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& 6th International Conference on Innovation and Entrepreneurship (ICIE)

Fostering Global Knowledge Economy
through Innovative and Creative Engineering & Management Studies

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9th International Conference on Engineering and Business Education (ICEBE) 
and 
6th International Conference on Innovation and Entrepreneurship (ICIE) 

On 

Fostering Global Knowledge Economy through Innovative and Creative Engineering & Management Studies 

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Conference Theme

A knowledge society in the context of increasing globalization can be established based on the innovative and creative methods of education. It essentially empowers people with the requisite competitive skills and knowledge. A knowledge-based economy predominantly relies on the use of innovative ideas and application of technology rather than the transformation of raw materials or the exploitation of cheap labour. Equipping people to deal with new demands requires a new model of education, a model of innovative learning. So, the main theme of conference is “Fostering Global Knowledge Economy through Innovative and Creative Engineering & Management Studies” and sub themes are mentioned as under.

The sub themes of conference are as under:

1. Innovations in Engineering and Management Education for promoting Entrepreneurship
2. Active Learning: Project and Activity Based Learning
3. Smart Cities Development through innovative Engineering and Management Concepts
4. Government policies in promoting entrepreneurial environment
5. Research Orientation in curriculum development
6. Contribution of Engineering and Management Education to “Make in India, Start Up and Stand Up India, Clean India Initiative
7. Smart Energy solutions
8. Nurturing ‘Competitiveness’ and ‘Ease of Doing Business’
9. Developing Socially Responsible Educational institutions
10. Introducing Design Thinking in Engineering Curriculum
11. Sustainable Development through Innovation and Creativity
Synopsis of a KeyNote Presentation on:


By: Dr. Ronny Adhikarya *)

At the 6th International Conference on Innovation and Entrepreneurship (ICIE) and the 9th International Conference on Engineering and Business Education (ICEBE) on:

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In today’s “Flat World” Age and CSM (Cloud, Social Media and Mobile) Decade, the competitive GloCal (GLObal Vision/Trends, LoCAL Adaptation/Action) marketplace requires different and new mind-sets, competencies & skills from the Millennials Generation. To maximize the potential impact of the Demographic Dividends, the age-cohorts of 15-25 need timely and appropriate learning experiences that will be relevant in the 2020 decade!

It is a challenge for educational institutions to provide relevant learning programs for these TGIF (Twitter, Google, Instagram and Facebook) and/or FANG (Facebook, Amazon, Netflix and Google) Generations whose learning objectives, needs, styles and/or methods/habits may be different from previous generations of the 20th Century.

The “GloCal” K-Economy & Society even today will need new competency profiles for human resource who can work for new types of enterprises which are considered as industry “DISRUPTORS”, such as UBER, NETFLIX, AIRBNB, TESLA, AMAZON, PAYPAL, KICK-STARTER, etc. These types of innovative “Disruptors” have radically changed many other GloCal business strategies, management & operational practices worldwide requiring new types of trained personnel who are still rare and in short supply.

Furthermore, the rapid economic, social & cultural, demographic and esp., technological changes affecting GloCal K-economy & society have put increasing pressures to learning organizations for undertaking significant educational curricula reforms & changes to meet the new/different market demands. Forecasting 5-7 years ahead, monetizable “NICHE” learning areas may include, among others, robotics, genomics, stemcell tech., gerontology, cyber & forensic-security, “blue”-technologies, mega-batteries, actuarial science, neuroplasticity-based sports/fitness, etc.
In the “Flat World” era, characterized by information & communication-enabled Knowledge Democratization, the main value of education institutions is no longer as a “purveyor” of “explicit” knowledge (mainly taken over and monopolized now by Google). To be valuable, learning organizations need to transform into “Tacit” Knowledge Brokers which can facilitate and monetize knowledge management, sharing and utilization, esp. on practical best/poor practices of lessons learned from real-life experiences.

To ensure market-demand relevance and cost-effective management of Universities or Learning Organizations, the use of a “Quadruple Helix” model for K-economy & innovation development in the context of a Knowledge Society & Democratization should be considered. Thus, strategic collaboration and partnerships among (i) University, (ii) Industry/Private Sector, (iii) Government/Public Sector, and (iv) “People/Community-based Initiatives/Inputs” (e.g., through mass & social media-assisted Crowd-Sourcing and Crowd-Funding, etc.) should be forged.

In addition, due to increasing easy access to, and widespread use of, online Crowd-Sourcing communication, new peer-based and experiential/testimonial learning are gaining more popularity, credibility and usefulness. Like the future fate of advertising, the old educational paradigm of top-down, vertical communication from “experts” to “students” model & method has become less functional and valuable. Thus, learning organizations will need to adapt or adjust their learning strategies and methods by incorporating some Crowd-Sourcing” features, tacit knowledge sharing & peer-based learning methods.

In view of the fast changing of many “cognate” or technical/subject matter knowledge, and also the changing belief that “curiosity” & “passion” are two very important traits for professional success (more so than just IQ), the priority for learning in the K-Economy & Society is the opportunity to “LEARN on HOW to LEARN, RELEARN and UNLEARN”, esp. in the context of knowledge acquisition, management, and utilization.

Many innovative and progressive universities are gradually transforming as centers for “incubation” of innovation & entrepreneurship, rather than simply providing “education”. Their main purpose has shifted to developing graduates who can provide employment to others rather than to prepare graduates for a job. Such a transformation requires substantive curriculum reform affecting significant changes in faculty profiles, financial management, and learning methods as well.

GloCal competitive market place will make life for everyone more complex, complicated and interdependent. With almost free & instant access to “explicit” knowledge from the likes of Google and other crowd-sourcing places, many people, corporations and organizations have now the opportunities and abilities to benefit from such “information & data mining” and “knowledge explosion” resources.

The above-mentioned changing societal context and human resource’s needs of relevant competencies/skills-set for the 21st Century present challenges & opportunities for educational institutions & learning organizations to rethink and reform its learning goals, strategies, curricula, and methods. Effective and sound decision-making processes thus require much smarter “tacit” knowledge acquisition, sophisticated holistic analysis, innovative strategic thinking, and comprehensive risk-management.

One of the important and essential strategies, methods and aspects to address the above issues is the need for a holistic, interdisciplinary educational approach taking into consideration of GLObal vision & trends with appropriate adaptation and application for loCAL actions. Hence, the imperative for a holistic & interdisciplinary “GloCal” (i.e., NOT Global or Local)
education, possibly also by incorporating **Cloud-Technology and Crowd-Sourcing** methods of learning.

In this KeyNote Presentation, some contemporary illustrations will be discussed re. the various global trends, generational life-styles, changing communication patterns & modalities and the educational/learning needs in the 21st Century. And how these holistic competencies and skills-set can manage the “disruptive” GloCal political, economic, social and cultural changes landscape, including a proposed **Conceptual Framework of an Interdisciplinary Education Curriculum**.

*) **Dr. Ronny Adhikarya** had a 40-year career in international development assistance, serving for the World Bank, United Nations, and other international organizations. He was also associated with educ. & research institutions such as Stanford Univ., the East-West Center, and had conducted training in many learning institutions worldwide. He retired from the World Bank in 2003, and was then reappointed as the Food & Agriculture Organization (FAO)/United Nations Representative & Country Director (w/Ambassador-level credentials) for Pakistan.

At the World Bank, he directed the Knowledge Utilization through Learning Technologies (KULT) Program, which included franchising, & marketing demand-driven educational/training services to ensure financial health & sustainability as part of institutional/staff capacity development programs. He promoted the improvement of training quality and effectiveness through excellence in customer service and appropriate uses of interactive & distance or mobile learning technologies, cyber-marketing, quality assurance, peer-based & participatory knowledge management, sharing and utilization.

Originally from Indonesia, Dr. Adhikarya since 1972 has undertaken professional assignments & official missions in 50 countries, and travelled to a total of 94 countries. He has written 8 books (two are also available in electronic/CD-ROM version) on communication, extension, training and education subjects published in Germany, Italy, England, USA, Singapore and Malaysia as well as numerous book-chapters, journal articles, and consulting reports.

Dr. Adhikarya has served various international advisory boards/committees of several leading development organizations and/or educational or training institutions in Singapore, Thailand, England, Switzerland, etc. He obtained his Masters from Cornell Univ. and his Ph.D. from Stanford Univ. He now lives in the “Silicon Valley” of California and Honolulu, Hawaii, where he also serves as a member of the Board of Directors of the Hawaii-Indonesia Chamber of Commerce (HICHAM).

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CAPTURING THE BEST SKILLS TO GENERATE AND INSPIRE THE MULTIGENERATIONAL WORKFORCE

Sr. Imelda A. Mora, OSA, Ph.D
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Abstract: The study was conducted to assess and describe the best skills to generate and inspire the multigenerational workforce. The subject of this dissertation has been chosen to find out strategies on how to create a cross-generational friendly school; and how to create an environment that will be comfortable to all generation groups and when culture of excellence will thrive. Leaders will find this research an appropriate reference for managing multigenerational personnel. The seven (7) schools that participated in the research were: a) Assumpta Academy Bulacan, b) Colegio del Buen Consejo, Pasig City, c) La Consolacion College, Mercedes Pasig City, d) La Consolacion School, Balagtas, Bulacan, e) La Consolacion College, Valenzuela City, f) La Consolacion College, Caloocan City and g) La Consolacion College, Tanauan City, Batangas. The questionnaire consists of three parts. Part I is for the demographic profile of the respondents comprising of gender, highest academic degree, level in the organization and generation group. Part II is the quantitative part with three sections. Section A is the adaption of Carol Dweck’s mindset Scale. This is a 20 item quiz that aims to determine the orientation of the mindset of the respondent (growth mindset or fixed mindset). The study utilized the descriptive method of research using simple purposive sampling technique. Based from the data collected, the following were concluded: there is no significant difference in the behavioral skills between Males and Females, there is no significant difference in the behavioral skills between Bachelors, Master, and Doctor degree holders, there is no significant difference in the behavioral skills among the Administrators and Faculty members and there is no significant difference in the behavioral skills among Builders, Baby Boomers, Gen Xers, and Millennials.

Keywords: Best skills, multigenerational workforce

1. INTRODUCTION

Among the global realities many sectors of society need to look into, are the demographic trends and realities because it affects a lot of the major concerns of humankind. Evidently demographics is closely related to the focus of this paper, with its title Capturing the Best to Generate and Inspire Multigenerational Workforce. A forecast has been done that the recent decline of today’s developed countries and drive the rise of today’s emerging markets (Jackson, 2011). Demographic change shapes economic and geopolitical power. The long-term prosperity and security of the global security may depend in crucial ways on how effectively it prepares for the demographic transformation now sweeping the world. Most of the developed world finds itself on the cusp of an unprecedented new era of population aging and population decline. According to the United Nations, Department of Economics and Social Affairs, Population Division (2014), the Median Ages of Western Europe and Japan, which were 34 and 33 respectively in 1980, will soar to 47 and 52 by 2030, assuming no increase in birthdates, In Italy, Spain, and Japan, more than half of all
adults by then will be older than the official retirement age – and there will be more people in their seventies than in their twenties.

In India, Badkar (2014) says that the future of an economy is determined heavily by its evolving demographics. Knowing how young or old a country’s population will be is crucial for investors and businesses. Many point to population growth in developing nations as a source of rising domestic demands. But there’s a lot more to be considered. For example, Arab Spring was an extreme, but important reminder of what can happen when you have a young and able workforce with little access to jobs. With that in mind Badkar (2014) drew on George Magnus’ presentation to The Conference Board titled “The Age of Ageing: Global Demographics, destinies and coping mechanisms.” In it, Magnus highlights five big demographic trends shaping the world right now. The ratio of children to older citizens stands at about 3:1 but is declining. By around 2040, there will be older citizens than children. By 2050, there will be twice as many older citizens as there are children. Some exceptions to this however are China and Russia. The time taken to double the share of those over 60 years old from 7% to 14% of the population took a long time in western countries. But the emerging markets are aging “at an astounding pace,” according to George Magnus.

The rising dependence of those over 65 on the working age population is referred to as the old age dependency ratio. This is a product of weak fertility and rising longevity. The old age dependency ratio in countries like Germany, Japan, Italy, and Spain is expected to rise rapidly. These countries are characterized as the “hares” because of the rapid progression of old age dependency. The number of workers per older citizen is expected to fall from about 3-5 today to about 1.5 by the mid-century mark. Meanwhile, the Anglo-Saxon economies like Sweden and France are tortoise by comparison. Here the support ratio will fall from 4-5 workers today, to about 2-2.5 by the mid-century. This is because of higher fertility rates and a more open immigration policy. The tortoises of the emerging markets have a support ratio of 10-20 workers per older citizen, and this is expected to get to where developed countries are by mid-century.

But in some countries in sub-Saharan Africa, the pace of aging is much slower than say in Indonesia, Turkey and Brazil. India is a demographic choice because one-third of its population is aged fewer than 14 and its working age population will grow in the next 20 years, to more than the existing stock of working age people in Western Europe today.

This is a phase that countries go through when child dependency is falling and the working age population is expanding. But they’re also in a phase just before old age dependency starts to rise. Typically, this phase comes with stronger trends in income, savings, investment and technical progress. This is where other emerging markets countries hope to be in the next few decades. Once the old age dependency ratio starts to rise, however, the demographics dividend can’t be exploited and it tends to drag on growth. The demographic dividend creates the opportunity to draw on these benefits, but doesn’t guarantee it. Exploiting your demographic dividend depends on four is, according to Magnus – better institutions, investment climate, infrastructure, and innovation.

Staying up to date on the latest demographic trends enables organizations to identify existing and emerging markets for their products and services. By evaluating customers’ and prospects’ demographic trends, business decision-makers can identify changing needs in
the marketplace and adjust to them. Demographic trends can also help organizations spot future spending trends. For example, the spending trends of Boomers could change as they age out of their peak earning years and head into retirement. When combined with behavioral and attitudinal data, demographics can be used to improve marketing effectiveness by helping business targets new customers segments with the right messages at the right time. When done well, businesses can increase customer awareness, improve customer acquisition efforts, and bolster customer retention rates.

The Philippines ranks as the 9th most populous country in Asia and the 14th in the world. While the country’s population growth rate has gone down from 3.3% to 2.4% over the past 30 years, this growth rate, if unabated, will cause the population to double to 128 million by 2025. The population structure (where 40% are under 15 years of age) as of 1990, with its dependency ratio of 75/100, is indicative of the strain on the limited resources both at the household and at the national level. The last 25 years have seen continued rural to urban migration, resulting in a major shift in the balance between rural and urban populations, and affecting the quality of life both in the cities and the rural communities. Outward movement of Filipinos to other countries, either through emigration or through overseas employment, has caused significant pressure on the integrity of family and community life. It is expected that rapid population growth and imbalances in spatial distribution would continue if there is no recognition of the relationships between population, resources, environment, and development in policy decision-making at all levels of governance, as well as the crucial role that family plays.

International surveys show that Filipinos rank first in religiosity and spirituality. The values of Maka-Diyos and maka-kalikasan are closely woven together in the Filipino’s concern for the environment. In addition, the inherent strengths of the Filipino culture continue to reinforce social cohesion within Philippine society. These include: openness, freedom of expression, gender sensitivity, facility at conflict resolution, resilience, flexibility, highly personalized approach at relationship, strong family orientation, bayanihan spirit, and passion for creative expression (as in the arts). These values are also embodied in the growing tradition of local activism as manifested in the presence of formal Non-Government Organization/People’s Organization (NGO/PO) networks throughout the Philippines (at least formal network in 70 out of 78 provinces). These positive Filipino traits are being felt and recognized globally as demonstrated by the active participation and/or leadership of civil society in complex discussions at various international summits such as the Earth Summit in Rio, Social Development Summit in Copenhagen, Women’s Summit in Beijing and the Habitat Summit in Istanbul, among others.

Continuing difficulties in the implementation of agrarian and urban land reform and comprehensive rural development programs have contributed to unabated migration to urban areas. The absence of far-reaching comprehensive land use and human settlement plans has resulted in the growth of informal settlements. Rapid urbanization has resulted in the conversion of agricultural land to residential, commercial and industrial use and has displaced informal settler communities and undermined food security. Thus, Philippines cities have deteriorated as human habitats, beset with intractable and often interrelated including inadequate mass transportation and road systems; pollution, inadequate and inappropriate waste disposal; flooding; inadequate and unsustainable shelter; water shortage; deterioration of sanitation, health
and other basic services, the proliferation of illegal drugs, increase in violence and criminality and other social ills. Existing measures of human development, such as the Human Development Index (HDI), which are limited to health, education and income, indicate some improvement over time. This improvement has in part been achieved through greater empowerment of the populace. Economic empowerment is evidence by a reduction in the poverty incidence. Physical empowerment is indicated by the increasing upward trend in the life expectancy, while educational empowerment is shown by the increasing functional literacy of the population. However, these improvements are uneven across geographical, income and ethnic groups and are benefiting men more than women. Increasing cultural awareness, gender sensitivity, and local activism are indicative of an expanding consciousness. Nonetheless, the development of full human potential is being impacted by continuing challenges/trends such as; rampant substance abuse; economic exploitation (including prostitution and child labor, among others); break-up of families; significant incidence of street children and homelessness; increasing exposure of people (especially children) to environmental toxins; mixed quality of education; and limited access to livelihood opportunities. Some sectors are being marginalized in the development process leading to poverty and cultural decline as the major human development problems.

While there is acceleration in the growth of our economy, there is evidence that environmental quality is fast deteriorating, as dramatized by the increased occurrence of environmental disasters. Specifically, the gains of economic growth are being diminished and/or even negated by deforestation; mine tailing; pervasive and health-impairing pollution; coral reef deconstruction; massive pesticide poisonings; degradation and erosion of agricultural lands; siltation of rivers and farmlands; salt water intrusion into aquifers; and ill effects that arise from promotion of monocultures (oil palm plantations, for example); destructive eco-tourism; introduction of new technologies that adversely impact the environment; marsh and mangrove conversion; bio-prospecting / bio-piracy; land conversion to golf courses with attendant impacts on water supplies and surrounding ecosystems; massive reclamation projects which disrupt coastal ecosystems; open pit mining; pollutive cement plants and environmentally destructive coal-fired power plants as well as “dirty” energy sources; continued reliance or non-renewable energy sources; destructive fishing methods; indiscriminate oil exploration and exploitation of seas. The cost of remediating water and air alone has been estimated at a minimum of 34 billion and 16 billion pesos, respectively. The regenerative capacities of already fragmented areas of various biogeography zones are similarly threatened.

The current wave of globalization is increasingly posing some threat to the country’s national sovereignty as the imperatives of global capital often cannot be expected to be attuned to the national interest. Domestically, the rich continue to the corner political power.

2. OBJECTIVES

This study attempted to suggest strategies on how to create a cross-generation friendly school; and how to create an environment that will be comfortable to all the generation groups and where culture of excellence will thrive. This study will also determine the current mindset of the respondents, their behavioral skills as well as the similarities and difference of the generations. It also sought to capture the best skills to generate and inspire multigenerational workforce.
3. RESEARCH METHODOLOGY

3.1 Design
This study employed an action research design which according to Fraenkel, Wallen and Hyun (2012), is one of the most common forms of research engaged in educational settings. It involves asking a large group of people questions about a particular topic or issue. Quantitative data were also gathered using the same the survey instrument. The purpose of this is to find out what they think and feel about something that is related to school management and practices. And once data are on the hand, intervention can be introduced, pilot-tested and assessed.

3.2 Respondents
This study was conducted in seven (7) schools under the Augustinian Sisters of Our Lady of Consolacion (ASOLC), namely: Assumpta Academy of Bulacan, Colegio del Buen Consejo, Pasig City, La Consolacion College, Mercedes, Pasig City, La Consolacion School, Balastas, Bulacan, La Consolacion College, Valenzuela City, La Consolacion College, Caloocan City and La Consolacion College, Tanauan City, Batangas. According to website of the congregation, ASOLC was founded as the Congregacion de las Hermanas Augustinas Terciarias de Filipinas in 1883 following the rule and spirituality of St. Augustine and upholding its Marian and Missionary character. The first group of four Beatas left Barcelona aboard Magallanes on March 1, 1883. It consisted of the Priorress, Sor Antonia Campillo, Sor Rita Barcelo, (it was she whom our General Chapter in 1969 declared as our Congregation’s Foundress), Sor Agostina Basegoda and Sor Querubina Samarra. They arrived in Manila on April 6, 1883. The second group of Beatas who came to the Philippines to care for the orphans was Sor Monica Mujal, Sor Alfonsa Sabat and Postulant Joaquina, the future Mother Consuelo Barcelo, and blood-sister for Sor Rita Barcelo. In November 21, 1883, the Postulant Joaquina received the Augustinian habit of the Tertiary Order. She was given the same Sor Maria de la Consolacion and was called Sor Consuelo whom we fondly call Mother Consuelo (declared as our Co-Foundress during the General Chapter of 1969 but in 20th Gen Chapter of 2009 was declared as Foundress). The Apostolate today counts 23 schools that they administer throughout the country. The criteria used in selecting the respondents were: (1) they should be an administrator of the school (top or middle); or (2) they should be member of the teaching staff. Other staffs were excluded. Purposive sampling was employed in this study. This is a non-probability sampling that involves selecting participants based on their particular profile (Polit & Beck, 2008). The questionnaires were distributed to the respondents and they were instructed to submit them once they were accomplished already.

3.3 Scales and measures
The questionnaire consists of three parts. Part I is for the demographic profile of the respondents comprising of gender, highest academic degree, level in the organization and generation group. Part II is the quantitative part with three sections. Section A is the adaption of Carol Dweck’s mindset Scale. This is a 20 item quiz that aims to determine the orientation of the mindset of the respondent (growth mindset or fixed mindset). A 4-point rating scale was used with the following description:

<table>
<thead>
<tr>
<th>Scale</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Highly Agree (HA)</td>
</tr>
<tr>
<td>3</td>
<td>Agree (A)</td>
</tr>
<tr>
<td>2</td>
<td>Disagree (DA)</td>
</tr>
<tr>
<td>1</td>
<td>Highly Disagree (HD)</td>
</tr>
</tbody>
</table>

In the analysis of data, growth mindset items (2, 3, 5, 6, 9, 10, 13, 15, 18, and 19) and fixed mindset items (1, 4, 7, 8, 11, 12, 14, 16, 17, and 20) were separated. Each group was scored accordingly. For growth items: 3= HA, 2=A, 1
= DA, and 0 = HA. For fixed mindset items: 0 = HD, 1 = DA, 2 = A, and 3 = HA. The results were interpreted as follows:

- **Strong Growth Mindset** = 60-45 points
- **Growth Mindset with some fixed ideas** = 44-34 points
- **Fixed Mindset with some Growth ideas** = 33-21 points
- **Strong Fixed Mindset** = 20-0 points

Section B is the behavioral Skills of the respondents based on the quantum leadership. It consists of the seven behavioral skills, namely, seeing, thinking, feeling, knowing, acting, trusting, and being. Each area has five statements for a total of 35 statements. A 4-point scale was also used with the following description.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Highly Agree (HA)</td>
</tr>
<tr>
<td>3.51-4.00</td>
<td>Agree (A)</td>
</tr>
<tr>
<td>3</td>
<td>Agree (A)</td>
</tr>
<tr>
<td>2.51-3.50</td>
<td>Disagree (DA)</td>
</tr>
<tr>
<td>2</td>
<td>Disagree (DA)</td>
</tr>
<tr>
<td>1.51-2.50</td>
<td>Highly Disagree (HD)</td>
</tr>
<tr>
<td>1</td>
<td>Highly Disagree (HD)</td>
</tr>
<tr>
<td>1.00-1.50</td>
<td>Highly Disagree (HD)</td>
</tr>
</tbody>
</table>

The items in questionnaire were stated negatively. They are “not” the desirable behavioral skills. This means that the lower the score, the more respondents disagree with the statements. Ideal result should be low (1.00 to 2.50) or in the highly disagree (1.00 – 1.50) to disagree (1.51 – 2.50) scales. Section C is for the perception of the respondents on the work-related behavior. It has five areas, namely: success in the workplace, the development of the both workforce and the institution, leadership attributes, selected aspects of the workplace culture, and meaning for the work. Each area has 10 items; respondents were instructed to select five items on what that they think are important.

Part III is the qualitative part of the questionnaire with two sections. Section A is for the millennial only while section B is for the older generation (Builders, Baby Boomers, and Gen Xers). Respondents have to give their views on the following topics; social interaction, dealing with change, decision making, organization/management style, and work habits.

