, "Empirical Study of Various Speckle Noise Removal Methods", International Journal of Emerging Technologies in Computational and Applied Sciences (IJETCAS).
- [10] Nishtha Atlas, Dr. Sheifali Gupta, "Reduction of Speckle Noise in Ultrasound Images using Various Filtering techniques and Discrete Wavelet Transform: Comparative Analysis"
- [11] Zhou Wang and A.C. Bovik, "A universal image quality index," IEEE Signal Processing Letters, vol. 9, no. 3, pp. 81-84, 2002.
- [12] Z. Wang, A.C. Bovik, H.R. Sheikh, and E.P. Simoncelli, "Image quality assessment: from error visibility to structural similarity," IEEE Transaction on Image Processing, vol. 13, no. 4, pp. 600-612, April 2004.
- [13] Lin Zhang, Lei Zhang, X. Mou, and David Zhang, "FSIM: A feature similarity index for image quality assessment," IEEE Transactions on Image Processing, vol. 20, no. 8, pp. 2378-2386, August 2011.

PROJECT MANAGEMENT IN INDIA: A REALITY CHECK

Dr Malini Pande

*Professor & Head, Department of Management Studies,
Dr MGR University, Chennai, (India)*

ABSTRACT

In India the GDP growth rate for fiscal year 2015 is at 7.4 percent and is targeted at 8-8.5 percent for fiscal year 2016. The target of the government is to increase growth to double digits in the coming years. The Budget 2015 stressed on the need for accelerating investment and developing infrastructure. To stride towards the path of growth it is imperative that development projects that provide employment, stimulate investments, create infrastructure and a positive business environment are initiated and completed on time. Project Management is defined as the achievement of the objectives of the project through people. It involves organizing, leading, planning and control of the resources assigned for the project. Here we are going to talk about Project Monitoring, Control, and Evaluation. Exploratory research technique using case study analysis has been used and the researcher investigates a few ongoing government projects that have been delayed in the construction industry in Chennai. Literature review and in depth interviews have thrown some light on understanding the best method of monitoring projects. There is lack of good Project Management in several projects leading to time and cost overruns. Successful completion of any project requires effective project monitoring. Planning, Allocation, Implementation, Measurement, Evaluation, and Adjustment - all these six steps need to be followed to be successful in project implementation.

Keywords: *Project Management, Project Monitoring, Planning, Allocation, Implementation, Measurement, Evaluation, and Adjustment, Economic growth.*

I. INTRODUCTION

Development and growth are the buzz words in economics. Developing nations wish to enhance their Gross Domestic Product to improve the income levels and living standards of the masses. In India the GDP growth rate for Fiscal Year 2015 is at 7.4 percent, is targeted at 8-8.5 percent for Fiscal Year 2016, and the ambition of the government is to increase the growth to double digits in future. The Budget 2015 stressed on the need for accelerating investment and developing infrastructure. To achieve an increase in income and stride towards the path of growth it is imperative that development projects that provide employment, stimulate investments, create infrastructure and a positive business environment are initiated and completed on time. In India projects are being created and implemented all the time for faster economic growth. These projects besides creating the prerequisites for growth infuse liquidity in the economy and stimulate a multiplier effect, where an initial dose of investment spurts a multiple increase in income. These investments will involve several large projects and for the projects to be completed successfully it is absolutely imperative that efforts are made towards good project management.

II. PROJECT, PROGRAMME, AND PROJECT MANAGEMENT: MEANING

There is a difference between a project and a programme. Several projects may be parts or constituents of a programme. So a programme is a broader term, designed to solve a particular problem and it may have several projects in it. A programme is for long term, it starts on a particular date but its ending date depends on the completion of all the projects that form a part of the programme. Projects are basically activities undertaken to complete the programme. A Project can be defined as a complete package of investments, policy measures, and institutional and other actions designed to attain a specific objective or objectives within a specific time period. Projects can also be defined as a one time job that has a specific starting and ending date, a clearly articulated objective, and a predefined budget. Projects that are often called development projects in developing countries include capital formation and infrastructure development.

Project Management is defined as the achievement of the objectives of the project through people. It involves organizing, leading, planning and control of the resources assigned for the project. So project management consists of identifying development needs, designing the project, implementing the project, monitoring and controlling the projects, and finally evaluating the performance of the project. Here we are going to talk about Project Monitoring, Control, and Evaluation.

III. RESEARCH METHODOLOGY

In this research Qualitative Research technique has been used to understand the issues related to Project Management with reference to government projects in Chennai city. Qualitative analysis in this research involves analysis of data such as words from interviews. The case study approach is a widely practiced approach by all researchers for qualitative research involving non statistical procedures. Exploratory research technique using case study analysis has been used and the researcher investigates a few ongoing government projects that have been delayed in the construction industry in Chennai. These projects are the cases studies for this research. Our research has not created any new theories in project management but tried to confirm that most of the projects falter at the monitoring stage. Based on the interviews made with the respondents one truth stood out clearly that project monitoring is a neglected area and attitude towards monitoring is very casual. This paper wishes to reaffirm the importance of step by step, methodical, and professional monitoring of projects and the lack of and therefore need for training the project managers in project monitoring and control. The names of the projects cannot be revealed due to request for confidentiality from the respondents. Data was collected through in depth interviews with contractors, Project Managers, and Government officials involved in the project. The information and knowledge gained through these interviews gave an insight to the researcher regarding the lack of professional project monitoring done in some of the projects. Successful implementation of projects requires a series of steps. We are not discussing all the steps in entirety. Here we are focusing on the part related to Project Monitoring which is extremely important for the success of a project. Literature review and in depth interviews have thrown some light in understanding the best method of monitoring projects.

IV. PROJECT MONITORING

The process of observing progress of the project, observing how resources are utilized and anticipating deviations from planned performance will come under the purview of Project Monitoring. If we wish to utilise the resources earmarked for the project in an optimal manner it is crucial that monitoring and control is done on

a regular basis. Timely completion of the project also requires continuous monitoring. Monitoring is also needed to ensure that inputs are converted into the highest quality of output. A good monitoring system will communicate reliable and accurate information about key result areas at a fast speed. There are several aspects of Monitoring. Some of them can be categorised as a) physical progress of implementation of projects (e.g. irrigation canals and drains, power projects etc), b) production, productivity, and profitability performance , c) maintenance of capital assets created so that there is no wastage of resources, d) ensure that there are no negative externalities or negative spill-over effects of the project.

V. PROJECT MANAGER AND HIS ROLE

A Project Manager plays a tremendous role in the success of a project. He or she needs to monitor and control the project by designing and implementing systems for the process so that there is the highest quality of output within the shortest possible time. The success in achieving this depends on how well the Project Manager involves, motivates, and guides his team. A Project Manager also needs to be capable of anticipating cost overruns and taking timely corrective action. This can be achieved by regularly monitoring resource absorption, following time deadlines, and having the intelligence and flexibility to vary the planned approach if there is any sign of overrun. He has to be fully knowledgeable about the control mechanisms and also ensure that other staffs of the project are properly prepared i.e. skilled and motivated to monitor the performance of the parts of projects under their control. Constant supervision and vigil is imperative.

VI. STEPS IN MONITORING AND CONTROL

Monitoring and Control means that activities of the project are completed on time and within the budget, that is, there are no time and cost overruns. To ensure this six steps are necessary:

- 6.1. Planning - This is required for goal setting and goals help in setting expectations. It is against these expectations that project authority can control and monitor project performance.
- 6.2. Allocation – This is about applying the resources to various activities in the project.
- 6.3. Implementation- This is about undertaking all the technical work that is required to complete the project. It absorbs resources and provides results for the project.
- 6.4. Measurement – Project management requires that deviation from goals and performance should be detected at the earliest stage. All performance indicators need to be observed and deviations measured.
- 6.5. Evaluation – This is about understanding the why and how of deviations, what caused the deviations from the set goals and planned performance.
- 6.6. Adjustment – This means taking remedial or corrective action to resolve any deviations that exist.

VII. AREAS IN MONITORING

Any project needs to keep three things in minds:

First, that it meets its goals and delivers what it was supposed to deliver.

Second, that it is completed on the planned end date.

Third, the project is completed within the specified budget.

VIII. MONITORING TECHNICAL PERFORMANCE

There are various methods of monitoring technical performance of a project. Some of them are:

8.1. Technical teams or Activity teams in the hierarchy of reporting to output managers or Department Head

They are most appropriate for the purpose of monitoring because these are people who are directly responsible for conducting the work and ensuring that the deliverables are made.

8.2. Activity Bar Chart

This is a graphic way of showing the schedule of project activities. This chart can provide information related to a complete list of objectives, outputs, activities, calendar for the entire project, and start and end date for each activity. This is actually a tool for monitoring technical performance of a project and indicates the dates by which these deliverables should be completed.

8.3 Peer Review

To evaluate the quality of the technical work peer review can be very useful. However its usefulness is contingent on the peers being technically capable and knowledgeable.

8.4. Third Party Technical Review

This is done by people or an individual who has no stake in the project. This review gives objectivity and expertise which only a third party can give.

IX. MONITORING TIME PERFORMANCE

Activity bar chart represents the project schedule. For monitoring time performance two devices have been found useful. They are:

9.1 Resource Bar Chart

This is a good monitoring device which helps us to consider the impact of the schedule delay on all aspects of the project. This bar chart indicates when the materials were supposed to come and when they have actually come. From this resource bar chart it is simple to assess if time schedule has been followed in project implementation.

9.2 Expenditure Schedule

The budget allocated to individual activities can be aggregated by output. On the basis of activity level monitoring data, this enables the Project Manager to monitor the schedule of expenditure for the complete project.

X. MONITORING COST PERFORMANCE

Cost performance also is of crucial importance and could be a critical strategy for monitoring the project. Some important tools are:

10.1 Budget as a Tool for Monitoring

If the budget is compared to the actual costs as they are incurred then it could be an effective tool for monitoring. But if one has cost category budgets at the activity level, then one can detect financial deviations early in the project. The accountant in the project team can help the activity team create a simple monthly

statement which compares actual to planned expenditure per cost category. The periodic statement reflects financial activity during the current period. This reveals the cost performance.

10.1 Cash Flow Projection

Cash flow is a useful tool for predicting real costs and actual incomes. It also helps in anticipating cash shortages. If optimal performance is the goal then all three elements – technical, time, and cost performance should be monitored simultaneously.

10.2 Value Engineering Review

There is always a stress on reducing project cost. Value engineering is a reviewing process of the value of the item used in the project. The value engineering review uses costs as a basis of review. Value of an item refers to the minimum cost at which the activity provided by the item under review could be obtained from any other item. This means that when non-functional cost is reduced or removed from an item, its value can be increased.