### 3.4 Data analysis

After recording and tabulating the data, the following methods of data analysis were employed: To answer the preparatory research questions, frequency and percentage distribution was used for the profile of the respondents and perception of the respondents on work-related behavior; and weighted mean to compute for mindset and behavioral skills.

### 4. LITERATURE REVIEW

This study is anchored on the General Systems Theory by Ludwig von Bertalanffy (1901-1972). He formulated theory in general to account for similarities in the functioning of such diverse phenomena as living organisms, machines, galaxies and organizations. It was a unique departure from the earlier emphasis on separate analysis of individual parts. It is the most appropriate framework for this study because of its multidisciplinary nature, ability to engage complexity, capacity to describe system dynamics and change, ability to together the natural and human worlds (Chen and Stroup, 1993). The core of this study is the manpower as the input of the school system. The profile of school personnel vary in terms of gender, educational attainment, position and rank in the school, and generation group. All these when factored in can affect the overall performance of the school. It is more important that the differences in profiles in the areas of mindset, Behavioral skills, and generational preferences...
and addressed properly to ensure smooth working relationship among the staff and effective and efficient of the school.

5. ANALYSIS

5.1 On the profile of the respondents:
In terms of gender, females dominated the respondents consisting of great majority of 87% as compared to males with 13% only. In terms of highest academic degree, majority of the respondents are bachelor’s degree holder at 69%. Master’s degree holders come in second with 27% and doctors’ degree holders at 4%. In terms of level in the organization, more than half of the respondents are faculty members at 72% and 28% are administrators in terms of position in the organization. In terms of generation group, Majority of the respondents are millennials at 40% followed closely by the gen Xers at 34%. Coming third was the baby boomers at 24%. Trailing behind was the builders at 2%.

5.2 On the current mindset of the respondents using Carol Dwecks’s scale
All the mindset scores of the seven schools were in the positive scale. Six out of seven schools have a Growth Mindset with some Fixed Ideas with scores varying from 35 to 43. Only one school reached the Strong Growth Mindset at 57 points. Average score of all the scores fall under Growth Mindset with some Fixed Ideas.

5.3 On the behavioral skills of the respondents in term of:
All the weighted means of the seven behavioral skills (seeing, thinking, feeling, knowing, acting, trusting, and being) fell under Agree. The strongest are (lowest weighted mean) among the seven behavioral skills are Seeing (wm = 2.52), followed by Thinking (wm = 2.69) and Feeling (wm = 2.70) respectively.

5.4 On the perception of the respondents on the work-related behavioral (top three):
Success in the workplace: Understanding of goals (81%); Communication (78%); Willingness to learn new things (75%). Development of the workforce and the institution: Building of the trust (83%); Resolve conflicts constructively (69%); Understands other’s perspective (65%). Important aspects of the workplace culture: Professionalism (77%); Collaboration/Teamwork (76%); Personal growth and development (65%)

Meaning for the work: Gives meaning to my life (80%); A fulfillment (72%); Energizes my spirit (57%).

5.5 On significant difference in the mindset of the respondents when grouped according to profile
In terms of gender, there is no significant difference in the mindset between males and females. In terms of highest academic degree, there is significant difference in the mindset between Bachelor’s degree holder and Doctor’s degree holder. When Master’s degree holder is compared with other groups, there is no significant difference. In terms of level in the organization, there is no significant difference between the Administrators and Faculty members. In term of generation group, mindset of Millennials significantly differs with Baby Boomers and Gen Xers but not with Builders. Builders, Baby Boomers, and Gen Xers have no significant difference when compared with each other.

5.6 On significant difference in the behavioral skills of the respondents when grouped according to profile
In terms of gender, there is no significant difference in the behavioral skills between Males and Female. In terms of highest academic degree, there is no significant difference in the behavioral skills among Bachelors, Master, and
Doctor degree holders. In terms of level in the organization, there is no significant difference in the behavioral skills between the Administrators and Faculty members. In terms of generation group, there is no significant difference in the behavioral skills among Builders, Baby Boomers, Gen Xers, and Millennials.

5.7 On significant difference in the perception on work-related behaviors of the respondents when grouped according to profile

In terms of gender, there is no significant difference in the perception of work-related behaviors between Males or Females. In terms of highest academic degree, there is no significant difference in the perception of work-related behaviors among Bachelor, Master and Doctor degree holders. In terms of level in the organization, there is no significant difference in the perception of work-related behaviors between the Administrators and Faculty member. In term of generation group, Builders’ choices on work-related behaviors differ significantly with Boomers and Gen-Xers, but not with Millennials. Boomers differ significantly with Builders and Gen-Xers, but not with Millennials. Gen Xers’ differ significantly with Builders and Boomers but not with Millennials. Millennials has no significant difference with Builders, Boomers, and Gen Xers.

5.8 On the perception of the millennials they from older generations in terms of (top three answers):

Social interaction: Openness to individual differences; socialize/interact with the new generation; and be more approachable and accommodating. Dealing with change: Willingness to accept changes, learn to adopt, be flexible; keep up with technology and innovation; and integrate new trends with traditional practices.

Decision making: Asking individual views/ideas before making final decision; should share their wisdom and experiences; and being fair always. Organization/management style: Should not be authoritarian; being competitive, go with modernization, to updated, not afraid of change, open to risks and possibilities; and should show professionalism. Work habits: Give time to themselves, they work too hard; they should be more innovative and technologically updated, accept new things; maintain professionalism.

5.9 On strategies that can developed to strengthen the positive perceptions of the older generations in terms of (top three answers);

Social Interaction; Groups activities; being open-minded; and observance of proper communication. Dealing with change: Being open-minded; group activities; and communication. Decision making: Collaboration and teamwork; being objective; and seminar, workshop, teambuilding. Organization/management style: Connect with the people; teambuilding/ coaching and mentoring; and transparency/being open. Work habits: Commitment, dedication; Motivation; and punctuality, respect for time.

6. CONCLUSIONS

Based on the findings of study, the following conclusions were drawn:

Regarding difference in the mindset of the respondents, the following conclusions are made:

- There is no significant difference in the mindset between Males and Females.
- There is no significant difference in the mindset between the Administrators and Faculty members.
- There is significant difference in the mindset among Bachelors, Master, and Doctor Degree holders.
There is significant difference in the mindset among Builders, Baby Boomers, Gen Xers, and Millennials.

Regarding difference in the behavioral skills of the respondents, the following conclusions are made.

- There is no significant difference in the behavioral skills between Males and Females
- There is no significant difference in the behavioral skills between Bachelors, Master, and Doctor Degree holders.
- There is no significant difference in the behavioral skills among the Administrators and Faculty members
- There is no significant difference in the behavioral skills among Builders, Baby Boomers, Gen Xers, and Millennials.

Regarding difference in the perception of work-related behavior of the respondents, the following conclusions are made.

- There is no significant difference in the perception of work-related behaviors between Males and Females.
- There is no significant difference in the perception of work-related behaviors between Bachelors, Master, and Doctor Degree holders.
- There is no significant difference in the perception of work-related behaviors among the Administrators and Faculty members.
- There is significant difference in the perception of work-related behaviors among Builders, Baby Boomers, Gen Xers, and Millennials.

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The Construction of Entrepreneurship Education Ecosystem of Shijiazhuang University of Economics

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Abstract: This paper, according to the theory of Ecological system, Education ecological system and Entrepreneurship education ecosystem, studies entrepreneurship education from the perspective of ecology and builds the Shijiazhuang University of Economics entrepreneurship education ecological system model by drawing lessons from the entrepreneurship education ecosystem model of American University and summing up the practice of entrepreneurship education of Shijiazhuang University of Economics since 1998. This model takes entrepreneurship education as research object, studies the ecological environment and dynamic balance mechanism which the elements of entrepreneurship education depends on and influences each other and co-develops. Finally it has in-depth analysis of the operation of entrepreneurship education ecosystem in Shijiazhuang University of Economics.

Key words: Ecological system, Education ecological system, Ecological system of Entrepreneurship education

Entrepreneurship is not independent education but a complicated ecological system. Entrepreneurship education, like nature's creatures, also needs a good living environment. So introducing the concept of the ecological system, studying entrepreneurship education from the ecological perspective and constructing an ecological system for the entrepreneurship education in colleges and universities are new requirements of scientific and technological innovation in a new era, as well as inevitable requirements of the development of higher education.

1. THE THEORETICAL EVOLUTION OF THE ENTREPRENEURSHIP EDUCATION SYSTEM

1.1 The basic theory of the ecosystem
In 1935, under the influence of Eugenius Warming, who was a Danish botanist, the British ecologist, Sir Arthur George Tansley, proposed the concept of "ecosystem" for the first time. He believes that the ecological system is not only a collection of all kinds of organisms, but also includes all the physical factors in the ecological environment. Creatures survive by relying on the material and energy from the surrounding environment, and eject some substances to directly or indirectly transform the surrounding environment. There always exist inseparable close links between creature and creature, and creature and environment, and by utilizing the flow and transfer of material, energy and information to organically connect them together, an integral ecological system is thus formed.

1.2 Education ecological system theory
In the middle of 20th century, inspired by ecological thinking, the Dean of American Teachers College, Columbia University Gremin L A and American education scholar Ashby E proposed the concepts of "Ecology of Education" and "Ecology of Higher Education" respectively. The core of Cremin's ecosystem ideas education is to regard education as an organic, complicated and unified ecosystem, to consider that the factors in the education ecosystem are connected organically, and this connection also dynamically renders consistency and contradiction, balance and imbalance. It was the first time that Ashby proposed and applied the concept of "Ecology of Higher Education" in his famous book Universities: British, Indian and African: A Study in the Ecology of Higher Education. He held the view that university structures must adapt themselves to the changing university environment.

1.3 Entrepreneurship Education Ecosystem

Essentially, the study of enterprise education ecological system belongs to a branch of organizational ecology, a new organization theory which develops from the sociology after 1970s, and it's mainly applied to study how the enterprise environment affects the enterprise and how to conduct efficient enterprise education, by the ideas, models, theories and methods from ecology. A Idrich, Tan, Carrol and Khessina have attempted successively to analyse the impacts exerted by all types of organisations and relevant social groups on the process of starting a business under the environment of entrepreneurial growth by viewing from the perspective of the study of ecological environment. Many world famous entrepreneurial universities have built their own entrepreneurship education ecosystem.

Massachusetts Institute of Technology in America was the first that paid attention to the entrepreneurship education ecosystem. MIT Entrepreneurship ecosystem was first found in an article named Entrepreneurship Ecosystem by Katharine Dunn. Dunn thinks that MIT's entrepreneurship education and training have not been only in MIT Sloan, but entrepreneurship ecosystem is formed, where dozens of organizations and centers of project train the entrepreneurship spirit together in the campus.

Aulet (2008) of Babson College of the US thinks that corresponding policies must be enhanced for the ecology system of entrepreneurship education to make enterprises and the government participate in entrepreneurial education and provide corresponding resources. Establish the multiple levels of university entrepreneurship education system, including individual (student, teacher, staff, manger), community (teachers, students), organization (incubator, center), project and community stakeholder (government, policymaker, industry, investor), the center is entrepreneurial activity, course, research extracurricular.

2 THE BUILDING OF ENTREPRENEURSHIP EDUCATION ECOSYSTEM MODEL OF SHIJIANZHUANG UNIVERSITY OF ECONOMICS

Entrepreneurship education ecosystem is a living body in the education ecosystem, formed by the school micro environment and the social macro environment. It restricts and controls the entrepreneurship education. Social macro environment includes the government, enterprises and so on, to provide effective supports such as policy guidelines, financial support, industry experience and entrepreneurship programs. The government agency shapes a fair law environment, and a
market competition environment through formulating policies that stimulate entrepreneurship to provide policy and fund support and administrative service for entrepreneurship. The school micro environment is the main position of entrepreneurship education as the implementer. Students in the college are the main bodies implementing entrepreneurship education and the main objects testing the performance of entrepreneurship education. The building of entrepreneurship education and ecology system must be driven by market and grasp the policy in order to deepen the close ties of industry, enterprise, society and school, and promote students to become self-employed.

A perfect ecological environment of education for starting a business is foundational to the success of College Enterprising Education; an effective entrepreneurship education ecosystem should at least contain: the microscopic and macroscopic environment of entrepreneurship education, stakeholders, the core factors of education and so on. Based on this, entrepreneurship education ecosystem of Shijiazhuang University Of Economics is structured, as shown in Figure 1.

![Ecological system model of entrepreneurship education in Shijiazhuang University of Economics](image)

**Figure 1: Ecological system model of entrepreneurship education in Shijiazhuang University of Economics**

The ecology system of entrepreneurship education is an open system, which inputs a variety of resources from the outside, and outputs entrepreneurial talents through the processing of the entrepreneurship education. The external environment for the entrepreneurship education ecosystem of colleges and universities are mainly the policies and resources provided by the government and enterprises. The internal system mainly refers to the interior of the school. The school provides a micro-environment for entrepreneurial education, including the strategies and guidelines of entrepreneurial education, the school cultural atmosphere that encourages innovation and entrepreneurship, the system that motivates teachers and students to innovate and start a business and the matching of relevant resources and so on. Teachers cultivate innovative and entrepreneurial talents through offering entrepreneurial education to students, which includes providing entrepreneurial
courses, organizing entrepreneurial activities and giving help in start-up incubating etc., as well as improving the three respects of thinking, knowledge and skills.

The internal factors of the ecosystem of entrepreneurial education interact each other, restrict each other, depend on each other, promote each other, leading to coordinate symbiosis and harmonious development.

3. THE PRACTICE OF THE ECOSYSTEM OF ENTREPRENEURIAL EDUCATION OF SHIJIAZHUANG UNIVERSITY OF ECONOMICS

Shijiazhuang University of Economics started to explore entrepreneurship education in 1998 and has constructed its own entrepreneurship education ecosystem on the base of summarizing practice experience and the entrepreneurship education ecosystem of other colleges. Main methods are as follows:

3.1 The organizational innovation of founding the school of innovation and entrepreneurship education

As the entrepreneurship education of school carry out in a deep-going way continually, the organization of entrepreneurship education is evolving as well. It developed from the initial College Student Entrepreneurship Competition Guidance Office under Youth League Committee to Innovative Entrepreneurial Talent Training Test Area under Economic Management Experimental Center in 2006, and to School of Innovation and Entrepreneurship Education founded by the school in 2013. The innovation and entrepreneurship education institute is the organization which is under the immediate leader of the school to arrange the school-wide entrepreneurial activities comprehensively. It takes "embedding the youthful student with entrepreneurial gene" as its mission, regards setting up the platform of "cultivating career-creating talents","spreading and practicing innovation thoughts" and "obtaining employment" as its goals and considers "innovation, study and openness" as its core values. The college is divided into the teaching center, the research center, the incubation center and the cooperation center, actively conducting various entrepreneurship activities.

3.2 Curriculum innovation

The school has an relatively early start in offering entrepreneurship courses, and has experienced the process from offering a single course to offering systematic courses. The first course the college offered was "Entrepreneurship", which was a public elective course for the whole college. Later, the secondary college offered some more entrepreneurship courses, which were however not systematic and not able to guide students well in starting their businesses.

In 2012, the school set up an experimental class of innovation and entrepreneurship, designing and developing a new entrepreneurship curriculum. A "triangle" setting model of entrepreneurship curriculum was developed in accordance with Mintzberg's management theory, which arranged curriculums for innovative thinking, entrepreneurship theory and entrepreneurship practice according to the "Eighty-Twenty" Principle.

Training is conducted in the aspects of entrepreneurial ideas, theories and skills. Greater attention will be paid to the training of entrepreneurial ideas and skills. Entrepreneurial skills are mainly trained from three aspects of key skills, business skills and essential skills, forming a systematic training from idea to theory, and from theory to skills, which allow students to master all skills necessary to start a
business genuinely.

The school will integrate the innovation and entrepreneurship into the professional teaching, incorporate the entrepreneurial factor into various courses and start the "Entrepreneurship Foundation" course around the school. The school also builds the business basis MOOCs actively in order to realize a blended learning model which combines online learning and offline learning and maximize the application of teaching resources about entrepreneurship.

3.3 Entrepreneurship faculties—Double-tutors system

"Double supervisor system" is implemented for the faculty of innovation and entrepreneurship education. On the one hand, we hire our own teachers who have experience of taking part-time jobs in enterprises. On the other hand, we engage successful businessmen and industrial leaders as entrepreneurial advisers to bring advanced administrative experience to the class, and provide direct guidance for students in terms of experimental practice.

Teachers in the college can take part-time posts in enterprises to experience the operating and managing process of an enterprise and improve their practical abilities, so that teachers will be cultivated with both solid theoretical knowledge and rich practical experience; entrepreneurship mentors outside school may explain problems and solutions in the corporative business process to students appropriately through organizing learning and improving the effect of teaching in class, according to the total instructional design and practical requirement. By united theory teacher in campus and entrepreneurship mentor outside of school, the teaching stuff was continued to enrich.

3.4 Students platform—entrepreneurial talent training platform

The student’s platform is the organizational form for the students from university entrepreneurship education ecosystem. Shijiazhuang University of Economics has built three platforms for students: the class of entrepreneurial managers, the class of mobile internet and the class of risk investment. Every student platform have gone through a university-level competition. They provide cultivation to students by establishing teams according to job-creating programs, exploring routes and methods to integrate job creating education and professional education.

3.5 Cooperation between universities and enterprises—multi-modes of cooperation

Cooperation between universities and enterprises is an important way to cultivate entrepreneurial talents. By relying on enterprises' resources and strengths and integrating resources from both universities and enterprises, college students are cultivated to have inner qualities, ways of thinking and outer behaviours that are necessary for creating a business. Move enterprises into campus, allow students to contact enterprises in campus and open up multiple cooperation models. For example, make joint efforts to build practice and training base, order-form training, establish the university with joint efforts, service outsourcing and so on.

3.6 Pioneering incubator—Pioneering park

The school builds over 200 project libraries, provided by enterprises, teachers and students. Based on those project libraries, high-quality projects are selected to be incubated, and the support will be offered in the aspect of incubation sites, technical guidance, personnel
training and so on.

The school has built an entrepreneurship incubation park of college students, covering an area of more than 1,400 square meters, which provides not only stations for settled enterprises but also relating content and service such as policies, laws, financing and process of entrepreneurship. For current students who have registered their companies, their companies can move into the incubator base and undergo a one-year incubation after the assessment.

The pioneer park is divided into multiple groups, which consist of finance and administration entrepreneurship group, method of art entrepreneurship group, engineering entrepreneurship group, science entrepreneurship group, integrated entrepreneurship group, geosciences entrepreneurship group, liberal arts entrepreneurship group, etc. and among which each group cooperates and shares resources with each other, forming an organic integrity.

4. CONCLUSION

In short, actively developing entrepreneurship education and establishing entrepreneurship education ecosystem can cultivate a large number of innovation-oriented and entrepreneurial talents, which are beneficial to the construction of innovation-oriented country; It's conducive to cultivate innovative talents in colleges and universities, and can also improve student abilities to start their own business and high quality employment; It is beneficial to improve the comprehensive quality of students in a dynamic complex environment and help students master the innovation-based mode of thinking and the ability to convert ideas into practical actions.

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EDUCATIONAL IMPACTS OF A RESEARCH TEAMWORK PROGRAMME

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Abstract: An international Students' Research and Development Teams (SR&DT) program being run since two years has produced positive on the educational impacts to the students participating at the program and those who were involved society at large. This SR&DT program is designed to address the challenges by two small Indonesian islands, by setting up teams composed by students of various disciplines. Each team is supported by partners from German and Indonesian Industry/Indonesian government as well as staff from Institut Teknologi Sepuluh Nopember (ITS), Surabaya, Indonesia and Wismar University, Wismar, Germany. It is expected that both teams could deliver sustainability ideas and solutions for the islands and their inhabitants.

Testimonies made by participants and people indirectly involved in the program reveal that: 1. The research in a teamwork has improved overall skills, individual and team work capability. 2. The program has broadened the horizon and curiosity in novelties. 3. The program has enhanced the capability to build a network between university, industry and community

Keywords: research teamwork, impact on education, multidisciplinary research

1. INTRODUCTION

Students’ Research & Development Team for Small Islands (SR&DT) program was established by Wismar University of Applied Sciences (HSW), Germany, in collaboration with Institut Teknologi Sepuluh Nopember (ITS), Surabaya, Indonesia funded by DAAD, starting from 2013. The program has been run involving students from HSW and ITS of various disciplines to address the challenges of small island development. The aim of the SR&DT program is to contribute in providing solutions on challenges faced by small islands, in particular Maratua and Poteran, through research conducted by students.

Maratua Island is located in East Borneo province, in the Makassar Strait, lies some 80 nm off the Borneo mainland, in the outermost border of the country. Its size is 24 sq.km, with the population of 3400 people. This island is known for one of the best diving spots in the world due to its huge marine biodiversity. The island has become an increasingly popular touristic destination. Nevertheless, the island’s
population faces huge challenges i.e. inadequate sea and land transport connectivity, insufficient fresh water and energy supply, low level of education and environmental threats.

Poteran island lies in the East Java province. This fertile island is some 200 km eastern of Surabaya. The island is very close the Madura island, connected by frequent ferry services. Agriculture industry is viewed potential for this island due to its fertility. Moringa oliviera trees of the best quality grow in many places, initially at the garden of people’s houses. As people are increasingly aware of the benefit of the moringa oliviera for health, a moringa oliviera plantation is considered as a potential economic source.

2. How the Research Proceeds
The program aims at contributing ideas and solutions to enhance the quality of life of the people in those remote areas, in a sustainable way. Two group of students consisting each 5 upto 10 students are assigned to address the issues of the island. The topics are defined by the industrial or governmental partners, and the research is executed by the students having multidisciplinary backgrounds.

2.1 Poteran Teams
Poteran team has come with an integrated concept of developing an agriculture industry. They have started with the investigation on the potential of Poteran island as a plantation for moringa oliviera trees. The first batch of the Poteran teams consists of students of the Biology department, whilst the second batch half of them are from the Biology Department, whilst the remaining are from Industrial, Ocean and Marine Engineering departments.

The teams investigated various techniques of cultivating moringa oliviera trees, chemical contents of the moringa leaves, bio-pesticides, drying processes of moringa oliviera trees and creating various end-products out of moringa oliviera leaves from tea, cakes, pudding until shoe cleaner. Besides, the team has also developed a plan form establishing a moringa oliviera plantation of 10 ha, by utilizing a modern irrigation system, setup a logistics system and business plan. The rather homogeneity of the disciplines, pre-dominantly students of Biology Department, have enabled the teams to organize team meetings easily.

2.2 Maratua Teams
These teams investigated potentials of developing a concept of implementing standard quality management of homestays, designing homestays and a community center, developing zoning concept for tourism areas, inhabitants’ economic activities, estimating the energy demand and supply of the island, and investigating the usage of wind energy as renewable energy resource.

The Maratua teams are heterogeneous in disciplines. Their disciplines range from chemical engineering, urban planning, architecture, ocean engineering, electrical engineering, geophysics till engineering physics. The first batch was marked by a very strong commitment, enthusiasm and less conflicting schedule among the group members. On the other hand, with the same level of enthusiasm, the conflicting schedules seem to be obvious, as most of the students of various disciplines were at the final semester of their study, in the period where they conducted their final project as well. The quality of the outcome was therefore also affected. In order to ensure an acceptable quality, the supervisors should be a more dominating role for this second batch.

2.3 Both Teams
Teamwork seems to be a very challenging task. We found out that the team members initially faced huge challenges to manage and share data, and to use the same assumptions for their team. All data was stored physically in the same folders, but when it comes to analysis, they used
various starting points and assumptions. The role of supervisor was then decisive, to organize a meeting, to reach an agreement for using the same starting points and assumptions.

3. IMPACTS ON EDUCATIONAL OUTPUTS
The shape of the modern education converges into delivering the following outcome: skills, knowledge and attitude. Students are expected to possess adequate skills, which is the proficiency and hands-on capabilities to address challenges of life or educational or research problems. In this program the students are expected to enhance their knowledge by deploying their theoretical background to be applied in addressing a small island’s challenges, such as energy, transport, agriculture and tourism. And finally, we expect that this research activity could affect the attitude of the students in the way how they think and act individually and as a team.