XI. CONCLUSION

The GDP growth rate for 2015 is at 7.4 percent, for 2016 it is targeted at 8-8.5 percent, and the ambition of the government is to increase the growth to double digits in future. The Budget 2015 stressed on the need for accelerating investment and developing infrastructure, if this dream is to become a reality. The additional fiscal expenditure is expected to go to infrastructure spending which in turn is expected to spur growth. The capital expenditure has seen an increase of 33.8 percent at Rs 1.35 lakh crore. Also the government's 'Make in India' programme to make India a manufacturing hub, presents a huge opportunity for job creation. All this focus and effort at boosting India's economic growth involves investments in high productivity sectors like infrastructure, manufacturing and related industries. These investments will involve several large projects and for the projects to be completed successfully requires efforts at good project management.

While the government is looking to fast-track stalled projects and start new projects a large number of mega infrastructure projects are facing delays. There is a lack of good Project Management in several of these projects leading to time and cost overruns. Successful completion of any project requires effective Project Monitoring. Planning, Allocation, Implementation, Measurement, Evaluation, and Adjustment - all these six steps need to be followed to be successful in project implementation. Our research has not created any new theories in project management but tried to confirm that most of the projects falter at the monitoring stage. Based on the interviews made with the respondents one truth stood out clearly that project monitoring is a neglected area and attitude towards monitoring is very casual. This paper wishes to reaffirm the importance of step by step, methodical, and professional monitoring of projects and the lack of and therefore need for training the project managers in project monitoring and control.

REFERENCES

- [1] The Economic Times, 1 March 2015 - Union Budget 2015
- [2] A.M. Odeh and H.T. Battaineh (2002) Causes of construction delay: traditional contracts. International Journal of Project Management. 20, p. 67-73. (2002)
- [3] S.A. Assaf and S.A. Al-Hejji (2006) Causes of delay in large construction projects. International Journal of Project Management. 24, p. 349-357. (2006)

- [4] CT. Ramanathan and S.P. Narayanan (2009) Management of Multiple Projects in Pre-design and Pre-construction phase. 2nd Construction Industry research achievement international conference (CIRAIC 2009). CIDB. Kuala Lumpur, Malaysia. (2009)
- [5] I.B. Arazi, S.P. Narayanan and CT.Ramanathan (2011) Review on Uncertainties causing time and cost overrun in construction projects. World Academy of Science, Engineering and Technology (WASET 2011), Bangkok, Thailand. (2011)
- [6] Delays and Cost Overruns in Infrastructure Projects: An Enquiry into Extents, Causes and Remedies Ram Singh Department of Economics Delhi School of Economics University of Delhi 110007
- [7] GOI(2006a), "Financing of the National Highway Development Programme", Report of the Core Group, Planning Commission, Government of Financing Support to Public Private Partnership in Infrastructure, Planning Commission, New Delhi.
- [8] GOI(2006b), "Guidelines on Financing Support to Public Private Partnerships in Infrastructure, Planning and Commission", New Delhi.
- [9] Managing Changes in Construction Projects, Written and compiled by the research team: University of the west England, Bristol Professor Ming Sun.
- [10] The Root Causes of Delays in Highway Construction, Dr. Ralph D. Ellis, Jr. Associate Professor Department of Civil and Coastal Engineering University of Florida
- [11] Construction Delay in International Projects, By Prof. Sami M. Fereig Ph.D., P. Eng. Dr. Nabil Kartam, Ph.D. Kuwait University, Kuwait.
- [12] "Pre-Execution Delays in Construction Project" by R.C. Boolchandani Chief Engineer (construction) MTP.

GSM BASED AUTHORIZED ACCESS WITH SEPARATE USER PASSWORD DOOR LOCK AND UNLOCK CONTROL SYSTEM

R. Alagu leela¹, A. Anandhajothi², P. Selvakumari³

*^{1,2,3} U.G Student, Department of Electronics and Communication Engineering,
Raja College of Engineering and Technology, Madurai, Tamilnadu, (India)*

ABSTRACT

Unlock Security logging door by a GSM application using a unique password entered through the GSM Modem. Opening and closing of a security logging door is achieved by using a GSM application. The user can connect and send SMS through GSM Modem. This method is very convenient as one doesn't have to get down of his car to open/close the door physically. The GSM module act as both transmitting and receiving unit employs the use of a mobile phone set serving as the communication device between the user at one end and the object of access (i.e. the door) at the other receiving end.

Keywords: SIM 300, PIC, Microcontroller

I. INTRODUCTION

Security is the main concern for everyone. Everybody wants themselves to keep safe or secure from varies incidents like theft. Security is mainly used in bank, document locker, jewellery shop etc. Security describes protection of life and property. There are doors to keep people out, Key locks and chains reinforce the mode of security. Doors are being made of metals not just wood anymore. Influential persons in our society have bullet proof doors to ensure a good measure of security of self and family.

II. RELATED WORK

Basically traditional locks are heavy and are not protective. Opening and closing of security door involves human labor. It is always convenient for thieves and burglars to target them. So we need another one improved security locking system.

III. PROPOSED WORK

SMS application sends data through GSM Modem. Another GSM device connected at the receiving end which is fed to the microcontroller. The sent data (password entered by the user) matches with the password stored in the microcontroller. The microcontroller initiates a mechanism to open the door through a motor driver interface.

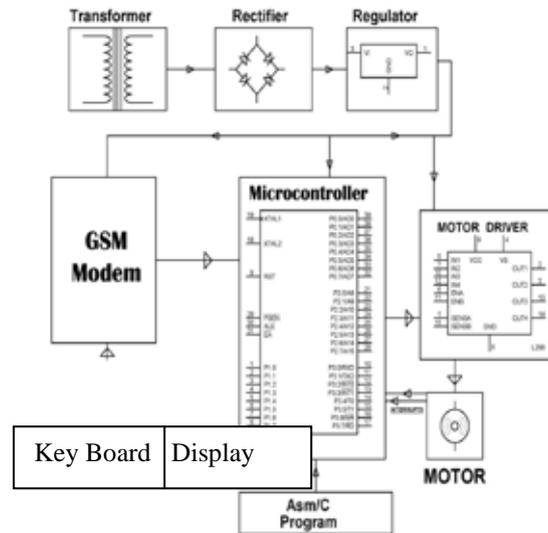


Figure 1: Block Diagram of Proposed Work

3.1 Power Supply Board

Step down transformer is used to supply the circuits in the range of 230/12v AC. Bridge rectifier is used to converter to AC to DC. Voltage regulator is used to range from 12v, 5v. Capacitor is used to purpose of smoothing.

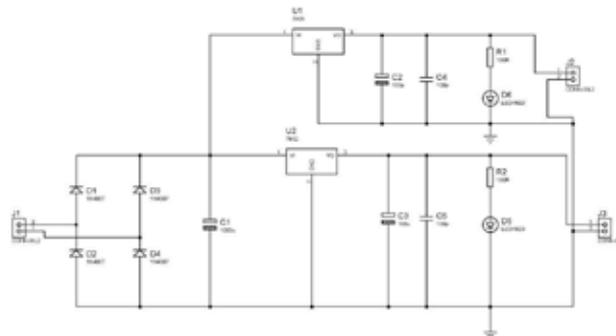


Figure 2: Symnatic Diagram of Proposed Work

3.2 Sim300

- ✓ Single supply voltage 3.2v-4.5v.
- ✓ Typical power consumption in SLEEP mode: 2.5mA.
- ✓ SIM 300 tri-band.
- ✓ MT, MO, CB, text and PDU modems storage: SIM card. Supported SIM card :1.8v ,3v

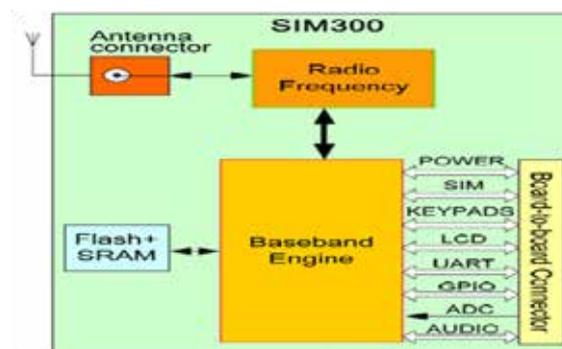


Figure 3: Block Diagram of SIM 300

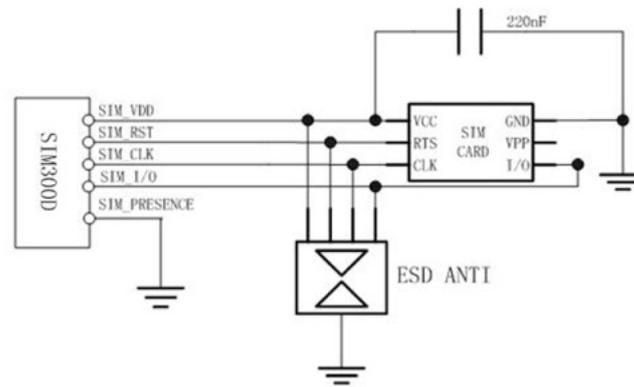


Figure 4: Symnatic Diagram of SIM 300

Antenna is used to divides the transmitting and receiving signal (frq range 800-1900MHz). Radio frequency is used to modulation and demodulation purpose. The demodulation o/p of the RF is connected to microcontroller. SIM 300 can used to send and receive the SMS. Transceiver and Receiver ports are connected to UART ports in micro controller. 12 v powers are used to supply to SIM 300.

3.3 PIC (16f877a)

- ✓ PIC microcontrollers are electronic circuits that can be programmed to carry out a vast range of tasks.
- ✓ The 16f877a IC is low cost, high quality, Ease of availability.
- ✓ Interrupt capability(up to 14 sources)
- ✓ Power on reset.
- ✓ Low power consumption etc.

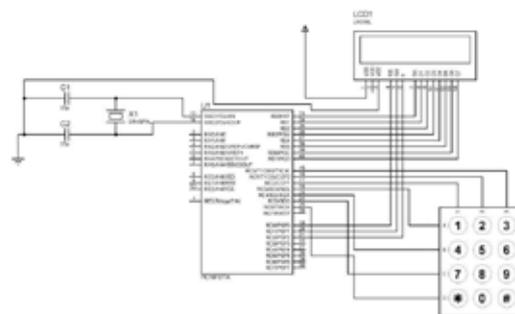
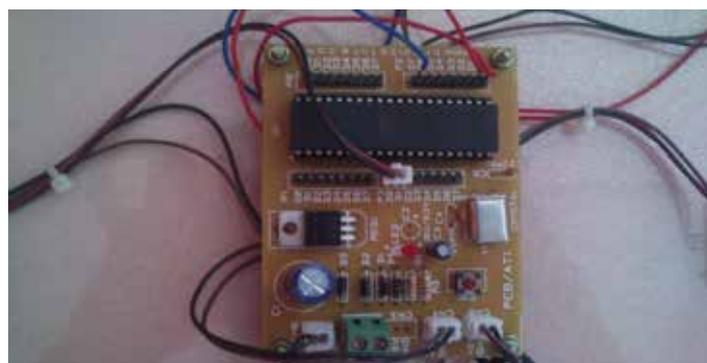


Figure 5: Symnatic Diagram of PIC (16F877A)

It is a 40 pin IC. C1 to c7 pins are connecting with keypad. D1 to d8 pins are connecting with display. UART ports are connecting with GSM Modem. 20 and 40 pins are connected with power supply.