The facts that this program has impacted to the participants are obvious. The following are few examples of them:
“As a project leader of SR&DT Maratua team, I learn to manage people from diversity education background which is very challenging. I learn to shape a bunch of ideas into one integrated tourism scenario since each of us has brought a special issue for Maratua sustainable plan. SIDI really helps me to improve my analytical thinking on how to think like a researcher and investor in the same time, which I have to think both deeply in research and futuristic way. This program gives me opportunity to get mentorship with expert in its field, working professionally with global mindset and standard. I also get heart fully friendship through SIDI, and we have decided to make a new platform for realizing our ideas. SIDI isn’t just like a program, it’s like home”. (Nadia Sanggra Puspita, Batch 1 participant, student participant, Department of Chemical Engineering)

“SR&DT program of SIDI gave us the opportunity to apply our knowledge and skills gained during the study at the university to help those in the Poteran Island. Although there were some challenges, together with the team members, we were able to conduct a feasibility study to set up a moringa oliviera and seaweed business plan which meets the international standard requirements. Another challenge in this program was that we have to work in a team consisting of multidisciplinary background students. We have to be able to work together, uniting the different ideas, adapting them, to produce one story”. (Nur Shabrina, Batch 2 participant, student participant, Department of Biology)

In order to systematically analyze the testimonies, we categorize the testimonies, see Table 1. Twenty students, former participants of the Batch 1 and 2, submitted their testimonies. We analyze them and put them in the table, as shown by the Tables 2 and 3. The scores in the table represent the number of respondents, out of 20 respondents in total, who explicitly mention the benefit of the corresponding category and item. The respondents of the survey were the participants of the Batches 1 and 2 of the SR&DT program.

The Batch 1 has been marked by the atmosphere of finding the right ways, the right styles in running the research activities. There was practically not so much reference available, except the fact finding reports in the earlier visits. This batch 1 has put a strong foundation on our understanding about the islands, their potentials and their problems. We were lurked too quickly to jump the solutions, which were really tempting. On the other hand, the second batch had more information available already. The problem formulation, was somewhat clearer. The total scores for both Poteran and Maratua teams are more or less equal, 16 and 17 respectively.
Table 1 Output Description: Attitude, Knowledge and Skills

<table>
<thead>
<tr>
<th>CATEGORIES</th>
<th>ASPECT</th>
<th>From the SR&amp;DT activities,</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>International orientation</td>
<td>I have a wider orientation, improved international network.</td>
</tr>
<tr>
<td>Attitude</td>
<td>New network</td>
<td>I enjoy having new friends, enlarged network.</td>
</tr>
<tr>
<td>Attitude</td>
<td>Interest in new areas</td>
<td>I am curious in new areas, and I am more open to accept new things.</td>
</tr>
<tr>
<td>Knowledge</td>
<td>New opportunities/interest</td>
<td>I have more interest in new fields of profession, have seen more opportunities in business</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Wider views</td>
<td>I have more respect on the importance of various disciplines and diversity.</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Deeper insights in original discipline</td>
<td>I have a deeper understanding in my current study, in how to apply my educational background to address problems</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Potential</td>
<td>I have seen SIDI has done a pioneering research approach &amp; education, esp. in the field of island development</td>
</tr>
<tr>
<td>Skills</td>
<td>New skills</td>
<td>I have learned a lot how to deal with new things (theories, new types of collaboration &amp; friendships etc)</td>
</tr>
<tr>
<td>Skills</td>
<td>Personal development</td>
<td>I have improved individual overall skills</td>
</tr>
<tr>
<td>Skills</td>
<td>Teamwork capabilities</td>
<td>I have improved capabilities to achieve higher goals in a team</td>
</tr>
</tbody>
</table>

Poteran research was marked by a very lengthy land transport from Surabaya to rural areas of Poteran island, which might take some six hours. This research involves a huge participation from local farmers and traders, inhabitants, local university and local government partners. This involves also tedious works to disseminate ideas, plans, and the expected outcome of the projects. The hope of local partners on its success is huge.

On the other hand, Maratua research has apparently more interesting things to offer. One of the best diving spots in the world has already attracted many to apply. The competition to be enrolled was fierce. Many put Maratua island as their priority of choice. The Maratua team went to Maratua island with a huge excitement. And they returned to Surabaya with even more excitement, with a wish to stay longer at the island or to visit the island once again.

Table 2 Summary of Testimonies

<table>
<thead>
<tr>
<th>CATEGORIES</th>
<th>ASPECT</th>
<th>BATCH 1</th>
<th>BATCH 2</th>
<th>BOTH BATCHES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>International orientation</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Attitude</td>
<td>New network</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Attitude</td>
<td>Interest in new areas</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Knowledge</td>
<td>New opportunities/interest</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Wider views</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Deeper insights in original discipline</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Potential</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Skills</td>
<td>New skills</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Skills</td>
<td>Personal development</td>
<td>4</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Skills</td>
<td>Teamwork capabilities</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 3 Testimony scores

<table>
<thead>
<tr>
<th>Testimony score</th>
<th>Batch 1</th>
<th>Batch 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poteran Team</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>Maratua Team</td>
<td>17</td>
<td>13</td>
</tr>
</tbody>
</table>

Following the return to the campus, they have to compile and synchronize all the data, to conduct a series of discussions. As the Maratua team members are diverse in discipline, and most of them were in the process of finalizing their final BSc thesis, it is challenging to secure their commitment concerning the work progress, quality and punctuality. And they admit it, as shown by their lower score compared to that of Poteran team, 13 and 17 respectively, see Table 3. The survey has also revealed this: those who appreciate more on the processes of conducting all the activities tend to show better results, see Table 4. The score
ranges from 1 to 10, which means that the higher is the better. This score represents the overall judgement on quality of the output and performance of the teams.

### Table 4 Achievement scores

<table>
<thead>
<tr>
<th>Achievement score</th>
<th>Batch 1</th>
<th>Batch 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poteran Team</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Maratua Team</td>
<td>9</td>
<td>8</td>
</tr>
</tbody>
</table>

### 3.1 ADDITIONAL IMPACTS

The SR&DT teams were involved in various events within the university and outside. They presented their works at the International Maritime Technology Conference (MARTEC 2014) and National Marine Technology Seminar (SENTA 2015), both in Surabaya. They participated also in various exhibitions, including at the Indonesian-France Institute.

The way how activities of SR&DT program were conducted and managed apparently has been viewed positive by those who is deeply involved in running and managing the program.

“During my work at SIDI/SR&DT, I experienced a lot of things: how to better manage things, how to work in an interdisciplinary international environment, how to think, explain and express something scientifically, yet easy to understand and many things more. Furthermore, SIDI/SR&DT has helped me a lot to understand more about my own country, especially its small islands with its surrounding aspects. This understanding has led me towards my unexplored passion. I now, put a lot of concern in the small islands development and how to cope with them in a sustainable way”. (Jauhari Alafi, Assistant, SR&DT Program at ITS).

### 4. BUILDING TEAMWORK CAPABILITIES

Solving practically relevant problems by interdisciplinary student teams is one of the most beneficial, nevertheless also one of the most challenging tasks of the SR&DT program. Students, especially from various engineering disciplines are not very used to working across the disciplines [5]. All batches of SR&DT Maratua and Poteran had, in least at the beginning of their works, more or less the same difficulties to develop boundary-crossing views and skills in order to effectively solve the complex problem. There is a strong tendency to divide the problem into a set of isolated, disciplinary tasks, which are then solved by the individual team members. If not corrected in an early project phase, just a set of partial, not matching solutions would be presented as result, instead of a comprehensive solution of the overall problem.

Ensuring effective, problem- and solution-oriented teamwork of the interdisciplinary student teams is a challenge for the project supervisors from industry and from education. We experienced some pitfalls, which are considerably hampering the establishment of effective interdisciplinary teamwork in student teams, in particular:

1. **Defining Sub-tasks**

   When the task assignment to the student team is already decomposing the overall task into sub-tasks of disciplinary character, we can be sure that the students will take this ball. They will assign each of the sub-task to one of the team members according to a “best match” principle. Afterwards, each team member will work individually on “his” task. Cross-communication of results and joint project planning and controlling will be reduced to a minimum.

2. **Matching problem and faculty**

   During selection and formation of the student teams according to the given problem statement, project supervisors can unintentionally lay the seed for individualistic work. This happens when, after analyzing the problem a decision is made, which faculties or disciplines shall be involved into the team. By doing this, an indirect task decomposition is
done, leading to similar team behaviour as when predefining sub-tasks. An even worse result can be expected, when the project supervisors try to “adapt” the problem statement to the available disciplinary resources.

(3) Selecting students working on their Thesis
Students who are working on their Bachelor or Master Thesis have a natural tendency to “unite” as much as possible their thesis work with their task assigned by the interdisciplinary student team. In other words, they rather try to “sell what they already have” to the project instead of effectively contributing to the overall project solution.

(4) Problem statement too general
If the description of the problem to be solved by the interdisciplinary student team is too vague or too comprehensive, the student team will reduce the scope of their work to their most convenient extent. For example, the problem statement “Analyze the conditions for touristic development on island XY” is giving low information about the expected results. The student team is then free to decide what they will be able to do in the available project time of 4-6 months. Here for sure only an incomplete “patchwork” result can be expected.

(5) Too few or too much control by the project supervisors
Both tendencies have negative influence on the self-organization of effective interdisciplinary teamwork by the student team. Too few control and guidance bears the risk that the project runs out of target orientation, due of misunderstanding of the problem, individualistic tendency or weak project management. (Most of the students work for their first time in an interdisciplinary team). Too much control and guidance by the project supervisors hampers the development of own capabilities for interdisciplinary project work by the student team. The students will just ask the supervisor for every single problem arising.

In both cases the educational objective of building teamwork capabilities will not be achieved in an optimum.

Learning from these pitfalls, we now prepare the 3rd batch of our Student Research & Development Teams. In cooperation with our industry partners we try to follow three objectives in an optimized way:
(1) Finding innovative solutions for practically relevant problems of our industry partners by effectively selecting, preparing, and controlling interdisciplinary student teams;
(2) Achieving the best educational effect for the student teams with respect to interdisciplinary working experience that stimulates students’ creativity and enhances their professional employment opportunities;
(3) Improving our own educational capabilities with respect to effective methods and resources for practice-oriented, inter-professional education.

The results of SR&DT Batch 3 will be benchmarked on these three objectives.

5. CONCLUSION
The SR&DT program has demonstrated huge benefits for students having participated at the research activities in a team. The students experience the benefits especially for their own personal development and teamwork capabilities. These improved skills have been obtained during the project execution. The program contributes very much in widening the horizon, and in enhancing curiosity in new things. The participants experience an enlarged capacity to build a network. Last but not least to mention, those benefits are also experienced by those involved in running the project as well. Nevertheless, some efforts to improve the program execution are necessary.
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1. SR&DT Teams. Research Reports Batch 1, ITS, 2015
Abstract: China and India are both rising powers with a common border and share natural resources such as water. As transnational water conservation and management become increasingly important (indeed a matter of survival) fundamental values toward nature help to guide policy makers in the negotiation and legislation of the necessary means of stewardship. Although the value systems of both China and India to some extent reflect Buddhist teachings, the understanding of nature is in many crucial ways divergent. In this paper I will discuss traditional attitudes toward nature and seek to identify common values that can support the negotiation of common water management policies. I will then address the question of how such common values can be taught in engineering and business/management programs.

Keywords: Indian and Chinese traditions, cosmology, stewardship of nature, value differences, engineering and business education.

1. INTRODUCTION

This discussion must necessarily range from traditional customs and beliefs in China and India about water to contemporary environmental science and engineering, with intermediary references to law and public policy, economics and geo-politics. There are allusions to ongoing debates in political philosophy. Ultimately, the paper suggests priorities and a general approach to teaching engineering and business at the university level. Despite this breadth and complexity, the underlying premise is simple and the concern elemental. Life on every level requires water and civilization emerged in proximity to its availability. In addition to the demand of living tissue for clean and uncontaminated water, the presence of water provides power, a means of waste disposal, a medium of ritual purification, the possibility of transportation (goods, people, ideas) and thus in myriad ways touches on every aspect of human and non-human life -- sometimes in contradictory ways.

Attitudes toward water are polyvalent, expressing both traditional cosmological and religious beliefs and those reflecting the needs of contemporary industrial and urban society. The polarities thus represented can lead to conflicts frustrating rational water management. Public policy is inevitably influenced by views issuing from both ends of the spectrum, and often the tools of modern administration and law are ineffective to resolve the differences in an amenable fashion. This difficulty is exacerbated when there are contesting legal and political jurisdictions and, a fortiori, if multiple value traditions influence the process.

This is certainly the case when one considers the problems inherent in managing the common water shed shared between India and China. The level of disagreement or conflict has
sometime risen to the level of political acrimony, with accusations from the Indian Prime Minister and others that China is not recognizing the rights and/or needs of India in its management and exploitation of waterways that originate or pass through China prior to supplying India.

The hypothesis to be entertained is that neither international law nor sophisticated and ecologically sensitive engineering can on their own lead to amicable policy regarding vital, scarce and shared water resources. The reason for this, it will be argued, is that in a fundamental way water means something different in the context of Chinese culture than it does in the Indian.

China and India are both rising powers with a common border and share natural resources such as water. As transnational water conservation and management become increasingly important (indeed a matter of survival) fundamental values toward nature help to guide policy makers in the negotiation and legislation of the necessary means of stewardship.

Although the value systems of both China and India to some extent reflect Buddhist teachings, the understanding of nature in the two countries is in many crucial ways divergent. I will discuss traditional attitudes toward nature and seek to identify common values that can support the negotiation of common water management policies. I will then address the question of how such common values can be taught into educational programs in engineering and business/management.

The fragility of nature is now recognized as one of the pervading challenges of our time. The human prospect on every level is connected to the conditions of the natural environment. The business and engineering sectors have great responsibility to care for the natural environment which is the basis for our continued existence.

2. Traditional views regarding the significance of water in Classical Chinese and Indian cosmologies

Early cosmologies still inform the imagination and mindset. In China and India these traditional cosmologies assert different values than some of those preserved in the Hebrew and Christian traditions dominant in the West. In the case of China we shall consider briefly the Confucian and Daoist approaches, while for India we shall refer to the Vedic tradition. Additionally, we shall raise the question of whether the Buddhist tradition, a global worldview at one time shared by China and India, might provide a platform of shared values.

Traditional Chinese cosmology and ontology of nature is based on the theory of the five agents and the dynamic equilibrium of yin-yang. Both the Confucian and Taoist elaborations, each of which places humanity within the cosmos or natural order, utilize these basic concepts and approach. The five agents are: wood, fire, earth, metal, water. Sometimes these agents or elements are understood as phases as they succeed each other according to the dynamic oscillations of nature. Chinese cosmology, in a manner rejected in the approach of modern Western science is teleological and thus is an important aspect of the principles of ethics, political theory and social order. Consequently the status of water as an element of nature is extended to those discourses as well. However, in the context of traditional Chinese cosmology, despite water's importance, it is just one of five elements/agencies/phases and therefore not regarded as having singular importance. It is the structure and function of the system as a whole that counts. Moreover, the Chinese discussion is proto-scientific, i.e., while perhaps not good science by current standards, it suggests a preparatory viewpoint that will be augmented and eventually superseded by science. In other words, this kind of explanation and the values
that inhere within it, are not in principle opposed to science and therefore current scientific explanations can preserve the traditional valuations of water. In short, the Chinese evaluation of water calls for rational understanding and administration and should support scientifically supported ecological accounts of nature. The main point is that the valuation of water is not part of an extra-scientific sacred discourse.

Contrast this type of outlook with the value of water that is expressed in this passage from the Rig Veda:

There was neither non-existence nor existence then
There was neither the realm of
Space nor sky which is beyond
What stirred?
Where?
In whose protection?
Was there water, bottomlessly deep?
Darkness was hidden by darkness in the beginning.
With no distinguishing sign, all this was water.
The life force that was covered with water emptiness.
The one arouse through the power of heat.

According to one scholar, "water was an extraordinary and omnipresent element in the Rig Veda. It was the upholder of all lives and the savior of everything living or dead on earth"
The "One" is everything that is and to understand the truth of nature it is necessary to recognize and embrace the one. So everything that is derives from water which is the elemental, living and redemptive force which accounts for everything. These living waters flow via rivers throughout India and the most sacred of rivers is the Ganges. It is well known that various life cycle rituals involve a degree of submersion in the River Ganges. The meaning of these rituals is complex but they concern the well being of the self/soul which is intimately connected with the One. Since the rituals involve the state of an individual's karma (i.e., the consequent record of one's actions and deeds and thus, in this tradition, the well being of past, present and future states.)

Without further discussion of the metaphysics involved in either tradition it is nonetheless quite clear that an account of how one regards and values water that is part of an entirely naturalistic worldview, as in the Chinese case, will be strikingly different from a sacred understanding that reveres water as the source of all being and in itself the purifying lifeforce for all to freely avail oneself of as it is in the Indian context.

When two heterogeneous and methodologically different accounts ostensibly deal with the same subject matter the potential for conflict is large. In the European tradition the conflict between religion and science, or as it is frequently put the conflict between faith and reason, presents a similar conundrum. Thomas Aquinas sought to resolve it by arguing that sacred scripture and the rational understanding of nature (generally that of Aristotle) were actually two revelations from God -- the divine author of nature -- and were both true, and mostly could be reconciled with each other, the differences being in the mode of expression, two paths to the same truth as it were. Could a strategy of this sort help to resolve the conflicting differences with respect to water use that prevail between China and India?

3. WHY DISCUSS CHINA AND INDIA?

Clearly the fragility of nature and crises of water are global issues. What is the purpose of limiting the discussion to China and India when arguably the problem is more immediately critical in some other parts of the world? There are obvious answers such as the extraordinarily large population of either country alone let alone combined. Also, in the future both
countries will exert great influence on global policy decisions such that their example may determine the well being of the earth. But the purpose of focusing on them in this discussion is to take a few steps toward correlating two unfortunately disparate perspectives (primarily in the West) that see China and India either in romantic or Orientalist terms or in the context of globalized economic or technocratic projects. The later approach tends to treat every region of the world interchangeably, as for example in the notion of the BRICS (Brazil, Russia, India, China, South Africa) countries which sees as applicable essentially the same paradigms for development in each. The former approach exoticises and posits as different and either irreconcilably other those cultural traditions branded as non Western. Both make points but also lead to to the inability to comprehend fully those situations where past, present and future coincide and inform the conditions for making decisions. For practical or strategic purposes I think those who hold the latter, modern outlook, will be served by making the effort to frame their position in a way that acknowledged and even honors (to a degree, at least) the canons of a traditional view. Such may be the case for water management issues between China and India.

To overcome this type of blindness it is necessary to analyze how values intrinsic to the traditional worldviews have been appropriated by contemporary Chinese and Indian societies. The analysis cannot be limited to project documents, social science, economic and technological analyses, legal rulings, etc., but must also examine genres of popular literature including art, music, religion, stories and novels, as well as cinema, television and all mass culture. Only in this way will it be possible to assess the living culture and determine the formulation, force and vitality of traditional values in the consciousness of the contemporary public.

This approach does not of course really face the basic problem which arrises whenever there is a claim to a universal good (human rights, for example) is contested on the basis of tradition, religion, long standing cultural value or some position that does not acknowledge the particular principle in question. John Rawls attempted to resolve this in his work on the idea of justice based upon fairness. To what extent must justice accept the claims of culture?

**4. SCIENTIFIC AND ENGINEERING PERSPECTIVES**

*Some basic issues of water management:*

- **RIVERS (Brahmaputra and Ganges)**
  - 1. What is done upstream happens downstream
  - Hydro-electric power
  - High mountain melt-off
  - Tradition versus Modernity or Ritual versus Industry

I have argued that the Chinese in contrast to the Indian tradition to a slight degree resembles a scientific point of view. This does not justify the inference that either view can be counted upon to embrace scientific rationale for water management. Since the scientific considerations manifest themselves as engineering projects, it must be clear that engineering does not threaten the balance of nature. This is the case from both Chinese and Indian points of view, although what it means to disturb the balance of nature is quite different in each case. As an example consider the most famous of massive engineering water management projects in recent years, viz., the Chinese Three Gorges Dam.

The Three Gorges dam holds 39 trillion kilograms of water 175 meters above sea level. That sheer mass of water coupled with the distance moved away from the center of the Earth has a fundamental impact on the rotation of the Earth. NASA has calculated it, and the
results showed that since the dam was built, every day lived by every human on this planet ever since is 0.6 microseconds slower than before.

This disturbance of nature need to be considered insofar as it might (or perhaps actually does) fundamental precepts in currently received versions of the traditional natural cosmologies. Does the impact upon the rotation of the earth for example violate a concept of the equilibrium of nature as received from the tradition? It may be possible to show scientifically that it does not. Or does simply the fact of damming the water in the Yangtze and its impact on the Brahmaputra and then ultimately the Ganges threaten the sanctity of the Ganges? An argument that it does not would be quite unlike the argument used in the Chinese context.

One thing is clear: an argument based simply and exclusively upon calculated economic benefits would be effective only if there were no or only trivial value conflicts.

In cases such as this science and engineering cannot be the handmaidens of a political or economic system but must strive to be economically disinterested and politically neutral. This is no easy task given the likely incentives for engineering and construction firms to advocate their approach as the best solution.

Science should be in the service of ecology, that is the stable balance of human and non-human systems for the preservation of the earth as our dwelling place. Ecology is a multidisciplinary subject that seeks to work across systems to understand the actions with systems and the interactions across systems. The stem beginning for both ecology and economy is οἶκος which means both home and household. Λόγος, Greek for reason, speech or logic combines with οἶκος to produce our word ecology suggesting the rationality of the household, expanded in this case to suggest the world as our abode. Similarly οἶκος combines with νόμος, yielding economy or the laws of the household. In their root meanings both words are holistic and aim at guaranteeing the well being of our home. The problem is the disagreement over true reason and genuine law.

5. EDUCATIONAL PERSPECTIVES

Since both engineering and business education are situated within human and natural ecological systems it should be imperative that teaching reflects this reality. This does not mean that engineering or business classes should be lessons in ecology just as they should not be about political philosophy, cultural difference or other important but strictly speaking not engineering or business. Those specific lessons will have to be learned elsewhere. The important point is to adopt an approach where the questions of ecology, political difference and cultural value are evident and acknowledged as essential to comprehensive treatment of most engineering challenges.

Some approaches for engineering education:

Is engineering “value neutral?”
- Yes: A bridge is a bridge, Ohm’s law is Ohm’s law
- No: Bridges and home or public lighting change lives

What should engineers teach?
- Materials, structures, circuits
- Examples and applications
- Respect

Some approaches for Business education:

- Is business value neutral?
- Prima facie: NO
- Business education teaches
  1. How to do business successfully
  2. How business ought to be done
  3. Where to do business
  4. With whom to do business, i.e., marketing
Business depends upon trust, fidelity, and respect. Localization strategies must incorporate these virtues.

6. FROM INDIA TO CHINA

It was mentioned that Buddhism, at one time the dominant worldview in both China and India, might be able to broker a common path to understanding values. To illustrate the kind of complexity that surrounds the various conflicts between China and India over water, especially in the context of global free trade and technology, consider this challenge:

• Suval Sivaraksa and Aubrey Meyer have suggested the following modifications of the Buddhist Four Noble Truths to make them relate to ecology:
  • Climate change is a reality. It is the source of flooding and drought, desertification and loss of land.
  • Climate change is caused by over-consumption of fossil fuels, loss of soil, and excessive herds of livestock. Individual over-consumption in the global North is an expression of greed and a fear of loss. Fear and greed are root causes of all suffering. Capitalism thrives on individual fear and greed.
  • The climate we have to change is the climate of greed and fear, in which consumerism and profiteering can thrive.
  • To overcome suffering, start at home, with yourself. Ask yourself: Where can I cut down my consumption? How can I repay my carbon debt to my children’s children? Plant trees. Don’t fly. Eat local and organic foods.

7. CONCLUSIONS

• The issue of engagement versus boycott often arises in matters of technology transfer (engineering) and enterprise (entrepreneurial economic activity = business). Education, whether business or engineering, is on the side of global engagement.

• As full global partners China and India are being asked to operate with procedures, standards and values which historically bear the marks of Western civilization, including colonialism.
• Globally shared natural resources – including water – require management that inevitably includes business and engineering practice.
• Cooperation and collaboration, rather than colonization (wrong but now also impossible) require respect for diverse values.
• This is the new mandate for engineering and business education.
Abstract: This paper aims to advance the understanding of theories and the application of solar energy as an alternative source of energy by studying two cases of Philippine HEIs. It provides examples of how these two pioneering and innovative projects experienced various challenges. Both Systems A (Solar Cooling) and B (Solar PV Net Metering) generated the energy output as per technical design. System A however, is more complex because of three integrated sub-systems. The theoretical return was not achieved in the actual application of the two systems.