IV. RESULTS AND DISCUSSION



V. CONCLUSION

In this project we have implemented GSM techniques that can provide the high level security in areas such as home, office, bank etc. This project identifies a high level model for the modification of existing security systems using security protocol as PIN strategy. Thus we designed the security terminal based on a GSM application using a unique password entered through the GSM application device.

REFERENCE

1. Anshu Shrivastava, Balkrishna Dwived and Deepak Parashar, "GSM based home security system", International Journal of Emerging Trends in Electronics and Computer Science, volume 2, issue 4, April 2013.
2. R.Ramani, S.Valarmathy, and S. Selvaraju, "Bank Locker Security System Based on RFID and GSM Technology, International Journal of Computer Applications (0975 – 8887) volume 57– no.18, November 2012.
3. Dr.Saylee Gharge Honey Brijwani, Mohit Pugnani, Girish Sukhwani, and Deepak Udherani, "Two way Password verification security system using RFID and GSM ", International Technological Conference-2014 (I-Techcon), Jan. 03 – 04, 2014.
4. Ushie James Ogri, Donatus Enang Bassey Okwong, and Akaiso Etim, " Design and Construction of Door locking Security System using GSM", International Journal of Engineering and Computer Science ISSN:2319-7242,volume 2 issue 7 (July 2013), page no. 2235-2257.
5. Mary Lourde R and Dushyant Khosla, "fingerprint identification in biometric security systems" ,international journal of computer and electrical engineering, vol. 2, no. 5, october, 2010.
6. Pramila D. Kamble, Dr.Bharti, W. Gawali, "fingerprint verification of ATM security system by using biometric and hybridization", international journal of scientific and research publications, volume 2, issue 11, november 2012.
7. Hugh Wimberly, Lorie m. And Liebrock, "using fingerprint authentication to reduce system security: an empirical study", 2011 IEEE symposium on security and privacy.
8. M.Gayathri, P.Selvakumari, R.Brindha, " Fingerprint and GSM based security system, International Journal of Engineering Sciences & Research Technology, April 2014.

EXPLOITING EARLY TAG ACCESS FOR REDUCING L1 DATA CACHE ENERGY IN EMBEDDED PROCESSORS

Kishore Kumar T¹, Azhagar Swamy P², Kathiresan M³

*^{1,2,3} U.G Student, Department of Electronics and Communication Engineering,
Raja College of Engineering and Technology, Madurai, Tamilnadu, (India)*

ABSTRACT

We propose a new cache design technique, referred to as early tag access (ETA) cache, to improve the energy efficiency of data caches in embedded processors. ETAs to determine the destination ways of memory instructions before the actual cache accesses two operation modes to exploit the tradeoffs between energy efficiency and performance. This enables significant energy reduction with negligible performance overheads.

Keywords: *ETA, LSQ, Energy Model*

I. INTRODUCTION

Reducing power consumption in cache memory is a critical problem for embedded processors that target low power applications. It was reported that on-chip caches could consume as much as 40% of the total chip power. Furthermore, large power dissipation could cause other issues, such as thermal effects and reliability degradation. This problem is compounded by the fact that data caches are usually performance critical. Therefore, it is of great importance to reduce cache energy consumption while minimizing the impact on processor performance. Many cache design techniques have been proposed at different levels of the design abstract to exploit the tradeoffs between energy and performance. As caches are typically set-associative, most micro architectural techniques aim at reducing the number of tag and data arrays activated during an access, so that cache power dissipation can be reduced.

II. RELATED WORK

Many cache design techniques have been proposed at different levels of the design abstract to exploit the tradeoffs between energy and performance. As caches are typically set-associative, most micro architectural techniques aim at reducing the number of tag and data arrays activated during an access, so that cache power dissipation can be reduced. Phased caches access tag arrays and data arrays in two different phases. Energy consumption can be reduced greatly because at most only one data array corresponding to the matched tag, if any, is accessed. Due to the increase in access cycles, phased caches are usually applied in the lower level memory, such as L2 caches, whose performance is relatively less critical. For L2 caches under the write through policy, a way-tagging technique sends the L2 tag information to the L1 cache when the data is loaded from the L2 cache.

III. PROPOSED SYSTEM

To Overcome the L2 Cache Memory, We proposed new L1 Cache memory for bringing the better performance and efficiency improvement in energy cache. In this paper, we propose a new cache technique, referred to as early tag access (ETA) cache, to improve the energy efficiency of L1 data caches. In a physical tag and virtual index cache, a part of the physical address is stored in the tag arrays while the conversion between the virtual address and the physical address is performed by the TLB. By accessing tag arrays and TLB during the LSQ stage, the destination ways of most memory instructions can be determined before accessing the L1 data cache. As a result, only one way in the L1 data cache needs to be accessed for these instructions, thereby reducing the energy consumption significantly. Note that the physical addresses generated from the TLB at the LSQ stage can also be used for subsequent cache accesses. Therefore, for most memory instructions, the energy overhead of way determination at the LSQ stage can be compensated for by skipping the TLB accesses during the cache access stage. For memory instructions whose destination ways cannot be determined at the LSQ stage, an enhanced mode of the ETA cache is proposed to reduce the number of ways accessed at the cache access stage. Note that in many high-end processors, accessing L2 tags is done in parallel with the accesses to the L1 cache. Our technique is fundamentally different as ETAs are performed at the L1 cache.