Thus, the study shows the advantage of System Model B, a private party partnership over System Model A, a direct purchase. Under these conditions, System A is not in a position to achieve a long-term sustainable operation, while System B, although slightly below its theoretical savings rate, is within acceptable standards based on the agreed 15-year contract. The study also shows that under-capacity utilization as main factor in not achieving the project’s economic return. But, maximizing their individual operational capacity requires an efficient solar power energy operation which involves managing the entire supply chain. In such a situation, HEIs are better off adopting System B than System A to minimize exposure to both operational and financial risks.

This case study validates both classical and contemporary theories on strategy found to be characteristic of successfully managed companies advanced by Peters (1981) on “close to the knitting”, Porter (1985) on the impact of the environment (external and internal) to the strategic “competitive position of the firm; and that “ an organization  must find to its true core competence in order to gain a competitive advantage” (Hamel,1994).

The authors recommend that in order to recover the huge investment on these pioneering and innovative but extremely risky projects, HEIs must fully maximize their designed technical capacities. In sum, this case study reveals the difficulty of institutions in finding a balance in achieving the two-pronged objective of operational efficiency and sustainability on one hand; and corporate social responsibility on the other.

Keywords: solar energy, Laudato Si, global warming, core competency, corporate sustainability and social responsibility

1. INTRODUCTION
The need to develop renewable energy solutions has become imperative nowadays in view of the threat of global warming and related issues facing all nations worldwide. This led heads of states, UN and all sectors including the Vatican...
to address the issues squarely. In the last Paris Climate Conference (COP 21) held December 2015, 195 countries adopted the first-ever universal, legally binding global climate deal. The agreement sets global action plan to put the world on track to avoid dangerous climate change by lowering global warming to well below 2°C by 2020 (EU, 2020). Prior to this, the Vatican issued through Pope Francis the encyclical *Laudato Si*, a “wake-up call to help humanity understand the distraction that man is rendering to the environment and his fellowmen” (Cotter, 2015).

The Philippines as a developing country has one of the highest energy-cost in Asia. This is brought largely by the high dependence on fossil fuel mainly from oil imports from Middle East countries resulting to price volatility. This position deters the growth of industries particularly the manufacturing sector and the flow of direct investments that will fuel the growth of the Philippine economy in the 21st century.

Higher educational institutions (HEI) are not insulated from this dilemma. Colleges and universities, although in the service sector, use a lot of energy to support its school operations particularly classroom, laboratory, and office air-conditioning.

HEI¹ based in Manila, Philippines took the initiative in 2011 to install a solar energy cooling system in cooperation with a Korean-based company. HEI¹ was the first institution in the Philippines, as well as in Southeast Asia, to install such a system which employs technology that relies on double vacuum tubes for thermal solar collection (Santos, 2011).

Subsequently in 2014, another HEI, Manuel L. Quezon University (HEI²) also based in Manila, Philippines, installed another solar energy system using a different technology, a Solar Photovoltaic (PV) Net Metering facility in private partnership with Solar PV Suppliers (SPS) and in cooperation with the Department of Energy (DOE) of the Philippine government.

HEI¹ likewise installed this technology in July 2014, making it the only HEI in the country to have two solar energy systems installed under two different technologies and financial scheme.

As in any pioneering and innovative project, many issues emerged during the implementation, particularly their technical and financial viability and the long-term sustainability of the HEIs. There is no formal empirical study yet on its post-implementation which will guide top management on the alternative strategies in finding a solution to the emerging problems. Thus, this case study aims to fill this gap by evaluating the experiences of these two HEIs in implementing their respective solar energy projects for the period 2011-2015. Specifically, this study seeks to answer the following research questions: a) What is the technical and financial feasibility of the Solar Energy Cooling System ?; b) What is the technical and financial viability of the Solar PV net-metering System ? ; c) Is System A a better solar energy solution than System B; and d) on the basis of the findings in a,b and c, what recommendations can be made to meet the two-pronged objective of HEIs of achieving a balance of sustainable school operation and corporate social responsibility.

This paper will include a literature review, which will be the basis of the conceptual framework and will discuss the results of these two different solar energy technology models as applied by the two HEIs using the case study approach, a method of choice when the phenomenon under study is not readily distinguishable from a context (Yin, 2003).

2. REVIEW OF LITERATURE AND THEORETICAL FRAMEWORK

Revived interest in the role of theory in doing evaluations (Bickman, 1987, Chen, 1990, Chen and Rossi, 1989) has had a continued counterpart in the role of theory in designing and doing case
studies. Critical examples include the importance of theory in explanatory (not just exploratory or descriptive in designing case studies (Yin, 2003). From this perspective, the following theories on renewable energy principles and models are presented.

Renewable energy refers to energy resources that do not have an upper limit on the total quantity that can be used. Such resources are replenished on a regular basis, and have a relative rapid regeneration rate allowing for its use over an indefinite period of time. These include, among others, biomass, solar, wind, geothermal and hydro (Aitken, 2003).

**Case A: The HEI$^1$ Solar Cooling System (Model A)**

Flat plate solar collectors are widely used in the Philippines; however, HEI$^1$ decided to install a system using double vacuum tubes as solar heat collectors. This decision was based on the knowledge that double vacuum tubes have greater heat collecting efficiency. This improved capability is due to the fact that the vacuum which surrounds each collector/tube greatly reduces convection and conduction heat loss. The greater amount of collected heat is used in conjunction with an absorption chiller to provide a renewable and environment-friendly system for cooling.

Solar power operates most efficiently on sunny days with the direct rays of the sun reaching the collectors. During this time, the heat energy within the system is stored in a water tank at a temperature of 65° to 95° Celsius. The higher the temperature of the water, the greater is the cooling potential of the system and therefore the more electrical energy is saved.

Through the use of all these technologies, the demand for electricity can be lowered by 70% with a corresponding reduction of carbon dioxide released into the atmosphere. This system (shown in Figure 1) was chosen because of HEI$^1$’s dedication to seek energy sources that reduce or eliminate contributing factors to global warming along with being eco-friendly (Santos, 2011).

**Case B: The HEI$^1$ and HEI$^2$ Solar PV Net Metering (Model B)**

The net metering mechanism is a consumer-based renewable energy incentive scheme wherein electric power, generated by an end-user from an eligible on-site generating facility such as solar photovoltaic (PV) and delivered by the distribution grid may be used to offset electric energy, the purpose of which is to encourage end-users to participate in renewable electricity generation and eventually contribute to the mitigation of greenhouse gas emission (RA 9513). The two HEI’s inked a 14.5 years contract with a local private PV supplier (mediated by the DOE) to install an electricity photovoltaic, solar power plant with a total generating capacity rated at approximately 42.84KWP for Phase I and 41.31kWp for Phase II at an agreed price of PhP 9.50 per KWh. The commercial rate at that time was PhP 11.50 (a difference of PhP 2.00/kwh) by MERALCO—the sole power distributor in Metro Manila, Philippines. The activities are shown in Table 1 below, while the systems flow is presented in Figure 2 as system model B.
Thus, the effect of the two systems is to be explored in this study using the following hypotheses shown as the Operational Framework in Figure 3 below:

H1: System Model A is technically feasible and meets its theoretical cost savings.
H2: System Model A is financially viable and exceeds the capital budgeting investment criteria.
H3: System Model B is technically feasible and meets the theoretical cost savings.
H4: System Model B is financially viable and meets the “spread” criteria between the contract price and current market price.
H5: System Model A is a better solar energy solutions than System Model B in terms of technical and financial feasibility

Figure 3 Operational Framework

3. RESEARCH METHOD

This study adopts a case-study approach using both descriptive and explanatory design, by examining internal documents, publications
from government bodies such as the Department of Energy (DOE) and the sole private energy distributor in Manila-MERALCO, and focus group interviews with key administrative personnel and technical staff from the two HEIs. As Yin (1984) suggests, this approach is considered to be useful in gaining an in-depth, holistic understanding of the phenomenon studied (Thang, 2013).

The hypotheses will be tested using the criteria in presented in Table 2. The theoretical rates for the technical feasibility for System A were based on the related studies on solar energy and experiences of solar energy installations in advanced countries as cited by the Research Center of HEI¹ and discussions with the Korean supplier; while for System B, the assumed cost savings rate was taken from the project specification provided by the DOE; and the contract price is based on the 15-year Memorandum of Agreement between the HEI and Private Solar Energy provider.

The financial feasibility criteria for System A are based on the computed cost of capital (long-term bank financing obtained by HEI¹ from a local bank). The first three years is based on actual cost of financing, while the remaining 3-15 years is based on assumed rates expected to be re-structured with the bank over a period of 10-12 years.

Table: 2 Criteria for hypotheses testing: System A and B

### Technical Feasibility

System A is technically feasible based on its technical design as the System run during its pilot test and for two years now would show.

Table 3 Summary of results of operation for two solar energy system models

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Theoretical rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Model A: Technical Feasibility</td>
<td>60-70% Cost Savings</td>
</tr>
<tr>
<td>System Model A: Financial Feasibility</td>
<td>NPV=&gt;1.00 IRR=&gt;8%-12%</td>
</tr>
<tr>
<td>Model B: Technical Feasibility</td>
<td>20-25% Cost savings</td>
</tr>
<tr>
<td>Model B: Financial Feasibility</td>
<td>Contract Price Php 9.50) &lt; current market Price (Meralco)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criteria</th>
<th>System A (Solar Cooling)</th>
<th>System B (Solar PV Net Metering)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Requirements</td>
<td>Divided into 3 subsystem a. Mechanical b. Electrical c. Digital System</td>
<td>Electrical (DC to AC) inverter and PV Solar Panel</td>
</tr>
<tr>
<td>Manpower Requirements</td>
<td>Trained personnel for these 3 areas</td>
<td>1 personnel to monitor performance and clearing of PVC</td>
</tr>
<tr>
<td>Energy savings-gain</td>
<td>Since air conditioning system requires a lot of energy, solar cooling does not require electricity for air compression</td>
<td>Fixed at 9.5 pesos per kwh plus energy sold to the grid during holidays including Sundays (no office and school operation)</td>
</tr>
</tbody>
</table>
Table 3 above shows a summary of the technical requirements of the two systems and as per actual run from 2013-2015 were able to function as designed.

System A however, turns out to be a highly complex system in view of the integrated technologies embedded: mechanical, electrical and digital that runs its boiler, cooling and computer systems. System B on the other is simple to install and operate because of its sole PV technology, which is electrical.

System A is affected by the external environment, particularly the weather. The Philippines has two seasons— wet/rainy season and the dry/summer season. During the wet season, solar collection has lower efficiency because of the clouds that block the collection of solar energy by the panels. Thus, System A needs to resort to alternative raw material—imported wood pellets and lately coconut chips to “fuel” the boiler.

During the dry season, on the other hand, solar energy collection through the panels is more efficient; but System A has difficulty cooling the rooms because of the outside temperature of 36°C, and the body heat emitted from the students averaging 40 per class prompting the use air conditioning system source from MERALCO line to cool the room for the first 30 minutes.

Table 4 Comparative Summary: Financial Analysis of Systems A and B (Cost Savings and Return)

Data in Table 4 above show that System A can generate a savings of 61% which falls within the theoretical savings rate of 60-70%. This 70% ceiling rate is based on the research findings of the Research Center of HEI; while the 60% base line is the “promise” of the Korean partner during the negotiation stage. This guarantee was never put into a formal contract and secured by a “performance bond” in a foreign financial institution.

For these reasons, H1: “System A is technically feasible”, is accepted.

Financial Viability

System A’s actual economic performance for the 3-year period 2013-2015 could be seen in Table 5. The figures show the monthly savings average when using solar energy and the supplementary material—coconut chips to “fuel” the boiler when there is not enough solar power collected. The table shows the 3-yearly monthly savings average of Php 77,175 which is 61% savings when solar energy is used.

It is noteworthy that this savings in percentage is not sufficient to translate into a large amount of savings return in peso value. The Php 77,175 monthly average or Php 926,100 per year savings is insufficient to cover the amount of initial investment of PHP 80 million. To breakeven, at least on half of its expected life of 15 years, the System must generate a savings of at least PHP 10 Million annually to achieve a payback of 8 years.

If further subjected to discounting (present value), this requires a much larger cash flow.
This condition is largely attributable to System A’s very low capacity utilization rate. In other words, the system is not running to its designed capacity resulting to a lower cash savings. The main reason for this is the non-maximization of System A’s usage mainly due to drop in enrolment and other operational concerns.

Table: 5-HEI\(^1\) Electricity Savings using solar Cooling System A: 2013-2015

<table>
<thead>
<tr>
<th>Period Covered</th>
<th>Total Electricity Cost When Using MERALCO In PHP</th>
<th>Total Electricity Cost When Using Solar In PHP</th>
<th>Coconut Chips Cost</th>
<th>Monthly Savings In Peso</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov.2013 – Apr.2014 Monthly Ave.</td>
<td>575,921</td>
<td>148,517</td>
<td>93,120</td>
<td>334,284</td>
</tr>
<tr>
<td>May2014 – Apr.2015 Monthly Ave.</td>
<td>1,477,764</td>
<td>350,022</td>
<td>262,080</td>
<td>865,660</td>
</tr>
<tr>
<td>3-Year monthly Ave.</td>
<td>126,538</td>
<td><strong>77,175</strong></td>
<td><strong>61%</strong></td>
<td></td>
</tr>
</tbody>
</table>

*1 USD = 47 PH Pesos: **monthly savings exclusive of manpower and water

Actual savings percentage based on sample metering for two periods shows a savings of 16%-17 % which is computed based on the savings in Pesos (with solar) and supposed total energy cost without solar per month.

**Investment Analysis**

Years 1-3 data are based on actual operation from 2012-2015 wherein the HEI experienced a decline of enrolment by 2/3 at 1,000 resulting to a very low capacity utilization of less than 10% : years 4-10 is based on a forecast of 200% to put the level of enrolment by 2/3 of 2012 base year (2,000);and the 300% increase is to put the enrolment to 3/3 of the base year 2012 during the project inception (3,000).

Table 6 HEI\(^1\) System A Investment & Capital Budgeting Evaluation: 2013-2028 (In Million Pesos)

*Years 1-3 actual (1/3), 4-6 based on forecast of 200% (2/3) due to increase of utilization rate and years 11-15, a forecast of 300 to Year 0 level (3/3) .

Using the three capital budgeting techniques presented in Table 6, System Model A was not able to meet the minimum hurdle rates with a negative NPV of PhP 68.8 Million, IRR of < 12% and a payback period of more than 7.5 years. This projection is based on the assumption that the actual results for the last 3-year period (2011-2013) will remain in the next 10 years of annuity period for NPV and IRR. The payback period is a theoretical computation, since a solar power plant has an assumed book value life of 15 years. Thus, the expected hurdle rate for payback period is 7.5 years, i.e. half of its useful life.

For these reasons, H2: “System A is financially viable”, is rejected.
System Model B: The Solar PV Net Metering System of HEI\textsuperscript{1} and HEI\textsuperscript{2}

System B Technical Feasibility

System B turned out to be easy to install and operate, and its system design is simple to operate including the net metering system between the host implementing institution, the solar energy project provider and the private commercial energy distributor, Meralco.

Tables 4 and 5 in previous sections show that the system run of System B for the two institutions obtained a cost savings of 16-17\% and 17-19\% for HEI\textsuperscript{1} and HEI\textsuperscript{2} respectively.

This validates the rationale of the DOE Program that this System can generate a savings for HEIs installing the system; however for the two run periods, is short of the theoretical rate of 20-25\%. This rate of return may be increased if the utilization rate is increased depending on the two institutions usage of the System and the installation of more solar panel for the private partner for the next 13 years.

For these reasons, H3: “System Model B is technically viable”, is accepted.

Financial Viability

The criteria for financial viability is based on the spread between the fixed contract price in the MOA for the 15-year period (Php 9.50/kwh) and the prevailing market price of energy (MERALCO). The data show a downward trend in the market price of commercial energy provided by MERALCO over the past three years (Php 13.50-7.50/kwh) and this is due to the fall of oil price in the international market primarily middle eastern countries. This scheme is akin to the securities market; whereby the valuation of stocks and bonds is dependent on the volatility in the market price.

<table>
<thead>
<tr>
<th>Period of operation</th>
<th>Year 1-3</th>
<th>Year 4-10</th>
<th>Year 11-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Capital</td>
<td>12%</td>
<td>10%</td>
<td>8%</td>
</tr>
<tr>
<td>Ave. Annual Cost Savings Year 1-3 (Actual)</td>
<td>9.261 M</td>
<td>1.852 M</td>
<td>2.778 M</td>
</tr>
<tr>
<td>Years 4-10 (Forecast) Years (11-15) (Forecast-end of life of asset)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVIFA k,n</td>
<td>8.9825</td>
<td>7.7217</td>
<td>5.6502</td>
</tr>
<tr>
<td>Discounted Cash Flow (DCF)</td>
<td>8.318 M</td>
<td>7.151 M</td>
<td>5.232 M</td>
</tr>
<tr>
<td>Initial Investment (PhP)</td>
<td>80.0 M</td>
<td>80.0 M</td>
<td>80.0 M</td>
</tr>
<tr>
<td>Net Present Value(NPV) (PhP)</td>
<td>(68.6 M)</td>
<td>(66.8 M)</td>
<td>(64.8 M)</td>
</tr>
<tr>
<td>IRR (%)</td>
<td>&lt; 12%</td>
<td>&lt; 10%</td>
<td>&lt; 8 %</td>
</tr>
<tr>
<td>Payback (years)</td>
<td>&gt; 7.5</td>
<td>&gt; 7.5</td>
<td>&gt; 7.5</td>
</tr>
</tbody>
</table>

Based on this perspective, the host implementing HEIs-HEI\textsuperscript{1} and HEI\textsuperscript{2} “lost” in the last two years; however, like the bond and securities market being in the “long-haul”, the scenario may change in the next 13 years.

What is beneficial for HEI\textsuperscript{1} is that it can pass on the “spread loss” to the consumer-residents in its dormitories based on contract price. La Residencia 1 has a separate sub-metering system for each unit.

But this could not be possible for the other building facilities for both HEI\textsuperscript{1} and HEI\textsuperscript{2} since energy fee is fixed at the start of the semester. However, this could be corrected during the following academic year by adjusting their respective rates in the miscellaneous fees, and for dormitory facilities with fixed rate. (La Residencia 1). In both cases (HEI\textsuperscript{1} and HEI\textsuperscript{2}), there is no huge financial risk in terms of its capital investment which under this scheme is assumed by the private solar energy partner.
Based on these reasons, H4: “System B is financially viable”, is accepted.

Comparative Evaluation of Systems A and B. When compared to System A which generated a cost-savings of 61%, System B has a lower cost-savings (16-19%) but has a lesser risk on the part of the HEI client. The only risk by the HEI is the volatility of the market price of energy against the contract price of Php 9.5/kwh. Based on the experiences of the two HEIs, the cost of energy in the Philippines decreased for the last 3 years because of the oversupply of oil in the world market; a reduction from Php11.5/kwh in 2013 to Php 9.50 in 2014 and down to Php 7.50 /kwh late 2015. Based on this 3-year trend, it is evident that the contracted fixed price of the HEI is higher than current market price of energy under System B.

System-B on the other hand, while experiencing volatility of market price i.e., commercial rate is sometimes lower than the contract price of P 9.30/kwh, the institution can, pass on the price difference to the customer (students and residents). This flexibility in the form of a hedge, is the risk main advantage of System B.

For these reasons, H5: “System A is a better solar energy solutions than System B in terms of technical and financial feasibility”, is rejected

5. CONCLUSIONS AND RECOMMENDATIONS
System A is technically feasible based on its technical design but is extremely risky. Its operation is highly complex due to the presence of three technologies in its design: mechanical, electrical and digital. This makes it difficult to sustain its operation which is dependent on many external and internal factors.

The system can generate a savings of 61% which is within the theoretical savings rate of 60-70%. However, this savings performance is insufficient to translate into cash flows that would cover the initial cost of capital of Php 80 Million when discounted to its cost of capital over the asset’s book life of 15 years.

The main issue is the under capacity utilization (less than 20%) which is due to many factors: the sharp drop of enrolment of the HEI, weather condition which affects solar solar energy collection, material supply (fuel oil and wood pellet, system breakdown due to mechanical and electrical issues and computer software which controls the over-all system (web-based and intranet) resulting to substantial idle time.

System B turned out to be easy to install and operate, and its system design is simple to operate including the net metering system between the the host implementing institution, the solar energy project provider and the private commercial energy distributor, Meralco.

In both cases (HEI¹ and HEI²), there is no huge financial risk in terms of its capital investment for System B, which under this scheme is assumed by the private solar energy partner.

This case study validates classical theories on strategy on the impact of the environment (external and internal) to the strategic position of the firm (Porter,1985); and that “the firm must stick to its core competence in order to gain a competitive advantage” (Hamel,1994). The initial intent of the HEI to use solar energy as a cost reduction measure to gain a competitive advantage following Porter’s generic strategy model is seemingly logical.

However, it turned out that that the choice of solar energy solution Model with a technology that is not adaptable to Philippine environment and not within the distinctive competence of an institution to implement did not match or fit this strategy. Porter’s value chain concept puts the “primary value” of generating process on manufacturing or service delivery process (in the case of HEIs—instruction)
This observation leads to the conclusion that “strategic positioning, strategy choice and implementation must be emerging and evolving throughout the entire process”. (Jones,2014) and (Mintzberg,2009). They advocate an intensive feasibility study of long-term projects during the strategic choice phase not as a fixed blueprint but as a guide to strategic changes that will emerge during the entire process.

The authors recommend that to recover the huge investment in this pioneering and innovative but extremely risky project, both Systems, particularly System A must fully maximize their designed technical capacities. However, maximizing their individual capacities require a continuous and efficient solar power energy operation which involves managing the entire supply chain of the power plant.

But this raises the issue opined earlier that this function of power plant operation is not within the core competence of an HEI. In this regard, we recommend further to outsource this non-core function to enable HEIs to focus on its core functions. This strategy is consistent with the Private Partnership Program of the Department of Energy (DOE) designed for HEIs who intend to install solar power as an alternative source of energy.

The main lessons learned from these two cases are a) that it is extremely difficult for HEIs to find a balance in achieving the two-pronged objective of economic return and corporate social responsibility and; b) that although the financial objectives were not achieved, the moral impact it brought to the academic community in particular and to society in general, on the firm resolve and commitment of the leadership of the two institutions in addressing the environmental issues directly, faithful to the call of the Church as initiated by Pope Francis in his encyclical *Laudato Si* is a laudable act.

6. ACKNOWLEDGMENTS

The authors would like to acknowledge the support of the heads of the two institutions, including their technical and administrative staff in undertaking this case study.

7. REFERENCES

HIGHER SUCCESS RATE IN DEVELOPMENT AND SURVIVAL OF INNOVATION-DRIVEN START-UPS

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Abstract: The purpose of the paper is to contribute to increasing the success rate of innovation-driven start-up through their improved market-product fit and market-revenue fit by using a proven framework of start-up development. Therefore, factors of failure of innovation-driven start-ups are analysed first based mainly on the information from the US environment, with the highest level of support and coverage of start-ups in research and business practice. Then follows evaluation of selected frameworks for start-up development aimed at the best product-market fit and market-revenue fit under high level of uncertainty and analysis of the main factors of start-up failures and survival. The benefits of the Disciplined Entrepreneurship framework appear to meet the requirements stated above in an efficient manner in order to bring the desired results for start-ups.

Keywords: Innovation-driven start-up, start-up development framework, start-up failure, market-product fit.

1. INTRODUCTION
Innovation as an engine of development of start-ups is linked with high degree of uncertainty and risk about the product to be launched to the market, its potential customers, their purchasing power and their response to product growth in the market. Therefore, the concepts, tools and frameworks on start-up development aiming at reduction and control of these commercial and innovations risks are of great interest to both start-up founders and investors.

2. OBJECTIVES
Insufficient market-product fit and market-revenue fit of innovation-driven start-ups tend to be weaknesses of their development which increase the risk of their failure significantly. Therefore, first there will be analysed the factors of start-up failures. They can be reduced considerably by application of start-up design frameworks based on a scientific approach to start-up development stressing the need for validated learning. Consequently, selected current frameworks for start-up development under high level of uncertainty will be evaluated and application of the most suitable of them will be recommended to increase the survival and success rate of innovation-driven start-ups.

3. RESEARCH METHODOLOGY
The research will bear qualitative character dealing with the analysis of literature, surveys and statistical data on innovation-driven start-ups, their risk, failure and success factors and current development approaches to start-ups under conditions of an advanced economy with developed and well-structured start-up ecosystem.

4. START-UP DEFINITIONS
The essence of start-ups is generally related to the concepts of early stage of company
development, ambition, innovation, scalability, and growth. “Start-up is a temporary organisation built to search for answers to what makes a repeatable and scalable business model” (Blank – Dorf, 2012: 539). They distinguish small businesses usually without any scalable business model from scalable start-ups (technology entrepreneurship) and buyable start-ups built to be purchased by larger companies often to acquire talent as much as the business itself. P. Graham, founder of the start-up accelerator Y-Combinator, defines a start-up as follows: "A startup is a company designed to grow fast. Being newly founded does not in itself make a company a startup. Nor is it necessary for a startup to work on technology, or take venture funding, or have some sort of "exit." The only essential thing is growth. Everything else we associate with startups follows from growth...For a company to grow really big, it must (a) make something lots of people want, and (b) reach and serve all those people." (Graham, 2012). B. Aulet stresses five distinguishing features of an innovation-driven enterprise: focus on global or regional market, the source of its potential competitive advantage is some sort of innovation, jobs in the enterprise do not have to be performed locally, diverse ownership base including various external capital providers, enterprise starts at loss but if successful, it will achieve exponential growth (Aulet, 2013: 7).

By E. Ries a startup is "a human institution designed to deliver a new product or service under conditions of extreme uncertainty “ (Ries, 2011: 27). Summing up a startup may be defined as an early stage company designed to deliver new product or service, searching for a scalable business model fostering fast growth under conditions of extreme uncertainty. The size, sector or industry of this entity make no difference. Therefore, we shall not take into consideration definition attempts with some quantitative characteristics of start-ups, e.g. company actively striving for or avoiding IPO with less than 100 employees, annual revenue less than $50 million and worth less than $500 million (Wilhelm, 2014).

Main prerequisites of a successful start-up are: qualities of team members, quality of product or service developed and favourable market conditions for market launch of the product/service (scope of market demand and its validation, right timing of market launch, and other) as a result of application of deliberate start-up framework, as well as a stimulating startup culture. The common values recognized by start-up team members and qualities of their interrelations can contribute to startup development or eclipse (Zajko, 2013). A favourable start-up culture is characterized by the following attributes (Gottesmann, 2009):

1. evaluation of ideas by their qualities and not by their authors,
2. work in a startup is a mission not a job,
3. zero tolerance of mediocrity,
4. cost conscious attitudes to expenses,
5. equity-driven company strategy,
6. perfect allignment of company vision and strategy with roles and activities of team members,
7. open and clear communication in a team on strategy and hard issues, especially in bad times,
8. strong and positive team leader takes that responsibility seriously and leads by example,
9. mutual respect among the team members,
10. obsession for defining customer wants/needs, proactive learning and meeting customer needs,
11. high energy level in work, work is fun for team members,
12. honesty and integrity of team members.

5. START-UP FAILURES AND SURVIVAL

The consequences of the dot-com bubble in the USA (1997 – 2000), and widely accepted culture of giving entrepreneur the second chance as well as learning from failures have created interest in start-up failures research data. The failed start-ups survive for some time which complicates statistics. There are also different definitions of failure. If failure means liquidating all assets, with investors losing all
their money, an estimated 30% to 40% of high potential U.S. start-ups fail. If a failure is defined as failing to see the projected return on investment, e.g. a specific revenue growth rate or date to break even on cash flow - then more than 95% of start-ups fail. Enterprise failure/death requires an additional time lag compared to data on enterprise births due to the process of confirming the event. The common rule of thumb is that out of 10 start-ups, only three or four fail completely. Another three or four return the original investment, and one or two produce substantial returns. The National Venture Capital Association estimates that 25% to 30% of venture-backed businesses fail (Gage, 2012).

Table 1 Failures technology companies by sector (2010 -2013)

<table>
<thead>
<tr>
<th>Sector</th>
<th>(1) Internet</th>
<th>(2) Mobile &amp; Telecom</th>
<th>(3) Software</th>
<th>(4) Computer hardware &amp; Services</th>
<th>(5) Electronics</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>79%</td>
<td>6%</td>
<td>12%</td>
<td>3%</td>
<td>-</td>
</tr>
<tr>
<td>2011</td>
<td>76%</td>
<td>17%</td>
<td>3%</td>
<td>3%</td>
<td>-</td>
</tr>
<tr>
<td>2012</td>
<td>70%</td>
<td>27%</td>
<td>3%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2013</td>
<td>79%</td>
<td>15%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
</tr>
</tbody>
</table>

Source: (Gage, 2012), Note: (3) excludes (2)

According to the CBInsights survey of 146 start-up failures in the USA in the period 2010 to 2013 70% to 79% of all failed technology companies have been in the internet sector (Table 1). As for the technology start-ups a majority of funding and deals has gone to the internet sector and so it would follow that this sector would have the largest proportion of failed companies as well. The failure rate in the mobile sector was much lower but more volatile. The talents in these companies made them main target for acqui-hires\(^1\). Acqui-hired companies have typically raised less than $5 million and last raised a funding about 14-15 months before acquisition (CBInsights, 2014). Stoppage of investor funding is one of frequent reasons of start-up failures. 55% of failed start-ups raised $1M or less, 14% - $1 to $5M, 9% - $5 to $10M, and 8% - $10 to $25M. 71% of the failed companies lasted less than 2 years after their last funding round (CBInsights, 2015). While some companies can take up to 5 years after their last funding round to be officially declared a failure the average company dies about 20 months from its last funding round and after having raised $1.3 million. Subsectors with the highest failure rate were: social sector, marketplace, advertising, sales and marketing, music and video.

The main reasons of start-up failure (Swart, 2013; CBInsights, 2015) are the following:
1 Insufficient product market fit – 42% of start-ups from the CBInsights survey, e.g. due to - lack of product focus or efforts to meet and exceed customer expectations, - pivoting for different types of customers, neglecting of marketing, - insufficient market size for product adoption and exponential growth of sales, - insufficient validation of ideas/decisions of entrepreneurs with customers, especially with early adopters, premature product launch to market, 2 Running out of cash – 26% of of start-ups from the CBInsights survey, it stresses the need for the position of CFO and judicious financial planning, 3 Internal issues within the team of co-founders - 23% of start-ups from the CBInsights survey, 4 Ignoring the competition – 19% of of start-ups from the CBInsights survey, 5 Mistakes in pricing new product for market and costs – 18% of start-ups from the CBInsights survey,

\(^1\) The recent phenomenon of acqui-hire regards a struggling company (mostly an early stage startup) that is acquired primarily for talents of its team, not for its product.
6 Flaws in the business model for scaling up the business or no business model – 17% of start-ups from the CBInsights survey.

In general, companies without VC funding fail more often than venture-backed companies in the first four years of existence, typically because they do not have the capital to keep operating if the business model does not work. Venture-backed companies tend to fail following their fourth year after investors stop injecting more capital. Of all companies, about 60% of start-ups survive to age of three and roughly 35% survive to age of ten, according to separate studies by the U.S. Bureau of Labor Statistics and the Ewing Marion Kauffman Foundation, a nonprofit that promotes U.S. entrepreneurship (Gage, 2012).

6. START-UP DEVELOPMENT FRAMEWORKS

There are several approaches to start-up development, such as Agile Software Development (Beck, 2001; Larman, 2004), Business model design methodology (Osterwalder - Pigneur, 2010), Customer Development framework (Blank - Dorf, 2012), Lean start-up framework (Ries, 2011), Lean user interface design (Gothelf - Seiden, 2013), Disciplined Entrepreneurship (Aulet, 2013). These approaches have several intersections or complement each other.

Agile Software Development is an umbrella term for a set of methods and practices based on the four values and twelve principles expressed in the Agile Manifesto (Agile Alliance). It is an iterative and incremental approach to software development. It emphasises frequent interactions over extensive documentation and the ability to respond to changes in specification over the linearity of advancing a pre-negotiated plan. Solutions evolve through collaboration between self-organizing, cross-functional teams utilizing the appropriate practices for their context. It is perfectly suitable for situations where it is known what customers ultimately want, but where the team is unable to predict the best way to get there due to a lack of past experience in solving that problem.

User interface design is the design of hardware and software aiming at the most favourable user experience. It requires a good understanding of user needs and is related to agile product development. Lean user interface design is also referred to as Lean User Experience design. User experience (UX) means person's perceptions, emotions and attitudes about using a particular product or service. It is influenced by three factors: system, user and context of use and may change over time. Its distinguishing features are derived from the Lean UX Manifesto: 1) early user validation of his/her digital experience, 2) collaborative design, 3) solving user problems, 4) measuring KPIs, 5) applying appropriate tools, and 6) nimble design (Viviano, 2014).

The Business Model Canvas framework developed by A. Osterwalder is a strategic management and entrepreneurial tool that allows to describe, design, challenge, invent, and pivot business model for an emerging start-up. It is a flexible and efficient method of formulation, testing and verification of hypotheses on key components of a business model of a new business: customer value propositions, customer segments, customer relationships, distribution channels and revenue streams on one hand and its key partners, key activities, key resources and cost structure on the other hand. Thus it can replace the traditional, intricate and rigid business plan creation and helps organizations conduct structured, tangible, and strategic conversations around new businesses or existing ones. It is supported by an online application Strategyzer (available as mobile application as well) for users to build their own business model canvas.

The Customer Development framework was developed by S. Blank. It consists of two phases of the search for a business: Customer Discovery and Customer Validation, and two
phases of the growth of a business: Customer Creation and Company Building. It is executed by a small team led by founder and/or CEO. Each phase has a cyclic character, measurable milestones and can start after completion of the preceding phase only. Emphasize is on learning and discovery before execution. The first phase deals with formulation of hypotheses (on product, customer and problem, distribution and pricing, demand creation, market type and competition), their testing and verification. In the second phase there is stated customer value proposition, sales prepared and executed to the first customers - “early evangelists” and completed by validation of product, sales and channels roadmaps, business model. If this phase is successfully completed the phase three can continue: market analysis, market segmentation and positioning, creation of demand and product launch preparation. The final phase of company building comprises securing of mainstream customers, and creation of management, culture and functional departments. Key points of this framework are: 1) four phases of product and company growth, 2) learning about the customers by contacting them and listening to them, 3) definition of three basic market types for start-ups with specific challenges (creation of new market, launch of new product to existing market), and re-segmentation of existing market), 4) finding a Minimum Viable Product for a specified market, 5) validated learning and iteration of activities especially in the first two phases.

The leading framework for startup design appears to be the Lean Startup framework developed by E. Ries using everal key concepts of S. Blank. It leans on three pillars: 1) use of platforms enabled by open source and free software, 2) application of agile development methodologies which dramatically reduce waste and unlock creativity in product development, and 3) strict customer-centric rapid iteration, as exemplified by the Customer Development framework. It is not a defined set of steps. Its skeleton is the overall Build-Measure-Learn feedback loop complemented by the technique of Five Whys and concept of MVP. The first step is figuring out the problem that needs to be solved and then developing a MVP to begin the process of learning as quickly as possible. Once the MVP is established, a start-up can work on tuning the engine. This will involve measurement and learning and must include actionable metrics that can demonstrate cause and effect question. It provides a scientific approach to creating and managing startups and getting a desired product to customer faster. The Lean Startup methodology teaches how to steer a start-up, when to turn, and when to persevere-and grow a business with maximum acceleration. In 2012 E. Ries started editing the collection of books The Lean Series written by the best people in the field on topics that matter. He has also travelled extensively to promote the Lean Startup methodology at conferences, and lean startup meetups in cities around the world to build the Lean Startup Movement supported by the website www.leanstartup.com. Several prominent high-tech companies have begun to publicly employ the Lean Startup methodology. The Lean Startup principles are also taught in classes at Harvard Business School and UC Berkeley and are implemented in projects of municipal governments, e.g. Code for America.

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2 Minimum Viable Product (MVP) – the smallest set of product features that will elicit customer feedback. It illustrates the problem/need of a “core” customer and demonstrates the product’s solution.

3 This methodology deals with unknown problems with unknown solutions.

4 The "Five Whys"- asking simple questions to study and solve problems along the way. When this process of measuring and learning is done correctly, it will be clear that a company is either moving the drivers of the business model or not.
7. DISCIPLINED ENTREPRENEURSHIP FRAMEWORK

The Disciplined Entrepreneurship is further development of frameworks and concepts of E. Ries and S. Blank by the MIT Managing Director of Martin Center for MIT Entrepreneurship B. Aulet. It is as a roadmap with several iterative loops to guide founders of innovation-driven start-ups in the process of starting a new venture and increase their chances of survival and success by securing the best possible product-market fit at initial launch. It is in line with the statement of founder of Lotus Mitch Kapor quoted by Aulet: “Entrepreneurship is not only a mindset but also a skillset”. It consists of 24 steps related to six groups addressing the following topics:

1. Who is your customer? (6 steps),
2. What you can do for your customer? (5 steps),
3. How does your customer acquire your product? (3 steps),
4. How do you make money off your product? (4 steps),
5. How do you design and build your product? (4 steps),

The Group 1 starts with the Step 1 – Market segmentation. It identifies all potential markets to be narrowed down to the list of 6 to 10 particularly interesting ones. Each market should be characterised by the following categories: end users of product, use of the product by end user and end user benefit, lead customers, pluses and minuses of the market, possible partners and competitors on the market, market size and complementary assets required for end user to get full product functionality. Preferably it is based on primary market research involving direct talks to customers and their observation.

Step 2 – Selection of beachhead market is continuation of the segmentation process in order to focus at a well-defined and homogenous viable market opportunity. This is the first market new venture will be selling in. It is a significant learning experience for co-founders, so the beachhead market of smaller size will be a more suitable one. Focus is the keyword of this step.

Step 3 – Building an end user profile is a critical step in the analysis of target customer. It consists in further processing of primary market research to elaborate a detailed description of the end user using specific demographic features that is sufficient for calculation of the total addressable size of the selected beachhead market. It presumes that in general each customer consists of an end user and a decision-making unit (champion, primary economic buyer or influencer) where these entities need not necessarily be identical.

Step 4 – Calculation of total addressable size (TAM) for the beachhead market is based on the demographics from the end user profile and the market size calculated helps determine whether further market segmentation is needed. The TAM indicates the annual revenue for company if it achieves 100% market share. This analysis should be bottom-up (extrapolation from customers identified in the primary market research to the broader market) and validated by the top-down elaboration (from market analysis reports to the specific customers).

Step 5 – Detailed description of Persona consists in elaboration of profile of end user selected from one potential customer. The Persona fact sheet differs from the end user profile being a composite of target customers by representing an example/individual of a primary customer for the beachhead market, especially his/her purchasing priorities. All co-founders should be involved in this step to achieve alignment within the team. It may be the final step in customer identification unless there occurs the compelling need to revise it in the further steps. The better co-founders understand the needs, behaviour and motivations of their Persona, the more successful they will be at making their product and a new venture serving them.
Group 2 starts with the **Step 6 – Full life cycle use case** involving a detailed description how the Persona finds out about his/her unmet need, then finds a product, evaluates it, acquires it, uses it, gets value from it, pays for it, receives support for the product, and buys more and/or tells others about it. It may include a visual representation of this full life cycle. The key requirement of this step is looking at the product through the eyes of of the customer and not through the co-founders’ eyes.

**Step 7 – Creation of a high-level product specification** involves visual representation of a product (e.g. diagrams for hardware and storyboards for software) complemented by description of various product features, their translation into functions and the benefits customer will gain from each. It is a critical joint exercise of the founding team to resolve any disagreements and issues among them. The output of this step may take form of a marketing brochure of the product. It may also be shared with potential customers as validation of the business ideas. Keeping this specification high-level will save costs of this step and make further changes and refinements easier. This product specification will be gradually refined over the remaining 24 steps.

**Step 8 – Quantification of value proposition** should result in concrete understanding of benefits product will bring to the Persona (target customers) expressed in a metrics in line with his/her top priorities. It can be a comparison of the status quo without the product to be developed (using the Full life cycle use of the Step 6) to the anticipated state when customer is using the solution represented as clearly and simple as possible for evaluation of target customer. A visual, one-page diagram is the best output for the validation.

Group 1 ends with the **Step 9 – Identification of the next 10 customers.** It involves further high-potential customers meeting the end user profile (of the Step 5) besides the Persona to validate their similarity with it and their willingness to buy product. This can help strengthen the confidence of co-founders that the steps carried out up till this moment have been correct, that this business opportunity is scalable as well as their credibility with customers. In case of issues occurring in this step, it enables to go back, find out the flaws in the preceding steps and improve them before further progress. The level of detail of the customer feedback, even if it is negative may signal their interest in the product. The negative feedback is especially valuable. The output of this step helps significantly reduce the risk of a new venture and confirm the direction to success.

Group 2 continues with the **Step 10 – Define the core of your solution.** The core is what differentiates the product from those of the competitors and what is worth of continuous protection and further enhancement. This is an essential step to maximize the value of new venture. It is not an easy task and once co-founders agree on the core it should not change without a great deal of consideration. It must be done efficiently as well. It may involve going for a specific form of intellectual property rights (IPR). However, the effectiveness of the IPR depends considerably on the industry.

Group 2 concludes with the **Step 11 – Definition of the competitive position** which consists in drafting the chart of competitive position showing fulfilment of the Persona’s top two priorities by the product of new venture compared to that of competitors and to the customer’s status quo. It is the link between priorities of the core (Step 10) and Persona communicating the qualitative value proposition to target customer. The chart should be reviewed with the target customers for feedback and refined until it accurately describes its purpose. The best outcome is high fulfilment of both top priorities of the Persona. If it is not achieved the product should be reevaluated to improve the fulfilment of priorities or abandoned if the improvement is not
achievable. It is an efficient way of validation of product against the competition including the customer’s status quo.

Group 3 starts with the **Step 12 – Determination of customer’s decision-making unit (DMU)**. It analyses the details of decision-making powers and influences in the purchasing process of Persona and next 10 customers, in particular who has to be convinced that the product is worth acquiring. Understanding the DMU of target customer enables to determine how to develop, position and sell the product. The relationships within purchasing process may be mapped in a chart for clarity and reviewed with customers to get their feedback.

**Step 13 – Mapping the acquisition process of a paying customer** deepens the understanding of internal purchasing mechanisms of the target customer using the information on the Full life cycle use case (Step 6). It involves further details on how the DMU makes decisions, how long do purchasing steps take and hidden obstacles in the purchasing process. The estimates of the purchasing process should be conservative and validated.

**Step 14 – Calculation of the total addressable market size (TAM) for follow-on markets** is a quick validation if there are other similar markets for product sales (e.g. upselling or selling the same product to new „adjacent markets“) and calculation of their size. If the follow-on markets exist it increases the long-term potential for business which is of relevance for investors and founder team. The methodology used for the TAM calculation in the Step 4 can be used here as well. This step is a part of the Group 6.

Group 4 starts with the **Step 15 – Design of business model**. A business model is a framework by which the new venture extracts from its customers some portion of the value its product creates for them. It can be done by examining the business models used across industries and selecting a hybrid business model with respect to the specific conditions or by inventing a new model for the venture. The best option is a business model that distinguishes a venture from its competitors and can be source of advantage over them. It is a crucial decision worth the time and efforts of co-founders since it will determine the venture profitability measured by variables: the Lifetime Value of an Acquired Customer (LTV) and Cost of Customer Acquisition (COCA)\(^5\). It is very difficult to change the business model once the venture has established a customer base.

**Step 16 – Setting pricing framework** consists in usage of the quantified value proposition (Step 8) and business model (Step 14) to set out an appropriate pricing framework. It influences the profitability of venture and is necessary for calculation of the LTV and COCA in the following steps. Pricing may be seen as a compromise between achieving maximum revenue and pricing framework should be attracting maximum customers. It should be based rather on the value the customer gets from the product (quantified value proposition from the Step 8) than on the cost incurred. It should also take consideration of the DMU (Step 12) and acquisition process of a paying customer (Step 13) to identify price limits and differentiate the prices with respect to the specific customer segments\(^6\). Pricing should also be flexible with regard to the early testers and „lighthouse customers“\(^7\).

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\(^5\) The lifetime value of an acquired customer (LTV) and Cost of Customer Acquisition (COCA) is explained in the Steps 17 and 19.

\(^6\) G. Moore - five customer segments according to their response to a new product on the market:

- technological enthusiasts, early adopters, the early majority, the late majority, and laggards/skeptics.

\(^7\) Early testers collaborate with a venture in product improvement. „Lighthouse customers“ strongly influence the purchasing decisions of the others in an industry.
Step 17 – Calculation of the lifetime value (LTV) of an acquired customer. The LTV is the average profit provided by a new customer, discounted to reflect the high cost of acquiring capital that a startup faces, i.e. net present value of profits of a venture over a five-year period expressed in USD per customer. For each revenue stream will be used its gross margin and retention rate for individual years and the resulting profit will be discounted to get its present value. The present values of all annual profits will be added up to arrive at the LTV which can be then compared to the cost of customer acquisition (COCA). The ratio of these variables for a potential successful startup should be 3 to 1 or greater. It helps measure the long-term viability of a new venture.

Step 18 – Mapping out the sales process to acquire a customer is the final step of the Group 3. It deals with calculation of cost of sales process (sales channels) to gain a new customer. The sales process changes over time and therefore its short-term, medium-term and long-term analyses are required. The ultimate goal of this step is to establish an inexpensive long-term strategy of customer acquisition.

Step 19 – Calculation the cost of customer acquisition (COCA) is a logical follow-up of the Step 18 and at the same time the final step of the Group 4. The calculation should be carried out top-down: first to tabulate the aggregate sales and marketing expenses over a period of time and divide it by the number of new customers acquired during that period. It varies over time and therefore it should be calculated for five subsequent periods to be comparable with the LTV. The LTV and COCA analysis enable to identify financial problems of a new venture early in the process of its creation and later keep an optimal LTV to COCA ratio for it.

Group 5 starts with the Step 20 – Identification of key assumptions for correct operation of new venture is a step entrepreneurs tend to skip and rely on their intuition or previous market research. These assumptions are based on the primary market research and were made in the preceding steps of this framework, e.g. top priorities of Persona, customer value proposition, estimated gross margins, identification of the next 10 customers and their importance (interest of “lighthouse“ customers). These assumptions need to be broken down into specific narrow statements - hypotheses that can be empirically tested in the next step.

Step 21 – Testing of key assumptions consists in design and execution of empirical tests to validate the assumptions formulated in the previous step. The tests should be cheap and quick to execute (e.g. surveys, requests to vendors for quotations). The purpose of the testing is to decrease the risk of start-up.

Step 22 – Definition of minimum viable business product (MVBP). The MVBP is a combination of the most important key assumptions into one integrated product that can be sold thus enabling to test if customers will pay for the product. It represents a systems test of a product. It should meet the following three conditions: 1) customer gets value out of the use of product, 2) customer pays for the product, and 3) the product is sufficient to start customer feedback loop enabling iterative product improvements. It is a broader and more accurate concept than the Minimum Viable Product (MVP).

Group 5 ends with the Step 23 – Verification of interest of customer for minimum viable business product (MVBP). This step involves taking the MVBP to target customer to see if they will actually use and pay for the product. It includes data collection on this use and word of mouth regarding MVBP as well as their analysis to find trends and understand underlying drivers.

Group 6 ends with the Step 24 – Development of a product plan. The MVBP included only a minimum feature set of the product. The
product plan will be result of consideration which of the product features not included in the MVBP should be reincluded in the product meeting the Persona’s needs.

8. CONCLUSIONS
The Disciplined Entrepreneurship is an integrated framework that can be applied not only to software but also to hybrid innovations (hardware, processes and business models). It builds on the startup frameworks Lean Startup and Customer Development expanding it with the quantitative methods used in the Steps 4, 8, 14, 17 and 19, where the realistic calculations of LTV (step 17) and COCA (step 19) are of utmost importance for profitability of prospective venture. Further important distinguishing steps of this framework are: detailed description of Persona (Step 5), identification of the next 10 customers (Step 9), definition of the core of solution (Step 10), which should be reflected in design of business model (Step 15), formulation and testing of the key assumptions of new venture operation (Steps 20 and 21) as well as definition of MVBP and verification of customer interest for it. The framework is supported by the website with case studies and other resources, and a tool box. It is used by numerous start-ups, universities and corporations all over the world.

I conclude with two Aulet’s statements: “The world needs more and better entrepreneurs because our world’s problems are becoming more dire, complex and ubiquitous”, and “Knowledge doesn’t set you free, but action does” (Aulet, 2013:262).