3.1 Proposed Eta Cache

In a conventional set-associative cache, all ways in the tag and data arrays are accessed simultaneously. The requested data, however, only resides in one way under a cache hit. The extra way accesses incur unnecessary energy consumption. In this section, a new cache architecture referred to as ETA cache will be developed. The ETA cache reduces the number of unnecessary way accesses, thereby reducing cache energy consumption. To accommodate different energy and performance requirements in embedded processors, the ETA cache can be operated under two different modes: the basic mode and the advanced mode.

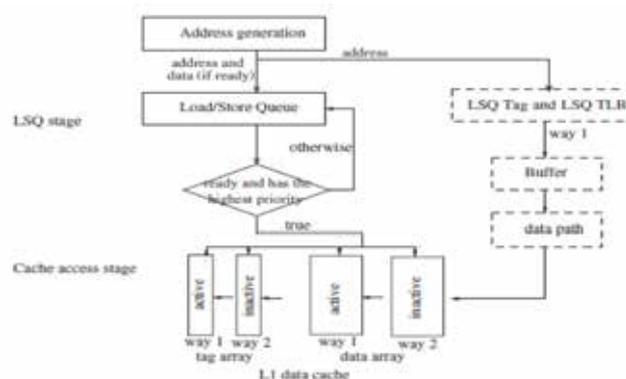


Fig. 3. Operation of a load/store instruction between LSQ and L1 data cache under the proposed ETA cache.

3.2 Basic Mode

It is possible to perform an access to the tag arrays at the LSQ stage due to the availability of memory addresses. In the basic mode of the ETA cache, each time a memory instruction is sent into the LSQ, an access to a new set of tag arrays and TLB is performed. This new set of LSQ tag arrays and LSQ TLB are implemented as a copy of the tag arrays and TLB of the L1 data cache, respectively, to avoid the data contention with the L1 data cache. If there is a hit during the LSQ lookup operation, the matched way in the LSQ tag arrays will be used as the destination way of this instruction when it accesses the L1 data cache subsequently. If this destination way is correct, only one way in the L1 data cache needs to be activated and thus enables energy savings. On the other

hand, if a miss occurs during the lookup operation in the LSQ tag arrays or in the LSQ TLB, the L1 data cache will be accessed in a conventional manner, i.e., all ways in the tag arrays and data arrays of the L1 data cache will be activated. We can see that the two sets of tag arrays and TLB are accessed at two different stages: LSQ stage and cache access stage

3.3 Implementation

This section presents the VLSI implementation of the proposed ETA cache. Depicts a two-way set-associative L1 data cache for demonstration. The key components in the ETA cache, such as LSQ tag arrays, LSQ TLB, information buffer, way decoder, and way hit/miss decoder will be discussed in the following sections.

3.4 LSQ Tag Arrays and LSQ TLB

To avoid the data contention with the L1 data cache, the LSQ tag arrays and LSQ TLB are implemented as a copy of the tag arrays and TLB of the L1 data cache, respectively. There are two types of operations in the LSQ tag arrays and LSQ TLB: lookup and update. Each time a memory address reaches the LSQ, the LSQ tag arrays and LSQ TLB will be searched for the early destination way. In case of a hit, the early destination way will be available; otherwise, the instruction will cause either an early tag miss (if the access to the LSQ tag arrays encounters a miss) or an early TLB miss (if the address is not in the LSQ TLB). For update operations, the contents of LSQ tag arrays and LSQ TLB are updated with the tag arrays and TLB of the L1 cache, so that they are identical to avoid cache coherence problems. The update logic of LSQ tag arrays and LSQ TLB is the same as that of the tag arrays and TLB of the L1 cache.

Consider that generally at most N instructions can enter the LSQ while the L1 data cache allows M replacements to occur at the same time. Therefore, there might be at most N lookup operations and M update operations occurring at the LSQ tag arrays and LSQ TLB at the same time. In order to perform these operations simultaneously, the LSQ tag arrays and LSQ TLB have N read ports and M write ports. Write/read conflicts occur when the lookup and update operations target the same location of the LSQ tag arrays at the same time

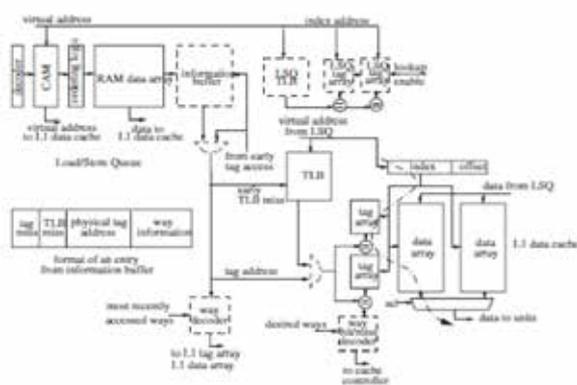


Fig. 10. Proposed ETA cache (blocks in dash line are new components and dotted line is the timing critical path).

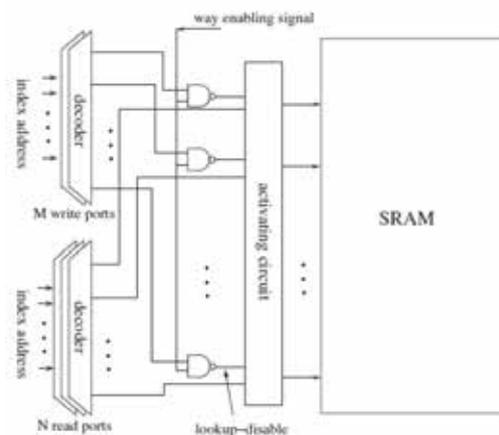


Fig. 11. Implementation of LSQ tag arrays (only one way is shown for simplicity).