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Abstract: Mathematics is one of the most important subjects most essential for life and society. Due to its vastness and abstract nature, teaching mathematics to the students always remained a challenging job. Over the years mathematics evolved in its natural way and accordingly mathematics teaching also taking a natural shape. But in the last few decades, with the advancement of technology and computers, mathematics is growing in an exponential rate. Day by day new topics are being added up and old methods get substantial facelift with the development of the new tools. In this scenario, teaching mathematics in conventional way not only make mathematics learning process slower, it also creating a gap between desired mathematical skill to actual mathematical skills among students globally. To fill up the gap between desired and actual mathematical skill and to teach mathematics in an easy, effective and faster way, a new method of teaching mathematics have been designed and developed. The new method of teaching mathematics has been developed by Chanchal Dass. The entire curriculum was designed and developed based on the philosophy that “I listen-I forget, I see-I remember, I do-I understand”. This philosophy is the central in the new Mathematics teaching technique. Another aim of the new system is to remove abstractness of mathematics. Every mathematical concept is being explained geometrically with geometrical meaning.

The innovator took advantage of matrix multiplication to explain how dynamism can be added to the abstract analytical methods. Here the innovator introduces the homogeneous coordinate system which helps in explaining many mathematical concepts behind the dynamic world. These ideas are the foundation of all the mathematical concepts in different topics and fields.

In this paper, an attempt has been made to explain the effectiveness of new mathematics teaching system over conventional methods and shows how this method can teach mathematics in an easy and enjoyable way within a short span of time.

Keywords: Mathematics, Innovator, Teaching, Abstract, Dynamism, Homogeneous Coordinates, Matrix, Geometrical Interpretation, Scaling, Shearing, Reflection, Rotation, Translations, Cartesian, Mentor.

1 INTRODUCTION:

Mathematics is a key subject required for everyday life. But teaching mathematics is a challenging job. Over the years mathematics is evolving - every now and then new theories and concepts are getting added with old ones. Science and technology is progressing rapidly. But mathematics teaching methods remained stagnant for years. Students still face huge problem to learn old concepts and theories. As a consequence, students are not even aware of the latest advancements of the mathematics. The objective of this paper is to present a new way teaching mathematics, so that students can able
to learn most of the advanced mathematics in a short span of time in an easy way.

2 OBJECTIVE AND SCOPE

Among the subjects being taught in schools and colleges, the students who like (leave- love) mathematics is few and far apart. This trend is not restricted to any community, province, country, continent, location, language or age. Mathematics over the decades has appeared to distinguish itself as one of the most dreaded and hated subjects. Why so? Is it because mathematics is a difficult, terrorized subject, or its structure is unfathomable, or very limited innovation has gone so far into making syllabus and curriculum adorable, or whether the problem lies in the format and style of teaching, or in all of these.

The most critical problem, however it is observed, has been that the current methods of teaching mathematics cannot engage the students with the subject. The system instead of widening the students’ thought process, narrowed down to few memorized limited algorithms and formulas. Instead of encouraging students to relate mathematics to the outside world, mathematics is being taught presently within the four-walls. The students are not told that everything happening inside and outside the school / college premises has something to do with mathematics. We as a humanity failed to realize that mathematics is essentially an outdoor subject. The result is no matter how aged a person is, mathematics seem overwhelming at times. Instead of learning easier and short-cut way to solve mathematical problems, we need to change our perspective on the subject.

In the present communication, I would discuss my effort in exploring a new applied way (easy and simple) of teaching mathematics that will engage students with the subject. The new system can accelerate the learning of mathematics and stop the current habit of memorizing mathematics. It is however agreed to the range of difficulty to change a well-settled system of math teaching running for centuries. Hence, we need to have patience in developing an all-weather art of teaching mathematics. Such a method must relate mathematics with the real and tangible world. Contrary to the present held believe that s/he who takes least time to answer a large multiplications are considered intelligent, the new system discourage memorization of basic multiplication also. More emphasis given on understanding the mathematical concepts rather than solving hundreds of problems.

Here, the first objective is to define mathematics and in doing so develop different tools and techniques to make mathematics easy to learn. Few of the most important tools that will be discussed first are drawing a point in excel, transforming the points through matrix multiplication, adding the slider to manipulate points, introduction of homogeneous coordinate system to capture the dynamic world behavior, etc. After the introduction of these tools and techniques, the next discussion will concentrate on the application of these tools in different fields and show how these tools help in explaining different concepts in linear algebra, calculus, vector algebra, complex analysis and other similar topics.

3. RESEARCH METHODOLOGY:

Main problem in teaching and learning mathematics is to decide from where to start. In schools and colleges, these are governed by the syllabus. It is expected that students learn specific topics in certain number of periods in certain duration at a particular standard. In this way we learn many mathematical topics during
our entire academic career. One of the major disadvantages of this system is that a student never get chance to integrate what he has learned throughout his academic career. The new mathematics teaching method teaches few tools and techniques which are being used to build mathematical models. With these tools students can explore any mathematical problem in any subject. Few of these tools and techniques are given below:

- Drawing a point in excel,
- Transforming the points through matrix multiplication,
- Adding the slider to change values,
- Introduction of homogeneous coordinate system to capture the dynamic world behavior,
- Interpolation of data points in between two values,
- Drawing a three dimensional object in two dimensional plane,
- Drawing a function of two variables for demonstration of partial derivatives and tangent planes.

### 3.1 Drawing a point in excel

Drawing a point in excel is easy. Let the point to be drawn in excel be P(3,5). To draw this point, first open an excel file. In the cell A1 write x and in the cell B1 write y. The x and y will be the column headings. Type 3 and 5 in cell A2 and B2 respectively. Put the cursor in any cell and click on the insert menu. From the chart tab panel, select insert scatter (x, y) or Bubble chart and from the drop down menu, select the option scatter with straight lines and marker chart. A chart as given in Figure-1 will appear.

![Figure-1: Drawing a point in excel](chart.png)

This will by default draw a line taking the value of cell A2 as first point and the value of cell B2 as second point. Delete the line by clicking on it and then pressing the delete button. Right click on the blank chart, then select the Select data from the drop down menu. A window named select data source will appear. Click on the Add button. Another window will open with title Edit series. Type the name of the chart as drawing my first point in Excel. A point will appear in the chart. To know the coordinates of this point, we will label the point. To label the point, right click on the point and select Add Data Labels from the drop down menu. The y value, which is 5 in this case, will appear beside the point. Right click on 5 and select Format Data Series from the drop down menu. Another window will open with label options. Tick in the Series Name, x value in the Label options window. The point (3, 5) with its labels will appear in the corner of the chart. Now click on the x-axis and right click. Select Format Axis from the drop down window. From the AXIS OPTION write 10 as maximum value. Similar operation is to be done to change the y-axis maximum to 10. The final chart is shown in Figure-2.
3.2 Transforming the points through matrix multiplication

Matrix Multiplication is a very important tool in modern day’s mathematics. Though matrix was introduced around 1860 by Arthur Caylay, it is taking center place in solving mathematical problems with the advancement of modern computer systems. Few of the points about matrix multiplication is given below:

- Rule: Number of columns of 1st matrix should be equal to number of rows of 2nd matrix.
- A 1x2 matrix forms when a 1x2 matrix is multiplied by a 2x2 matrix
- [x,y] is a row matrix represents a point. The [2x2] matrix is a transformation matrix.
- We are interested to know the effects of changes in individual elements of a transformation matrix on the resultant point.
- Matrix multiplication of a 1xn matrix by a nxn matrix results in a 1xn matrix
- Importance of Matrix Multiplications – it helps in transformations

Through these transformations, we can capture the dynamism around the world.

As mentioned earlier matrix multiplication is an easy process in excel. Let us multiply our given point P(3,4) by a 2x2 matrix \[
\begin{bmatrix}
1 & 4 \\
3 & 2
\end{bmatrix}
\]. In the excel worksheet, enter the values as shown in figure-3. The cells marked in x* and y* will be the output cell for the matrix multiplication.

For matrix multiplication, excel has a command *mmult*. Select the blank cells below x* and y*, i.e., at E2 and F2 and type = mmult (A2:B2, C2:D3). After entering the formula, press function key F2, and then press Ctrl+Shift+Enter. If the formula is not entered as an array formula, a single result will be returned in cell E2. If every data is entered properly, we will get the result as shown in figure-4.

The result of the matrix multiplication is P*(18,22). It can be said that by matrix multiplication, the point P(3,5) has been shifted to P*(18,22). By changing the values of the elements of the transformation matrix, we can transform the point P(3,5). The old
point and the new point are shown in the chart given in the figure-5.

**Figure-5: Graph showing the result of matrix multiplication**

![Graph showing the result of matrix multiplication](image)

### 3.3 Adding the slider to manipulate points

Now if I want to change the values of one of the elements of the transformation matrix, or I want to change the cell value then *scroll bar* or slider is a very good option. To add scroll bar in excel worksheet, we will be required to add *Developer* menu from the *excel options*. To add scroll bar follow the following sequence: *Developer*->*Insert*->*Scroll Bar (From Control)*, then click and drag. A scroll bar will appear in the worksheet. Here if we drag the scroll bar nothing will happen because we have not given any instruction to it to follow. To format the scroll bar, right click on it and select format control from the drop down menu. In the cell link, select cell whose value is required to be changed. A scroll bar is shown in Figure-6.

**Figure-6: Scroll bar**

![Scroll bar](image)

### 3.4 Introduction of homogeneous coordinate system to capture the dynamic world behavior:

We are living in a dynamic world where almost everything is moving. We do not have an easy way to handle these dynamisms. Homogeneous coordinate system gives us an easy way to capture this world dynamisms. All the dynamism around the world can be captured with six type of transformations as given below:

1) Scaling  
2) Reflection  
3) Shearing  
4) Rotation  
5) Translation  
6) Projection

With Cartesian coordinate system, a 2x2 matrix can help in scaling, reflection, shearing and rotation transformation but the translation and projection cannot be achieved. Homogeneous Coordinates help for complete transformations—Rotation, Scaling, Shear, Reflection, translations. Homogeneous coordinates also helps in shifting of origin.

The number of coordinates required in homogeneous coordinate system is, in general, one more than the dimension of the projective space being considered. For example, 3 homogeneous coordinates required to specify a point on a projective plane. 4 homogeneous coordinates are required to specify a point on a projective space and so on. The origin in homogeneous coordinate system in 2D is (0, 0, 1) and not (0, 0) or (0, 0, 0). If 2D cartesian coordinate is (x, y), corresponding homogeneous coordinate is (x, y, 1). As the point is (1x3) matrix, the transformation matrix is a 3x3 matrix. The last row of this transformation
matrix helps in translation and the last column of the transformation matrix helps in projection.

### 3.5 Interpolation of data points in between two values:

Frequently we are required to draw a line in between two points or select an interval in between two points in domain of a given function. In all these cases, interpolation helps and excel gives an easy option for this. Suppose we want to change a value from 2 to 5. This can be easily done with the introduction of a parameter, t. It is required that at start N should be 2 and at end N should be 5. It is achieved by the formula, \( N = N_{11} \times (1 - t) + N_{22} \times t \). The value of \( t \) varies from 0 to 1 in a regular interval, here it is 0.1. The data has been given in the table-1.

<table>
<thead>
<tr>
<th>t</th>
<th>( N_{11} = 2 \times (1 - t) )</th>
<th>( N_{22} = 5 \times t )</th>
<th>( N = N_{11} + N_{22} )</th>
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<tr>
<td>0.7</td>
<td>0.6</td>
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<tr>
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<tr>
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<td>0</td>
<td>5</td>
<td>5</td>
</tr>
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</table>

The graph of the interpolation data is shown in figure-7.

**Figure-7: Result of Interpolation from 2 to 5**

### 3.6 Drawing a three dimensional object in two dimensional plane:

We live in three dimensional world but every mathematical concepts are being explained in two dimensional plane. One of the main confusion or difficulty of learning mathematics lies here. If we have a tool to convert 3d objects to 2d objects, then understanding of mathematics will be very easy. One of the biggest problem is to accommodate the z-axis because 2d plane can accommodate only x and y coordinate. Homogeneous coordinate system gives us an easy way to convert 3d objects in 2d. A cube is shown in Figure-8.

**Figure-8: A 3d cube is shown in 2d plane**
Though it is a cube, it has been drawn in 2d plane. For creating an isometric view of the cube, we have to rotate the cube in y-direction first, then x direction and then project the same in z = 0 plane.

For doing this we have to create:
(i) Y – rotation matrix,
(ii) X – rotation matrix,
(iii) Z – projection matrix,
(iv) Multiply all these matrices to get the data for isometric view.

In this way a 3d object can be drawn easily in a 2d plane. This tool is very effective in describing problems related to calculus, algebra, trigonometry, vector algebra and many other fields.

3.7 Drawing a function of two variables for demonstration of partial derivatives and tangent planes

Another issue with the difficulty in learning mathematics is the problem in visualizing the functions of two or more variable. Actually it represents a surface. A quadratic surface with its tangent plane is shown in figure-9.

With the knowledge of homogeneous coordinate system, construction of these type of surfaces and its derivatives becomes very easy. These knowledge can be extended to understand the functions of several variables.

4. ANALYSIS PART AND FINDINGS:

The tools discussed above can be used for solving any mathematical problem. Here two examples are given for reference. The first one is the finding of volume of a solid by slicing method and the other one is the finding the volume of the solid of revolution by washer method. Once the students learn these tricks to mathematical model the complex mathematical concepts easily, they will not only confine to solve exam related problems, they will explore newer avenues in mathematics.

4.1 Finding volume of a sphere by slicing method:

Finding the volume of an irregular object is a very difficult task. But integration makes the calculation of the volume of an irregular object very easy. But understanding the concept in conventional way is very difficult. When we calculate in excel, then it becomes very easy to understand. For calculating the volume we first cut the solid into pieces. This is done by intersecting the solid with a plane. We calculate the area (A) of the cross section obtained by intersection. The cross section with infinitesimal thickness form a slice. Let the thickness of each slice be dx. Volume of individual slice is Adx and the total volume of the object can be given by:
\[ V = \sum A \, dx \]

Here, I have given a case of finding the volume of a sphere by slicing method. If we consider the sphere placed at the center, then the plane \( P \) intersects the sphere in a circle whose radius can be given as:

\[ y = \sqrt{r^2 - x^2} \]

Hence,

Cross sectional area = \( \pi y^2 = \pi (\sqrt{r^2 - x^2})^2 = \pi (r^2 - x^2) \)

And the volume of the sphere will be:

\[ V = \int_{-r}^{r} A \, dx = \int_{-r}^{r} \pi (r^2 - x^2) \, dx \]

\[ = 2\pi \int_{0}^{r} (r^2 - x^2) \, dx \]

\[ \Rightarrow V = 2\pi \left[ r^2 x - \frac{x^3}{3} \right]_{0}^{r} = 2\pi \left[ r^3 - \frac{r^3}{3} \right] \]

\[ = 2\pi \left[ \frac{2r^3}{3} \right] \]

\[ \Rightarrow V = \frac{4}{3}\pi r^3 \]

The same procedure has been demonstration in excel and shown in Figure-9:

Steps followed:
1. Creating a bounding box
2. Creating a circle in x y plane representing the sphere
3. Projecting the box and circle in z plane after rotating them in x, y, z plane for visualization in 3d
4. Creating a circle representing the slice in y-z plane

**Figure-9: Demonstration of calculating volume of solid by slicing**

4.2 Volume of Solids of Revolution by Washer Method:

Sometimes the solids of revolution is formed by two intersecting lines as shown in figure-10.

**Figure-10: Solid of revolution**

The volume of the solid formed by rotation of two intersecting curves and cross sectional area shown at dotted line in figure-10.

Let the curves be \( y = x \) and \( y = x^2 \). The region formed by the curves are rotated about x axis and formed the solid. The cross sectional area = \( \pi (r^2_2 - r^2_1) = \pi (x^2 - x^4) \)
\[ V = \int_{0}^{1} A(x) \, dx = \int_{0}^{1} \pi (x^2 - x^4) \, dx \]

\[ = \pi \left[ \frac{x^3}{3} - \frac{x^5}{5} \right]_{0}^{1} = \frac{2\pi}{15} \]

This type of problem is solved by washer method. The construction of the solid in excel is demonstrated in the following steps:

1. **Step-1:** First we find the inner and outer radius.
2. **Step-2:** Calculate the area of washer as \( \pi (r_2^2 - r_1^2) \)
3. **Step-3:** Calculate the volume of washer as \( \pi (r_2^2 - r_1^2) \, dx \)
4. **Step-4:** Sum the volumes.

The resultant graph is shown in figure-11.

**Figure-11: Demonstration of solid of revolution by washer method**

These are the two examples where a student can develop the mathematical models without having any knowledge of computer programming. Any mathematical model can be built in excel with very limited but effective tools. This is the key to the new mathematics teaching system. Once a student get hold of these tools, he can apply it to model any mathematical model related to science, engineering, technology or any other field.

5. **CONCLUSIONS:**

We all have heard the popular phrase, “necessity is the mother of invention.” In conventional methods of mathematics teaching, we all focus on the inventions, but we never give enough emphasis to the necessity that led to those inventions. That is the reason why, in my experience, the conventional classroom and bookish teaching of mathematics fails to allure the students towards mathematics, because they never truly contemplate the importance of the thing being taught and unable to reproduce the concepts in any form.

Hence in this paper, I approach all those important tools and techniques required for handling latest advancements in the mathematics and related subjects. As mentioned in the introduction, entire teaching methodology has been developed on the philosophy of “I do, I understand”. Earlier there were no tools available for doing mathematics. In this paper we have described few tools with which students can do mathematics easily. These are so effective tools that with these tools students can penetrate any mathematical topic, whether it is in engineering, science or economics or any other branch. This can be a game changer in the field of teaching mathematics.

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- Dr P L Salinkar, Alumni, Indian Institute of Technology, Mumbai.
GLOBAL COUNTRY STUDY REPORT (GCSR): AN INNOVATIVE APPROACH TO STRENGTHEN MANAGEMENT PROGRAM OFFERED BY GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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Abstract: Innovations are not limited to the field of Engineering. One stepping stone of novelty has power to change the entire world. Management education in India is struggling to achieve the required status and rank in top B-schools of the world. ‘Asia 2050: Realizing the Asian Century’ report proposes that Asia would account for greater than half of global Gross Domestic Product (GDP) by 2050. Looking at the contribution of Indian economy in global GDP, management gurus are constantly working to strengthen MBA program. Gujarat Technological University has introduced a new concept and proved that Management education can also be transformed through innovations. This research paper analyzes the need of ‘Global Country Study Program’ in management education and innovative methodology adopted by Gujarat Technological University in GCSR. Our analysis suggest that India can reap rich dividends in terms of increased foreign trade and providing global platform to local manufacturing units by adopting innovative methodology of including Global Country Study Report (GCSR) in Management education.

Keywords: Global Country Study Report, GCSR, Management Program, MBA, GTU

1. INTRODUCTION

India, with over 1.2 billion people, is the most populous democracy in the world. Bounded by the Indian Ocean on the south, the Arabian Sea on the south-west, and the Bay of Bengal on the south-east, India shares its political borders with Pakistan and Afghanistan on the west; Bangladesh and Myanmar on the east; the northern boundary is made up of the Sinkiang province of China, Tibet, Nepal and Bhutan. Trading across borders is an opportunity for India as it is surrounded by sea from three sides.

1.1 Overview of MSME:

Micro, Small and Medium Enterprises (MSME) sector has emerged as a highly vibrant and dynamic sector of the Indian economy over the last five decades. MSMEs not only play crucial role in providing large employment opportunities at comparatively lower capital cost than large industries but also help in industrialization of rural & backward areas, thereby, reducing regional imbalances, assuring more equitable distribution of national income and wealth. MSMEs are complementary to large industries as ancillary units and this sector contributes enormously to the socio-economic development of the country.
The Sector consisting of 36 million units provides employment to over 80 million persons. The Sector through more than 6,000 products contributes about 8% to GDP besides 45% to the total manufacturing output and 40% to the exports from the country. The MSME sector has the potential to spread industrial growth across the country and can be a major partner in the process of inclusive growth.

1.2 Prospects of international trade
International trade has been increasing and most of the fast growing economies in the last decade have seen marked growths in total exports and imports. It is generally accepted that trade leads to structural transformation and diversification of economies. The evolution of Indian export diversification is in line with global patterns of economic transformation. As countries develop they become less specialized and more diversified in terms of output, trade and employment.

### Total Trade: Top countries (Year: 2015-2016 Apr-Nov)

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<td>42,321.16</td>
</tr>
<tr>
<td>22</td>
<td>THAILAND</td>
<td>12,570.92</td>
<td>24,495.69</td>
<td>37,066.61</td>
</tr>
<tr>
<td>23</td>
<td>ITALY</td>
<td>17,416.03</td>
<td>17,617.39</td>
<td>35,033.42</td>
</tr>
<tr>
<td>24</td>
<td>VIETNAM SOC REP</td>
<td>21,846.92</td>
<td>11,111.53</td>
<td>32,958.83</td>
</tr>
<tr>
<td>25</td>
<td>FRANCE</td>
<td>19,673.39</td>
<td>12,281.19</td>
<td>31,954.58</td>
</tr>
</tbody>
</table>

Total of Top countries = 51,188.26 + 1,227,882.41 = 1,279,070.67

India’s Total = 1,112,616.27 + 1,683,650.83 = 2,796,267.10

% Share of Top countries = 67.52/77.87 = 74.47

Source: [http://www.commerce.nic.in/eidb/iecnttopn.asp](http://www.commerce.nic.in/eidb/iecnttopn.asp)

From the above table it is clear that India is engaged in trading with almost all countries. These transactions can be done optimally if we have knowledge of all environmental factors affecting industry of that particular country.
1.3 Structure of Global Management Program at Gujarat Technological University (GTU)

**Fig1: Structure of Global MBA program at Gujarat Technological University**

1.3.1 Global Country Study Report (GCSR)
Looking at the prospects of globalization, GTU has introduced the Global MBA program in August 2011. In order to be useful for ‘Global Economy’ of today, every MBA student is required to study, for two semesters, the culture, geography and business environment of one country, with a focus on Asia and Africa.

The two-semester course of Global Country Study Report has been introduced at the 3rd and the 4th semesters in MBA program and the students are encouraged to establish contacts with businesses and scholars in the country, which they are studying. Under this Global Country Study Report (GCSR) Program, a class of 60 students is required to study one country. GCSR program is, by far, the largest such program of any University.

1.3.2 International Experience Program
International Experience Program (IEP) is another unique initiative under global MBA program. GTU has signed the MOU with some renowned universities like, University of Alberta and Laurentian University (LU), Canada; Kansas State University, USA; and University of Wismar and DHBW Stuttgart, Germany. GTU arranges the student exchange programs and Summer Internship Programs (SIP) since 2011 for its students where the students visit the above universities in the semester gap and studies the various subjects of their respective courses. More than 800 students from various branches of Management, Engineering and Pharmacy have participated in Summer Internship program till now from 2011.

1.3.3 Indo-German, Indo-Canadian and Indo-East Asian Study Centre
Under Global Management Program, Indo-German, Indo-Canadian and Indo-East Asian Study Centres have been established which promote research work.

1.3.4 Foreign University Partners
Gujarat Technological University has established associations with 27 foreign universities through MOUs for exchange of students and joint research programs.

**Table 1**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Academic Year</th>
<th>No. of Countries Studied</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2011-12</td>
<td>48</td>
</tr>
<tr>
<td>2</td>
<td>2012-13</td>
<td>96</td>
</tr>
<tr>
<td>3</td>
<td>2013-14</td>
<td>109</td>
</tr>
<tr>
<td>4</td>
<td>2014-15</td>
<td>110</td>
</tr>
<tr>
<td>5</td>
<td>2015-16</td>
<td>103</td>
</tr>
</tbody>
</table>
1.3.5 International Students at GTU
GTU has enrolled around 300 international students from more than 30 countries sponsored by Indian Council for Cultural Relations (ICCR).

1.3.6 International Co-Supervisors in GTU’s Doctoral Program
GTU has a robust Doctorate program across the branches of Management, Engineering and Pharmacy. Under the International Doctoral Co-Supervisors Program, GTU has appointed more than 68 co-supervisors from esteemed international universities across the world.

2. LITERATURE REVIEW
The country studies chair was established at the Institute of international relations, Ukraine in 2003. The establishment was a result of introduction of regional studies specialization on “International Relations” division and a manifestation of preparation for introducing the educational specialty “Country Studies” at the Institute. The institute is offering course on “Country Studies: Asia, Africa, Latin America”. The course explores geographical location, climatic conditions, mineral resources, ethnic composition of the population, specialties of the cultural and historical development of legal systems, political systems, economic complex, foreign policy of Asian, African and Latin American states, as well as Ukraine's relations with these countries.