Consider a two-way set-associative cache for example. Assume that there is a replacement occurring at the way 1 of the L1 data cache. As a result, the way enabling signal is set to “1” and then sent to the NAND gates in the way 1 of the LSQ tag arrays. If the write decoder outputs a “0,” i.e., no update operation on this entry of the tag array, the lookup-disable signal will be set to “1” and the activating circuit will not block the lookup operation on this entry. Otherwise the lookup-disable signal will be “0,” and the activating circuit will block possible

lookup operations to avoid write/read conflicts. The lookup operation, if any in this case, is considered as a miss. This miss might cause some performance degradations if it turns out to be a cache hit in the cache access stage. Fortunately, this rarely happens. We observed from simulations that less than 0.01% of the total LSQ accesses experienced this issue. Note that if the way enabling signal is “0,” i.e., no update operation, the lookup operation will not be affected. This scheme is also used in the LSQ TLB. Since the activating circuit introduces no performance penalty, the enabling circuit increases the critical path of the LSQ tag arrays and LSQ TLB by the delay of an NAND gate.

3.5 Energy Model

The following energy model is employed in our study:

$$E_{tot} = N_{tag_hit} \times (E_{tag_hit,L1} + E_{info}) + N_{tag_miss_only} \times (E_{tag_miss_only,L1} + E_{info}) + N_{tag_TLB_miss} \times (E_{tag_miss,L1} + E_{TLB} + E_{info}) + N_{re-access} \times E_{re-access,L1} + N_{tot} \times (E_{info} + E_{LSQ_tag} + E_{LSQ_TLB}) + E_{others} \quad (1)$$

where N_{tag_hit} , $N_{tag_miss_only}$, and $N_{tag_TLB_miss}$ are the numbers of load/store instructions with early tag hit, early tag miss only, and both early tag and TLB misses, respectively, and $N_{re-access}$ is the number of cache re-accesses.

The energy consumptions per access related to these cases are denoted as $E_{tag_hit,L1}$, $E_{tag_miss_only,L1}$, $E_{tag_TLB_miss,L1}$, and $E_{re-access}$, respectively. N_{tot} is the total number of load/store instructions issued to the LSQ. E_{info} , E_{LSQ_tag} , and E_{LSQ_TLB} are the energy consumption per access of the information buffer, LSQ tag arrays, and LSQ TLB, respectively. Since the energy overheads from other components, such as the MUXes used in the ETA cache are very small, they are included in the E_{others} .

The energy overhead due to the update of LSQ tag arrays and LSQ TLB is also included in the E_{others} because update operations occur at a much lower rate than read operations (i.e., the miss rate is in general much lower than the hit rate). We employ CACTI to obtain the energy consumption per access under different operating modes using a 90-nm process. Since the proposed technique is technology-independent, these results are normalized by the energy consumption per access of the conventional L1 data cache for comparison.

IV. OPERATING MODES

4.1 ETA (The Basic Mode)

The energy reduction achieved by the proposed ETA cache under the basic mode over the conventional L1 data cache. We observe 34.1%–58.3% energy reduction across different SPEC CPU2000 benchmarks, with an average energy reduction of 52.8%

The energy reduction for the MiBench benchmarks is shown in Fig. Due to the higher percentage of early tag determination in the MiBench benchmarks. The achieved energy reduction is higher than that of the SPEC CPU2000 benchmarks. Note that these results include the energy overheads of early tag and TLB accesses at the LSQ stage, such as the lookup and update operations.

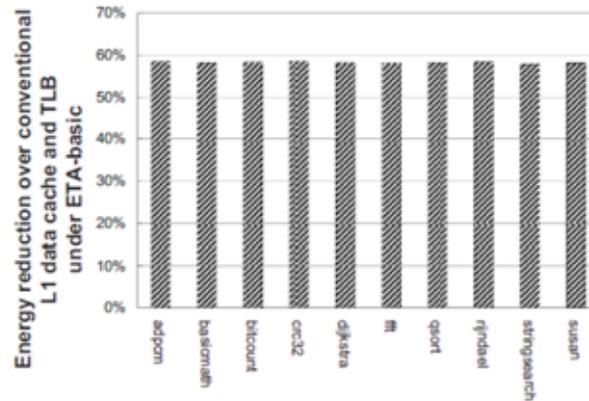


Fig. 16. Energy reduction of the ETA cache in the basic mode over the conventional L1 data cache and data TLB under MiBench benchmarks.

4.2 ETA (The Advanced Mode)

The energy reduction of the proposed ETA cache under the advanced mode for the SPEC CPU2000 benchmarks. The energy reduction ranges from 58.4% to 63.6% across different benchmarks with 59.6% on average, all higher than the corresponding measures in the basic mode. The advanced Mode is more energy efficient due to fewer ways accessed during the cache access stage. In particular, it is very effective for workloads whose memory instructions cannot find their early destination ways at the LSQ stage, such as amp and art.

IV. RESULTS AND DISCUSSION

The designs of the modules are coded using Verilog language and are compiled and simulated using modelsim software. The waveforms of the completed modules are described below.

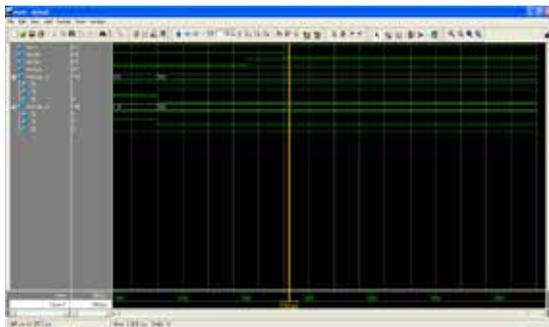


Figure 1. Simulation Result Of The Tag In

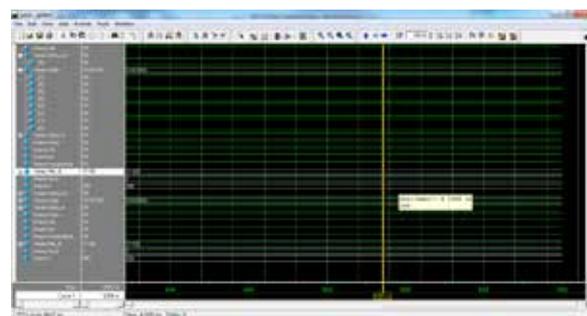


Figure2: Simulation For Tagged Out

The above figure explains about the output which is mentioned in data through policy for the given input data and clk and reset are enabled to form the MCD file. Multi clock Design it is to enable the data through access for the expression in the file ID and MCD in the given input.

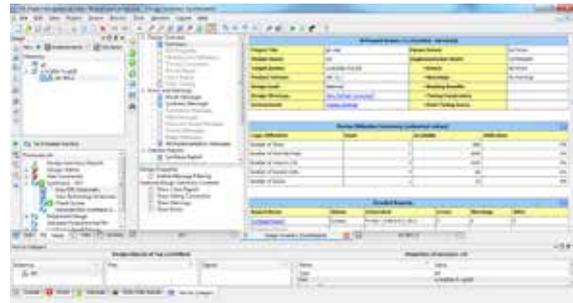
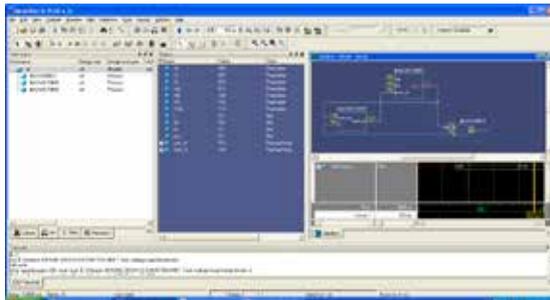
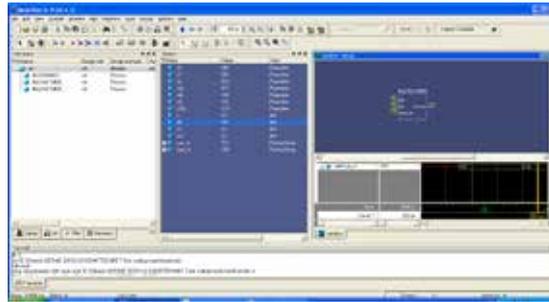


Figure3: Data Flow Diagram

Figure 4: Data Access Performance

V. CONCLUSION AND FUTURE WORK

Due to performance reasons, all ways in set-associative level-one (L1) data caches are accessed in parallel for load operations even though the requested data can only reside in one of the ways. Thus, a significant amount of energy is wasted when loads are performed. We propose a speculation technique that performs the tag comparison in parallel with the address calculation, leading to the access of only one way during the following cycle on successful speculations. The technique incurs no execution time penalty, has an insignificant area overhead, and does not require any customized SRAM implementation. Assuming a 16kB 4-way set-associative L1 data cache implemented in a 65-nm process technology, our evaluation based on 20 different MiBench benchmarks shows that the proposed technique on average leads to a 24% data cache energy reduction.

This paper presented a new energy-efficient cache design technique for low-power embedded processors. The proposed technique predicts the destination way of a memory instruction at the early LSQ stage. Thus, only one way needed to be accessed during the cache access stage if the prediction is correct, thereby reducing the energy consumption significantly. By applying the idea of phased access to the memory instructions whose early destination ways cannot be determined at the LSQ stage, the energy consumption can be further reduced with negligible performance degradation. Simulation results demonstrated the effectiveness of the proposed technique as well as the performance impact and design overhead. While our technique was demonstrated by a L1 data cache design, future work is being directed toward extending this technique to other levels of the cache hierarchy and to deal with multithreaded workloads.

In order to reduce access latency new proposed ELD3 Technique is added to reduce the energy level & Stall cycles in future. Stall cycles- When the pipeline architecture increases the execution time during tag & data access.ELD and ELA techniques are used in ELD3.

ELA- Early load access.

EDA- Early Data Access.

ETA- Early Tag Access.

REFERENCE

1. Afzal Malik, Bill Moyer, Dan Cermak (2008)- Low Power Unified Cache Architecture Providing Power and Performance Flexibility.
2. Jianwei Dai and Lei Wang (2013)-An Energy-Efficient L2 Cache Architecture Using Way Tag Information Under Write-Through Policy.
3. Santhanam.S (2008)-A low-cost, 300-MHz, RISC CPU with attached media processor
4. Ishihara, T. - 2005 A Way Memoization Technique for Reducing Power Consumption of Caches in Application Specific Integrated Processors.
5. Calder, B. (1995)- Next Cache Line and Set Prediction.
6. Michael K. Gowan, Larry L. Biro, Daniel B. Jackson (2000)-Power Considerations in the Design of the Alpha 21264 Microprocessor.