2.1 Need / Scope of the Study
Various management institutes are offering international business as one of the subjects in MBA curriculum. As far as country study program is concerned, research shows that Institute of international relations, Ukraine is offering course on “Country Studies: Asia, Africa, Latin America” and it is not being offered by any Indian university except Gujarat Technological University. GTU has taken this initiative to introduce GCSR program so researchers have tried to understand the need of ‘Global Country Study Program’ in Management education and how innovative approaches are valuable in successful implementation of GCSR.

3. RESEARCH METHODOLOGY
Research has been conducted on the basis of secondary data.

3.1 Research Questions
1. What is the need of ‘Global Country Study Program’ in Management education?
2. How Innovative approach is beneficial in successful implementation of GCSR?

3.2 Research Objectives
1. To analyze the prospects of international trade.
2. To study the concept of Global Country Study Program.
3. To identify the innovative practices implemented in GCSR.
4. To know the implication of GCSR program.

4. INNOVATIVE PRACTICES IMPLEMENTED IN GCSR:

4.1 National Day Celebration (NDC)
CGBS has started a unique and one of its kind activities called National Day Celebration (NDC) at university campus with the objective of making the GCSR program more efficient and interesting. Under this exclusive program, National Days of 68 countries have been celebrated from August 2013 to January 2016.

Key objectives of NDC
• To enhance the overall involvement of the students with the selected GCSR country.
• To strengthen the network among students, professors and other stakeholders with the selected country.
• To demonstrate and uphold the national pride and fellowship.
• To discuss the environmental factors for exploring the business opportunities with the Selected GCSR Country.
• To provide the platform to the faculties / students to interact with the diplomats / corporate leaders / Entrepreneurs of selected country.

4.2 Industry Internship:
It is mandatory to visit local company (1-2 week) during gap of semester III and semester IV.

4.3 Country visit:
GCSR program also encourage to visit the country during the two weeks of vacation between the 3rd and the 4th semester.

4.4 Afro Asian Conclave:
Every year GTU organizes Afro Asian Conclave where students and faculty members interact with Ambassadors/ Industry Experts of Afro Asian countries. Till now three such events have been organized.

4.5 Global Study News Network (GSNN):
GTU publishes news and current information of 7 regions of the world in E-Newsletter.

5. IMPLICATIONS OF GCSR PROJECT
Global Country Study project can be useful in many ways for all. Industries may get specialist in the form of GCSR experts on particular country and simultaneously students may get exposure in terms of working with industries which are interested in expanding their business globally. Few other benefits can be observed as
• Increased Job opportunity
• Developing Entrepreneurship Skills
• Help in setting up new business
• Promotion of ‘Make in India’ concept
• Expanding the horizons of SME/ MSMEs

• Building trade relations with foreign countries
• Enriching the value of goods and services
• Exporting the Indian products in the selected country
• Contribution in GDP in terms of increasing bilateral trade
• Consultancy work for selected country
• USP of Global MBA Program
• Faculty members and students can be a part of ‘Knowledge Economy’
• Reports are resource for country

6. CONCLUSION
Trade with foreign countries cannot be done blindly. We must have complete set of knowledge for developing fruitful business relations all over the world. Ease of doing business ranking differ from country to country because political, social, demographic, geographic location, technological advancement adopted by any country, ethical values and economic condition of the country are some important environmental factors which we cannot ignore. So it is the need of the hour to understand the environment factors of other countries. Looking at the need of today’s trade scenario, Gujarat Technological University has taken lead by introducing Global Country Study Report (GCSR) in the MBA curriculum and faculty members along with students are getting training and becoming expert in one country. Learning process does not stop here as they also learn how to study a country. Apart from creating knowledge hub of country experts, innovative practices adopted by Centre for Global Business Studies (CGBS) are also exclusive in nature and can be replicated anywhere in the world for better guidance to students. Successful implementation of GCSR is a motivating fact and true conversion of vision into reality.
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Abstract: This study assessed the determinants of faculty research productivity in Augustinian higher education institutions (HEIs) in Luzon. Findings of the study suggest that there is still a need for Augustinian HEIs in Luzon to further advance the faculty members’ educational experiences and background in research particularly in giving exposures to current professional literature and in the dissemination of research findings. Majority of the higher education faculty of Augustinian higher education institutions has recognized the value of scholarship as shown by their interest in doing research and taking small steps in attaining real work of research scholar. The findings of the study indicate that there is so much that can be desired in terms of improving the research productivity of the faculty members of Augustinian schools. Faculty research productivity in Augustinian HEIs in Luzon is significantly influenced by the extent of research promotion of institutions in terms of improving the research environment and providing mentors’ assistance. Augustinian schools may look into problems and issues related to research publications and productivity such as budget availability, IT infrastructure support mechanism and manpower training and development.

Keywords: Research productivity, faculty, nucleus, determinants, Augustinian universities

1. INTRODUCTION

The National Higher Education Research Agenda (NHERA; 2007) serves as a guide in managing researches of higher education in the Philippines. The ultimate goal is to propel higher education to produce a high level of human resource that is trained, developed and competitive to the global arena. It has been the national policy of CHED to enhance research in the Philippines. Research as required by CHED is among the three primary functions of all Higher Education Institutions (HEIs). Research productivity is also used as a criterion for university status, center of excellence, autonomous/deregulated status, institutional quality, and opening of graduate programs. (CHED Memorandum Order No. 25, Series of 1998, Priority Research Areas). In 2005, Hadjinicola and Soteriou identified the presence of research center as the vital arm of the school in improving research productivity of faculty members. The quality and production of faculty research are significantly influenced by the existence of external funding and higher academic achievement of a faculty member. External funding necessitates the researcher to come up with a quality and relevant research proposals for funding. These expectations on researchers result in the production of more and better quality publications. It was found out by Kurtz et al (2004) that quality of training on research given by the school determines the academic research productivity of a faculty member. They further opined those faculty members who have more administrative duties could not allocate the amount of time they desired to accomplish research endeavor. Betsey (2007) added
that faculty members become less research productive because of too much time is being allocated to teaching. The National Action Agenda for Productivity (NHERA: 2007) identified the issues which are still needed to be addressed namely: slow transfer of and poor access to technologies due to lack of appropriate and affordable inputs, inadequate public information education and campaign on research results, low rate of public investments in R & D, inequitable allocation of fund and weak linkages and coordination among HEIs. This paper intends to assess the determinants of faculty research productivity, which is considered as the nucleus of Augustinian Universities.

2. OBJECTIVES
The main objective of the study is to evaluate the determinants of faculty research productivity in Augustinian Higher Education Institutions (HEIs). Specifically, the study sought to find out whether the institutions’ efforts in improving researchers’ capacity, providing mentors’ assistance, and promotion of research environment have been significantly contributing faculty research productivity.

3. RESEARCH METHODOLOGY

3.1 Design
The researcher utilized the descriptive correlational method of research. The interest is examining the extent of promotion of research in Augustinian higher education institutions in Luzon, as determinants of faculty research productivity.
A validated semi-structured questionnaire was used as a primary data gathering tool. Documentary analysis was also used extensively in determining the level of research productivity of Augustinian HEIs in Luzon. The extent to which research productivity is being promoted in Augustinian HEIs was identified in the light of the institutions’ efforts to improve researchers’ capacity, providing mentors’ assistance, and promotion of the research environment.

3.2 Respondents
The respondents of the study were the faculty members of Augustinian higher education institutions in Luzon who were purposively selected based on the following inclusion criteria: (1) Full-time faculty member; (2) teaching in the college level; and (3) have at least three years of service in the institution. Using the criteria, a total number of 91 full-time faculty members in the seven Augustinian HEIs were made part of the study namely: La Consolacion College Caloocan (10), La Consolacion College Manila (22), La Consolacion College Novaliches (10), La Consolacion College Pasig (8), La Consolacion College Batangas (6), La Consolacion College Valenzuela (5), and La Consolacion University Philippines (30).

3.3 Scales and measures
The instrument used was composed of two parts. The first part elicited information on the extent of research promotion in Augustinian higher education institutions (HEIs) in Luzon, in terms of improving researchers’ capacity, providing mentors’ assistance, and promotion of research the environment. Part two of the instrument assessed the research productivity of full-time faculty members of the institutions.
The Content Validity Procedure was utilized in validating the instrument. The experts invited were (a) a long time research director experienced in managing the institutional and consortium research; (b) a President in one of the universities in Bulacan who is actively involved in research management; and (c) a research director and graduate school professor handling research in educational management.
3.4 Data analysis
The data collected were tabulated and processed using Statistical Packages for the Social Sciences.

4. LITERATURE REVIEW
As a study that hopes to contribute in improving the research productivity of Augustinian Higher Education Institutions, this research anchors its conceptual model on the framework of the National Higher Research Agenda in Higher Education (NHERA: 2016-2020). NHERA shall serve as a guide for CHED to manage all related researches in higher education as well as serve as a guidepost for the whole higher education community. It envisions that higher education shall have generated discovered and extended knowledge useful to education business industry and others and shall have developed a research culture supportive of sustained development and globally economic growth of the country. Indeed, the vision of NHERA seeks to bring out improvement in instruction and extension work in the pursuit of knowledge useful for survival in the next century’ (NHERA:2015).

4.1 Improving researcher’s capacity
The University of the Philippines has recently been mandated as the National University. This is timely in view of the significant improvement in its research performance in recent years. To function truly as such, it has to develop into a research university, the first to become one in the country. This would require some changes in faculty recruitment, in performance evaluation, and in academic programs. The principal criterion of faculty recruitment and promotion is research productivity. Valid publication is the main basis of rating qualification and performance rather than possession of an advanced degree by the applicant or the personal judgment of unpublished members of search committees. Emphasis of the university is graduate education, where at least one valid publication is the requirement for a doctoral degree. (Lacanilao: 2009)

To achieve such goal, improving researcher’s capacity is accomplished by the Augustinian schools through advancing faculty member’s educational experience and research background, uplifting researcher’s cognitive competencies, technical skills, and activating characteristics.

4.2 Providing mentor’s assistance
A mentor is someone who has experience with the challenges that trainees face, the ability to communicate that experience, and the willingness to do so. A mentor takes a special interest in helping another person develop into a successful professional. One crucial role for a mentor is to assist the trainee in understanding and adhering to the standards of conduct within his or her profession. Within a small research group, this can often happen through example, impromptu counsel, and the free-flowing exchange of thoughts and ideas. Today many research groups are too large or competitive for this to occur. Whether or not this change in scale has impeded the extent to which new scientists become aware of prevailing standards of conduct, it appears that issues of responsible conduct are not discussed frequently enough. The provision of mentors’ assistance includes research conceptualization, data gathering, data analysis and interpretation, preparation of the research report, and other assistance. (LCUP Manual, 2011)

4.3 Promotion of research environment
According to Clemena and Acosta (2006), a supportive research environment is indicated by the presence of the following:

Institutional research policies and agenda. This includes the presence of the research agenda based on the institution’s philosophy goals, mission and vision, as well as its
research emphasis and strategies for supporting and promoting research.

Departmental culture and working conditions. This refers to departmental research programs and strategies designed to encourage and sustain research productivity among the faculty (full time and part-time) and graduate students.

Budget for research. This pertains to the funds allotted by the institution for research. This also takes into account the ability of the institution and its departments to tap external sources (e.g., international donor agencies, non-profit organizations, industry) and obtain research grants.

Infrastructure. This includes the provision of a research unit, adequate research services, and facilities in different disciplines for the conduct of research.

Collaboration with and access to research professionals in other institutions. This refers to the ability to provide means for linkages with other institutions, local or international, in order to create intellectual synergy.

Policies and guidelines on research benefits and incentives. This pertains to rules and procedures on the granting of financial and nonfinancial (e.g. professional recognition) rewards for research.

Research committee. This refers to the research monitoring body that screens the types of research conducted and looks into ethical dilemmas involved, especially in sensitive fields.

Publications. This consists of the quality and quantity of research produced by the faculty members. This is evident in the number of published researches in local and international journals, awards attained by faculty, and patents, among others.

5. ANALYSIS

5.1 Improving researchers’ capacity

The Augustinian HEIs exert deliberate effort to advance faculty members’ educational experience and background through seven different indicators: (1) sending faculty members to seminars, workshops, conferences on research [3.61], (2) encouraging faculty members to become active members in research/professional organization [3.83], (3) requiring research appropriateness of major field of specialization [3.73], (4) supporting/motivating faculty members to publish their research outputs [3.51], and (5) promoting consistency in demonstrating professional integrity [3.64], (6) disseminating current researches and literature specific to the researcher’s field [3.33] and (7) encouraging the faculty members to seek reviews of current professional literature [3.43].

It may be implied from the data that there is still a need for Augustinian HEIs to further advance the faculty members’ educational experiences and background in research particularly in giving exposures to current professional literature and in the dissemination of research findings. This may be done by instituting research trainings that will enhance the faculty members’ capacity in conducting a review of current professional literature. The institution may send faculty members to research workshops that will motivate them to publish their research outputs in refereed journals.

Williams et al., (2007) believe that given the right nurturing, many people can become highly productive researchers. Research excellence comes by relentlessly training oneself in the right conditions. With this model, it could be far more economical to grow many different highly productive researchers. The result of the study suggests
the Augustinian HEIs exertion to uplift researchers’ cognitive competencies was to a great extent manifested by the (1) faculty members’ functional knowledge of the research process [3.68], (2) knowledge of area of the research content [3.59], (3) knowledge of methodologies [3.57], and (4) knowledge of existing literature of the problem [3.51]. Meanwhile, moderate extent of promotion was recorded as evidenced by the (5) faculty members’ working knowledge of statistics [3.30], (6) awareness of current literature in his field [3.35], and (7) knowledge of resources supportive of research linkages [3.17], and (8) scholarship of thesis [2.92]. This means that the provision for research promotion in these institutions is adequate and is functioning well.

In the words of Levine (Williams et al., 2007), faculty members with longstanding success or integrity in research are often admired by other faculty and students as being on the cutting edge of their career and are regarded as knowledgeable about most issues in their field. These faculty members are seen as more powerful educators and often serve as a frame of reference for junior faculty members or others who are developing their own research agenda.

In terms of the institutions extent of honing the researchers’ technical skill, great extent of promotion was noted as evidenced by the faculty members’ (1) familiarity with the use and resources of the library [3.81], (2) familiarity with standards, format and technical writing style, including organization [3.51], (3) documentation [3.5] and (4) style of writing [3.5]. Moderate extent of promotion was recorded in honing the faculty members’ (5) ability to choose correct words and organization of ideas [3.49], (6) skillfully selecting statistical design appropriate to the problem [3.32], (7) show clarity of computational aspect of the problem [3.07], and (8) exhibit knowledge in the use of research design, techniques, and measuring devices [3.24].

The extent of the institution research promotion in terms of developing the researchers’ activating characteristics was to a great extent as shown by the faculty members’ (1) patience and perseverance [3.61], (2) real concern for research [3.5], (3) intellectual honesty [3.56], (4) professionalism in his dealings [3.58], and (5) constructiveness of his criticism [3.68]. Moderate extent of promotion was evident in the following activating characteristics of the faculty members’ (6) commitment to scholarship [3.33], (7) alertness/enthusiasm [3.42], (8) regularity in monitoring his own progress [3.40], (9) willingness to go out of his way when needed [3.38], and (10) promptness with scheduled meetings [3.40].

This means that Augustinian HEIs with noted low extent of research promotion in terms of improving the researcher capacity may consider developing research programs that will further improve the faculty members’ capacity to do research and programs that will enhance the abilities of individuals, organizations and systems to undertake and disseminate high quality research efficiently and effectively.

5.2 Providing mentors’ assistance

The research promotion in terms of providing assistance in research conceptualization was perceived to a great extent as shown by the mentors’ care in going over the research title, major and specific problems, theoretical and conceptual frameworks, and methodology of the study submitted by the faculty member (3.52). This finding indicates that research promotion is moderately extensive and functioning very well. Moreover, moderate extent of mentors’ support was perceived in terms of giving assistance to researchers in the improvement of the research paper (3.49) and planning the time table of the research study with the faculty member (3.40).
finding indicates that research promotion is adequate and functioning well.

The study also revealed that adequate provision for research promotion functions very well in terms of data gathering support. This was shown by the obtained mean values in monitoring and supervising of data gathering (3.28), providing guidance in the editing, coding, and collating of data (3.32), and clarifying the proper statistical treatment for the data gathered (3.28). Data gathering is followed by data analysis and interpretation. Moderate extent of mentors’ assistance was recorded in offering guidance in the methodology of analysis (3.43) and directing in the mechanics of interpretation (3.36).

With regard to assistance in the preparation of the research report, direction in the use of proper style and format of the research report (3.33), regularity in checking the researcher’s progress (3.39), professionalism in giving critique (3.25), judicious examination of the research paper submitted by the faculty member (3.24), and encouraging faculty members’ independence in the process of writing the research paper (3.33) respectively, were provided by the mentor to a moderate extent which means that research promotion is adequate and functioning well.

Likewise, research promotion is adequate and functioning well in the provision of other assistance in the Augustinian HEIs. This was evidenced by the obtained mean values in correcting errors in grammar, spelling, and mechanics (3.37), writing with regard to proper style and format (3.37), correcting organization of ideas (3.23), providing assistance on the statistical aspect of the research design (3.18), supervising in the processing of data (3.16), and judiciousness in the certification to the readiness of the write-up (3.23).

Although mentoring alone may be insufficient, it is essential to promote a positive attitude and understanding of the responsible conduct of research. Mentoring is a shared professional responsibility of all the researchers in the institution. The enterprise of science depends on effective communication, not just about science, but about the practice of science, standards of conduct, and ethical and social responsibility. Taking an active role in helping to train the next generation of scientists should not be optional. Scientific trainees have a complementary responsibility to take an active role in their own development and seek mentors.

5.3 Promotion of research environment

With regard to the institutions’ extent of promotion of the research environment, research promotion was perceived to be very extensive and functioning excellently in developing a research agenda based on the institution’s philosophy, goals, mission and vision, as well as research emphasis and strategies for supporting and promoting research (3.57).

Also, research promotion of Augustinian HEIs was moderately extensive and functioning very well as shown by the following indicators: the departmental research programs and strategies are designed to encourage and sustain research productivity among the full-time and part-time faculty members (3.41), the institution develops and maintains a distinctive culture, positive group climate, decentralized organization, participative governance, and frequent communication that would enhance research among faculty members (3.42), the institution provides training and exposure to research in order to build research capacity among the faculty members (3.23), research capability is one of the criteria for recruitment and promotion of a faculty member (3.14), the institution allocates adequate funds for
research (2.96), and the institution looks for external sources and obtains research grants (2.95).

The study also revealed that research promotion was adequate and functioning well in terms of the following extent of promotion of the research environment of the Augustinian HEIs: provision of research unit, research staff, adequate research services, and facilities in different disciplines for the conduct of research (3.16), providing means for linkages with other institutions, local or international, in order to create intellectual synergy (3.04), instituting clear rules and procedures on the granting of financial and nonfinancial rewards for research (2.87), instituting a research monitoring body that screens the types of research conducted and looks into the ethical dilemmas involved, especially in sensitive fields (3.05), and producing quality researches as evidenced by the number of published researches in local and international journals, awards attained by faculty, and patents, among others (2.97).

The kind of research environment may lead to research productivity among faculty members in HEIs. Hence, developing an attainable research agenda, good culture of research, appropriate budget for research, functional research units and services, linkages and networks, provision of research benefits and incentives, research committee, and venue for publications are the essential elements supportive research environment which may be considered by the Augustinian HEIs in Luzon in order to motivate faculty members to become research productive.

5.4 Research Productivity of Faculty Members

There are four Augustinian HEIs whose faculty members are productive in research. Top producer of researches is the La Consolacion University Philippines with a total of 49 researches, 39 of which are scientific papers and 10 are accepted for publications. This is followed by La Consolacion College – Novaliches with a total of 47 researches, 25 of which are scientific papers and 22 are recognized for publications. Following closely is the La Consolacion College – Caloocan with a total of 37 research outputs, 20 are scientific papers and 17 researchers were published. Meanwhile, La Consolacion College – Manila recorded 22 researches of the full time faculty members where five are scientific papers and six were published. About eight scientific research papers were produced by the faculty members of La Consolacion Valenzuela.

It is very interesting to note that the majority of the higher education faculty of the aforementioned institutions have recognized the value of scholarship as shown by their interest in doing research. It would be more interesting if they would take cognizance of what Boyer (Glassick, 2000) is saying that it is not a matter of doing research for its own sake, but engaging in original research. For the real work of research scholar is stepping back from one’s investigation, looking for connection, building bridges between theory and practice, and disseminating research findings to students.

Moreover, it may be noted on the same table that the faculty members of the two Augustinian HEIs namely La Consolacion College– Pasig and La Consolacion College – Batangas have not yet started any research endeavors.

Furthermore, the number of active researchers in the Augustinian HEIs is not sufficient as evidenced by the limited number of active researchers which accounts to 44 out of 91 or 48.35 percent. There is 6 out of 10 or 60 percent of the full time faculty members who are actively doing research for both La Consolacion College –
Caloocan and La Consolacion College – Valenzuela. About 3 out of 5 or 60 percent of the full time faculty members in La Consolacion College – Valenzuela who are actively engaged in writing scientific papers. Also, La Consolacion College – Manila has 12 out of 22 or 54.55 percent active researchers while La Consolacion University Philippines has 17 out of 30 or 56.66 percent active researchers.

According to the National Higher Education Research Agenda (NHERA: 2008), research is one of the main functions of the higher education faculty. They are expected to lead in the conduct of discipline-based, policy-oriented, technology-directed and innovative researches that are locally responsive and globally competitive. The findings of the study indicate that there is so much that can be desired in terms of improving the research productivity of the faculty member of Augustinian schools. In order to improve the research productivity of faculty members of Augustinian HEIs, the institutions may encourage the faculty members to conceptualize and develop relevant research proposals in identified priorities for CHED’s funding supports in the form of Grants-in-Aid (GIA) or commissioned research grants.

The Medium-Term Development of Philippine Higher Education Institutions (MTDPHE, 2005) espouses that in order to promote and enhance the research culture in higher education; there is a need to develop graduate education in the medium term. That is providing training to the faculty members and grants to qualified researchers to respond to national development needs.

Acosta and Clemena (2009) support the idea that there are 12 factors present in high performing research environments. These are: clear goals for coordination, research emphasis, distinctive culture, positive group climate, decentralized organization, participative governance, frequent communication, resources (particularly human resources), group age, size and diversity, appropriate rewards, recruitment emphasis, and leadership with both research skill and management practice. On the other hand, DeHaven, Wilson, and O’Connor-Kettlestrings as cited by Acosta and Clemena (2009) identified unanimous and extremely important characteristics of successful research namely program director support, time, faculty involvement, didactic curriculum/journal club, professional support and guidance forum/opportunities for presenting. The extremely important characteristics include: early start, integrative curriculum, required projects, broad research definition, visibility, and research committee. Individual attributes, institutional and departmental attributes, as well as departmental culture and working conditions, affect research productivity. Additional indicators of research culture, derived from the broad criteria evident in CHED’s NHERA, are: research agenda, policies and guidelines on research incentives, services and facilities for research, publications, and research capable faculty.

5.5 Determinants of Faculty Research Productivity

Results of the regression revealed that of the three provisions in promoting research productivity, providing mentors’ assistance and promotion of a healthy research environment produced B coefficients of .736 and .709 respectively with associated probability less than the significance level set at .05. The findings indicate that for every unit increase in mentors’ assistance and promotion of the research environment could generate a .461 and .501 increases in research productivity of faculty members in Augustinian HEIs. The obtained Beta coefficients of .461 (Providing mentors’
assistance) and .501 (Promotion of research environment) indicate that the two factors contribute almost the same significant effects in the faculty research productivity. The factor “improving researchers’ capacity” also contribute to research productivity but not to a significant extent. The obtain F-ration of 3.545 which was found significant at .05 alpha indicates that the extent of research promotion of Augustinian HEIs in terms of improving researchers’ capacity, providing mentors’ assistance, and promotion of research environment formed a very significant set of predictor for the research productivity of faculty members.

Azad and Seyyed (2007) corroborated the findings of this study when they disclosed that the promotion of the research environment such as reward structure of higher education institutions produces more productive researches among faculty members. On the contrary, Williams et al. (2007) found out that educational experience and background are significant determinant of research productivity terms of quantity and quality. Faculty members’ confidence in their research abilities was found related to faculty research productivity. The perceived institutional supports for research work were the most important factors enhancing research productivity. Williams et al (2007) had confirmed these significant effects on research productivity. Those research references employed several indicators measuring institutional and departmental supports for researchers. The most important indicators were institutional policy that encouraged instructors to do research, institutional library budget and computing facility.

6. CONCLUSIONS
Based on the findings of the study, the following conclusions were drawn:
• There is still a need for Augustinian HEIs to further advance the faculty members’ educational experiences and background in research particularly in giving exposures to current professional literature and in the dissemination of research findings.
• Majority of the faculty members have recognized the value of scholarship as shown by their interest in doing research and taking small steps in attaining real work of research scholar.
• Faculty research productivity is significantly influenced by the extent of promotion of research environment and providing mentors’ assistance.

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THE APPLICATION OF BLENDED LEARNING IN THE POPULARIZATION OF THE ENTREPRENEURSHIP FOUNDATION: SHIJIAZHUANG UNIVERSITY OF ECONOMICS AS AN EXAMPLE

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Abstract: At present, information and communication technologies have largely changed the teaching environment and conditions of the Chinese universities, but from the traditional teaching to the network teaching, and then to blended learning, need teachers recognize and reuse in terms of teaching concept and teaching methods. Blended Learning as the foundation of the current Chinese universities to carry out the entrepreneurship education popularization provides a new thought and method, solves the contradiction between the Chinese large-scale popularization entrepreneurship foundation and the shortage of teachers. This paper takes the entrepreneurship education in Chinese higher education as the research object, with the examples of Shijiazhuang University of Economics, puts forward Online-Offline combination of blended learning mode based on the theory of entrepreneurship cognitive. Online, students can learn key knowledge through watching video, having test and discuss. Offline students do many entrepreneurial activities and complete the task of each module, achieving perfect combination of theory study and practice activities, so as to realize flip classroom, and improve the learning effect.

Keywords: Blended learning, Entrepreneurship Foundation, MOOCs

In recent years, the development of blended learning in higher education field caught people's eyes, which Pennsylvania State University thought as the "undoubted and inevitable development tendency in current higher education field". Under the background of the informatization of higher education, how to make use of information technology and related resources and how to rely on educational informationization to improve our teaching environment and learning effect are the calls of both the
educational practice and the information era.

Hybrid learning model based on the development of E-learning is formed by uniting both advantages of traditional teaching and network teaching, and it can offer new thoughts to the educational reform. Currently, Chinese tertiary institutions are making entrepreneurship basis education universal, which is provided an effective method by hybrid learning model. However, blended learning can't be separated from meticulous design and implement. Taking Shijiazhuang University of Economics as an example, it is to elaborate how blended learning is used in the popularity of entrepreneurial base.

1 DEFINITION OF BLENDED LEARNING

1.1 Concept of Blended Learning

Since the late 1990s, E-Learning has been rapidly applied and developed in the field of education, and thus pushed the innovation of education and produced many new thoughts and ideas in education. As Josh Bersin, the advocator of blended learning, said in The Blended Learning Book: Best Practicies, Proven Methologies, and Lessons Learned, that blended learning was not a brandnew concept but a learning method proposed by applying the new technological tools for the current teaching practices after the deep analysis of existing problems in the current education and learning area.

The simplest and directest understanding of the blended learning is to blend the E-learning with the traditional class learning (Michel E.W., 2002; Frank J.T., 2002). Harvi Singh and Chris Reed considered the blended learning as the learning projects with many delivery methods applied. Jennifer Hoffman (2001) put forward that a kind of thought is hidden behind the blended learning in Blended Learning Case Study, which is: instructional designers divide a learning process into a number of modules, and then decide to present them to the learners with the best media.

1.2 The Definition of Blended Learning of Entrepreneurial Foundation

Blended learning can have different mixed type according to different subjects and educational purposes. Entrepreneurial foundation is a course with strong theoretical and practical property. The entrepreneurship is a process and as well as a method. As a process, we can study each of its stage according to the creating process of start-up enterprises and understand theoretical basis and principle of different stages of entrepreneurship. However, entrepreneurship is not a linear process but a process of continuous iteration, modification and moving in circles. There are a lot of uncertainties. It can't be completed step by step according to the targets which have been set; Entrepreneurship is also a method that teaches people methods of entrepreneurial mindsets and behaviors. Obviously, the popularity of entrepreneurial base can only be taken on the basis of hybrid learning
method, which allows students not only to be familiar with the principles of entrepreneurship but also to master entrepreneurial methods and thinking through the practice.

Therefore, the entrepreneurship based hybrid learning is shown as in Figure 1. I think it's a mixture of a face-to-face classroom learning, after class practice and online autonomous learning, that is, under the guidance of the teacher, an organic combination of organized, planned, and targeted online learning and offline learning to achieve the perfect combination of the theory and practice.

![Figure 1: the Conceptual Model of Blended Learning](image)

1.3 The Application Model of Entrepreneurial Foundation Blended Learning

Business based blended learning is the mixture and combination of Online and Offline, which based on a deeper level of different teaching theories, such as constructive theory, behaviouristic theory, instructional design theory, and the mixture of educational media theory, activity theory and so on. This is to say: the blend of teacher-directed activity and students active participation, the blend of different learning environment with classroom teaching and online study, the blend of classroom teaching and after class activities, etc. The nature of "Blended Learning" stresses the organic unity between the leading role of teachers and the dominant role of students.

The application framework of the Entrepreneurship Based Blended Learning is shown in Figure 2, which is just a kind of learning method designed on the basis of
entrepreneurship based learning goals. The blended learning method of combining online and offline learning is currently an important teaching measure to carry out entrepreneurship education. The academic line includes learning and communicating key skills of entrepreneurship knowledge on online platform, while the teaching line mainly includes answering questions and consulting; Offline study is mainly done and presented in practices by face to face classroom lessons, while the teacher mainly organizes activities and comments; After class, students complete each task of teaching modules as a team, and teachers mainly evaluate the task. Through the blended learning model that combines the study on line and off line, the combination of theory learning and practice activities can be achieved, so that the flipped classroom can be realized. This mode reforms the learning style of the students and enables them to learn whenever and wherever possible, which is beneficial to improve the enthusiasm and initiative in learning and develop great creativity in learning and activities.

![Picture 2: Foundation for Entrepreneurship Blended Learning Application Frame](image-url)
2 THE APPLICATION OF SHIJIAZHUANG ECONOMICS COLLEGE’S BLENDED LEARNING IN THE POPULARITY OF FOUNDATION FOR ENTREPRENEURSHIP

2.1 Blending Learning Principles of Basic Course of Entrepreneurship

There are many schools about setting up entrepreneurship courses. The process school thinks that entrepreneurship courses should be designed according to the process of the enterprise operation and are tending to teaching in methods and tending to management in contents, which undoubtedly departs from the direction of the entrepreneurship education. The reason is that entrepreneurial education is both a kind of science and art, and even practice; however, the cognitive paradigm considers the setting of entrepreneurial courses as more conceptional, aiming to make entrepreneurs understand entrepreneurship. Behaviorism school holds that we should draw lessons from the lean startup principles to adopt blended learning method with the validation and iterative process from 0 to 1, as well as the combination of online and offline curricula settings; require students to continuously experience, discuss and practise, thus helping more entrepreneurs form a startup thinking and grasp the method of startup in actions.

Through years of exploration, Shijiazhuang University of Economics has built the blended learning approach based on the combination of on-line and off-line, embodying the perspective of behaviorism, concentrating on the training of entrepreneurial thinking and practice of entrepreneurial skills, focusing on training students' thinking style based on innovation and making innovative ideas into realistic methods.

2.2 Blended Learning Model of Entrepreneurial Base

Culture students' innovative thinking and entrepreneurial skills according to the requirements of training target in the course of "Entrepreneurial Base". The blended learning of the course includes three aspects: online platform, online courses, and offline activities. Each part needs to be carefully designed and implemented in order to achieve the teaching goal.

2.2.1 Online Platform

The online learning platform mainly has the function of learning process management and social contact, including watching videos of knowledge points, tests, downloading material of cases and extensive reading about knowledge points, summarizing learning inspiration, task management, work management and community exchange. It is shown as Figure 3.
Currently, there are 3077 students in the online platform. More than 30 classes are used, 308 entrepreneurial teams were formed and 1702 works were made.

### 2.2.2 Online Courses
Basic entrepreneurial course is targeted at all students, and it is the public mandatory course centering on cultivation of entrepreneurial spirits. It has five modules including entrepreneurial team, question probing, innovative plans, market testing and business plans, and covers more than 40 knowledge points. Each course module comprises of teamwork tasks and provides relevant materials for further study.

The total duration of the basic entrepreneurial course played on the platform is 3887 hours, which is equivalent to 162 days in total. The videos have been played for 126264 times totally.

### 2.2.3 Offline Activities
Offline activity is the practice of the online knowledge and a beneficial supplement to the online activity, two kinds of activities are mutual supplementing and indispensable. The offline activities are designed in allusion to every online module, which aim to make the students experience the process of entrepreneurship through practice, and exercise their entrepreneurial skill.

The offline activities are the application of the process of starting a business. The offline mode is mainly oriented by teamwork, projects, and products, which focus on how the practical activities are carried out rather than the outcomes itself. It converts practical activities into the knowledge of creation and re-creation, allowing students to learn to study, communicate, innovate and resolve problems during the entrepreneurial activities.

Offline activities mainly include two kinds. One is face-to-face learning in classrooms, and the other is the students' after-class...
activities. The face-to-face classroom learning is organized by teachers, who will make comments on the classroom activities and students' presentation so as to improve students' understanding of theories; students' after-class activities are mainly module tasks which are finished by students in a team. For example, the after-class activity for entrepreneurial teams is to establish a team and take a creative photo.

As a practical approach to entrepreneurship, offline activities include five modes: playing, empathizing, creating, testing, and rethinking. That exemplifies a blended teaching method combining theory with practice. Offline entrepreneurial activity, which is based on activitise, promotes the students' entrepreneurial competency and performance, enables students to exercise their innovative thinking, expand students' entrepreneurial capability, and continually improve the cultivation quality of the creative and entrepreneurial talents.

2.2.4 Hybrid Learning and Operation Process
Online: the students log in the online learning platform to form teams, accept team's tasks, watch videos, do tests, upload works and publish summaries; teachers grade the works and answer the questions online.

Offline: students' offline activities include classroom teaching activities and practical activities after class. Classroom teaching activities: students accomplish the classroom practice, works shows and so on; and teachers organize activities such as classroom activities, explanation, answering questions and commenting works. Practical activities after class: student team members fulfill the team task together after class, and teachers answer questions as well as provide consultations.

3 CONCLUSION
There is always a problem in entrepreneurial education: How to do entrepreneurial education? Based on blended teaching methods of online and offline learning, which is the solution for solving the conflict between the popularization of entrepreneurship basics and the shortage of qualified teachers in Chinese universities, and solving the problem of students' learning are limited by time and space. However, the popularity of entrepreneurial education basis and hybrid model of teaching require multilateral collaboration that creates synergy in order to achieve better results.

3.1 Student-Centered and Design-Blended Learning Content
The dominant position of students should be presented in each process of teaching activities. So when planning blended learning content, teachers should pay attention to the needs of students. On one hand, the ratio between online learning and offline learning should be well arranged. The online learning should not take students long extracurricular time, or it will cause a certain amount of pressure to the students; on the other hand, the design of the offline activities need to be innovative and
3.2 Improve the Teachers' Comprehensive Quality and Ability

Under the mix teaching model, teachers' task seems to be lessen, but actually more comprehensive qualities and abilities to teachers are required. The representation of teachers' teaching contents, the comments on teaching activities, the choices of teaching media, the application of teaching strategies and the smooth interactive mode between teachers and students directly depend on the comprehensive quality and ability of teachers. The blended teaching requires teachers to design refined course as well as apply the blended study idea throughout all course designing, and focus on students' learning satisfaction and efficiency.

3.3 Strengthen Teaching Resources Management of School

The key of launching blended learning is that to have abundant network resources and knowledge, while schools need to strengthen the management of equipment, electronic and human resources, increase the speed of network operating and provide good technical support for the operation of the online platform. Powerful teaching resources and network platform are the essential conditions for carrying out blended learning.

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ACQUIRING SOCIAL RESPONSIBILITY BY INSTITUTIONS THROUGH MISSION SHIKSHA

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Abstract: Education system in Kutch is facing various challenges such as lack of primary and secondary school teachers, lack of grants for infrastructure, developing teaching-learning materials and lack of academic support etc. As an developing Institute in the region of Kutch it is taken as responsibility to provide academic and teaching support to the schools located in various areas of Kutch. Keeping in view this aim, HJD Institute of Technical Education and Research, Kera-Kutch started the program named “Mission Shiksha” in December 2014. Under this program, we are promoting voluntarism in academic staff of Institute as an educated workforce that will keep education strong in Kutch region. Considering border area of Kutch district and the schools where the unavailability of teachers especially subjects like Mathematics, Science, English and Computer, the faculty members of Institute share their valuable knowledge and experience with the students of rural area of this region and fulfilling the basic needs by teaching these basic subjects under the vision of Trust “To uplift the education in the region”. The institute also arranges various technical and career counseling sessions for the students under this program. This program is accountable to both the District as well as local community of region.

Keywords: Social Responsibility, Mission Shiksha, Kutch, Voluntarism etc.

1 INTRODUCTION

Besides being busy in acquiring various goals, objectives and strategies for achieving Institute mission, its is also very important for an Institute to work socially for the society which will make it easier for the Institute to survive and enjoy satisfactory long-run profit”. The institutions should relate their operations and policies to the social environment in ways that are mutually beneficial to the institute as well as the society. [1][2]

Schools around the Kutch areas are quite lacking behind due to the unavailability of the teachers and due to lack of career counseling among the students. The students are having poor knowledge in the subjects like Mathematics, Science and English in their primary classes. As a result of which they are unable to select better technical subjects during their higher secondary classes. Also since there are so many Industries are available in Kutch but due to lack of skills, these industries have to outsource their manpower, So to acquire social responsibility towards Kutch region and to increase employability of technical skilled persons, Mr. Jagdish Halai, Trusty of Swa. Kanji Karshan Halai Education and Charitable Trust and Hon.Chairman of HJD Institute of Technical Education and Research, Kera launched the program “Mission Shiksha” which took great care to ensure “Vidya Daanam’- ‘The Gift of Education’.

“Mission Shiksha” is a program that is designed to empower under-privileged children born in rural and remote areas in Kutch by providing them the opportunity of an adequate modern education. It is
an attempt to create futures that were not otherwise going to happen.

The trust is fully devoted to the noble cause of the spreading education in the region and is committed to multi-dimensional growth of education. It is well aware of the social, administrative and technological needs of the contemporary society, which it targets to fulfill through education. We value the strong relationship we have with our community and strive to be responsive to it. So under the “Mission Shiksha” Programme we aims at providing education, knowledge, support to the school in and around Kutch. HJD Institute benefits the local and regional community is by its extensive Continuing Education at grassroots' level. We provide classes to students in special areas of like Science, Mathematics and English. We also tend to offer classes to school students on a module basis in month of December every year since 2014.

Almost all the areas of Kutch are covered like Lakhapat, Bhachau, Bhuj, Nakhatrana, Abadasa, Mandvi, Gandhidham, Anjar and Mundra. The villages like Narayan Sarovar, Panandhro, Shamakhali, Lakadiya, Varli, Meghpar, Makanpur, Baladiya, Paddhhar, Kera, Gajod, Hajapar, Madhapar, Mankuva, Nagalpur, Vithon, Mothara, Kothara, Bitta, Rampar, Bidada, Asambiya, Tuna, Kidana, Shinay, Sugariya, Sapeda, Bhadreshwar, Karagoga and Zarpara were covered in these areas.

2 VISION OF PROGRAM MISSION SHIKSHA

Feeding the hungry is a great thing. But the one fed feels hunger again and again later. It is not a permanent solution. But if you teach a man how to feed himself for the rest of his life, that would be the greatest service indeed, for he now knows what to do so as not to be a burden. Keeping this Vision in mind the concept of “Mission Shiksha” was launched in campus year Dec, 2014 which took great care to ensure “Vidya Daanam” - 'The Gift of Education'.

3 MISSION OF PROGRAM MISSION SHIKSHA

To empower under-privileged children born in rural and remote areas in Kutch by providing them the opportunity of an adequate modern education. It is an attempt to create futures that were not otherwise going to happen.

4 FEATURES OF PROGRAM MISSION SHIKSHA

This programme is an attempt to provide an opportunity for improving human capabilities to all children through provision of community-owned quality education in a mission mode.[4] It is a response to the demand for quality basic education all over the Kutch. This program allows children to learn about and master their natural environment in order to develop their potential both spiritually and materially. We must prepare an educated workforce that will keep Education strong, in our fast-growing region.

HJD Institute is striving to fulfill Trust’s mission while being accountable to both the District as well as our local community. This program prepares an educated workforce that will keep Education strong, in our fast-growing region.

- Under this program, Existing schools with inadequate teacher strength are provided with additional teachers, while the capacity of existing teachers is being strengthened by extensive training, grants for developing teaching-learning materials and strengthening of the academic support structure at a cluster, block and district level. The faculties of the Institute are free from their regular load of classes during the month of November and December since university examinations are going on at that time. So they are allowed to go to the schools in all over Kutch to educate the students. Under this program in the year 2014, 69 schools were covered and 5447 students were benefitted and in the year 2015, 112 schools were covered and 7466 students were benefitted.

- The visit for the students of various schools is being arranged within the campus. During these visits, a career counseling session is being prepared by the faculties of the campus in which students are being told by what is engineering, why they should choose engineering/science and which stream they should choose. After this career counseling sessions the students are taken
for the visit to the various departments and their respective labs. During which they are being given the basic introduction and significance of each departments and laboratories. Under this program in 2015, 12 various schools from the various region of Kutch visited the campus and around 1200 students took part in these visits. All the students were provided with high tea.

- The institute also aims at providing workshops free of cost to the Diploma students from all the colleges like GEC,Bhuj,Tolani Polythenic etc. Such workshop aims at providing knowledge to the students about their core/new subjects and also about the latest technologies used in their fields. In Jan-Feb 2014 each department of HJD Institute organized a workshop for Diploma students. Under these workshops 100 students from neighboring colleges took participate in each workshop under each branch.

- Under the program “Mission Shiksha” the institute also tends to provide “Career Counseling”sessions to the students of neighboring schools. Career counseling sessions helps the students to know the pros and cons of the different streams and the career path it offers, thus the students can make an informed choice. Counseling services include career counseling, career guidance talks, strategy and intervention planning, training, information sharing on student related issues, forums and campaigns.

5 REPORT OF PROGRAM MISSION SHIKSHA

This Program aims at providing following help to students of various schools
- Developing a lifetime enthusiasm for learning
- Developing positive communication and social skills
- Developing critical thinking and decision-making skills
- Working with peers and in teams
- Training them to protect themselves from harmful influences and peer pressure
- Empowering them to plan their careers and choose a profession they will enjoy
- Getting a better understanding of their strengths and weakness

- Giving confidence to take up difficult tasks without inhibition of performance related issues [5]

Every week in the month of November and December faculties from various departments within the Institute goes to schools and teach the students from all the classes.[6] A snapshot of weekly report of Mission Shiksha is given below :-

- **WEEK - 1 [24-11-14 To 29-11-14]**

  Figure 1 Mr. Dhairyajeet Parmar at Shree Roha(Sumari) Government Primary School, Roha, Ta. Nakhatrana[3]

  656 Students of 9 Schools by 14 Faculty Members in that week were taught. There were 3 Faculties from Mechanical Department, 3 Faculties from Civil Department, 2 Faculties from Electrical Department, 2 Faculties from CSE Department and 4 Faculties from HMS Department. The villages covered were Roha, Dhrang, Dhaneti, Adipur, Madhapar, Bhujodi, Moti Nagalpar.

- **WEEK - 2 [01-12-14 To 06-12-14]**

  Figure 2:-Mr. Haresh Chande at at Government Higher Secondary School, Bhadreshwar, Ta. Mundra

  1701 Students of 19 Schools by 20 Faculty Members were taught. There were 3 Faculties from Mechanical Department, 3 Faculties from Civil Department, 5 Faculties from Electrical
Department, 4 Faculties from CSE Department and 5 Faculties from HMS Department. The villages covered were Mithirohar, Padana, Shinay, Sapeda, Desalpar, Mankuva, Madhapar, Bhadreshwar, Moti Nagalpar, Ratnal, Bharasar, Bhujodi.

• WEEK - 3 [08-12-14 To 13-12-14]

Figure 3: Ms. Pooja Tank at Sahyog Sarashwati Vidhyamandir, Gandhidham

1833 students of 22 Schools by 15 Faculty Members were taught during this week. There were 2 Faculties from Mechanical Department, 2 from Electrical Department and 11 Faculties from HMS Department. The villages covered were Habay, Kera, Baladiya, Naranpar, Nagalpar.

• WEEK - 4 [15-12-14 To 20-12-14]

Figure 4 Mr. Hiren Kalola at Primary School, Jangi, Ta. Bhachau

782 Students of 09 Schools by 11 Faculty Members in that week were taught. There were 3 Faculties from Mechanical Department, 2 Faculties from Electrical Department, 1 Faculty from Computer, 3 Faculties from Civil and 2 Faculties from HMS Department. The villages covered were Madhapar, Sinay, Jangi, Gundiyali, Padana, Magvana, Sukhpar.

• WEEK - 5 [22-12-14 To 31-12-14]

Figure 5 Mr. Mehulsinh Jadeja at Sheth G. T. High School, Mandvi

475 Students of 10 Schools by 09 Faculty Members in this week were taught. There were 2 Faculties from Mechanical Department, 6 Faculties from Electrical Department and 1 Faculty from Civil Department. The villages covered were Karagoga, Madhapar, Shinay, Gajod, Bocha.

Seeing the success of Mission Shiksha 2014 this program was re started in the month of November and December 2015

• WEEK - 1 [02-11-15 To 07-11-15]

Figure 6 Mr. Saumyakumar Rana at Shri Sarswati Vidyalaya - Madhapar, Ta. Bhuj

1027 Students of 13 Schools by 08 Faculty Members in this week were taught. There were 4 Faculties from Mechanical Department, 2 Faculties from Electrical Department and 2 Faculties from Civil Department. The villages covered were Shamakhya, Madhapar, Shinay, Gajod, Lakadiya, Tuna, Kidana.
• WEEK - 2 [30-11-15 To 05-12-15]

2301 Students of 32 Schools by 17 Faculty Members in this week were taught. There were 5 Faculties from Mechanical Department, 6 Faculties from Electrical Department, 4 Faculties from Civil Department and 2 Faculties from HMS Department. The villages covered were Anjar, Varli, Kotda Ugamna, Kotda Aathamana, Jadura, Mirzapar, Bhujodi, Lakhond, Dabda, Mota Asambya, Nana Asambya, Bidada, Talwana, Mota Badiya, Nani Khakhar, Madanpura, Kodai, Mothara, Bitta, Kera, Madhapar, Mankuva, Sukhpar, Shadata.

• WEEK - 3 [07-12-15 TO 12-12-15]

905 Students of 14 Schools by 07 Faculty Members in this week were taught. There were 4 Faculties from Mechanical Department, 1 Faculty from CSE Department and 2 Faculties from HMS Department. The villages covered were Nirona, Ratiya, Makanpur, Haripura, Bhadreshwar, Madhapar, Meghpar, Godpar, Baladiya.

• WEEK - 4 [14-12-15 To 19-12-15]

1635 Students of 21 Schools by 14 Faculty Members in this week were taught. There are 4 Faculties from Mechanical Department, 5 Faculties from Electrical Department, 1 Faculty from CSE Department and 4 Faculties from HMS Department. The villages covered were Ratnal, Dhaneti, Sapeda, Sugariya, Surajpar, Hajaper, Nakhatrana, Angiya, Nagalpur, Vithon, Nagor, Chapredi, Atalnagar, Madhapar, Baladiya, Moti Khakhar, Faradi, Yoginagar.

• WEEK - 5 [21-12-15 To 26-12-15]

458 Students of 10 Schools by 06 Faculty Members were taught in this week. There were 5 Faculties from Mechanical Department and 1 Faculty from HMS Department. The villages covered were Vedhar, Orida, Modisar, Palanpur, Madhapar, Mithi Rohar, Dhorii, Sumarasar, Kukma and Padhar.
1140 Students of 24 Schools by 13 Faculty Members in this week were taught. There were 3 Faculties from Mechanical Department, 4 Faculties from Civil Department, 2 Faculties from Electrical Department and 4 Faculties from HMS Department. The villages covered were Karaghoga, Zarpara, Adipur, Antarjal, Kapurashi, Narayan Sarovar, Varmanagar, Navanagar, Ajrakhpur, Kidana and Rampar.

After the successful completion of the program Mission Shiksha in 2014 the Institute gave the Award of Appreciation to the Faculty who took higher teaching hours.

Table1:- Statistics of Load taken in various school in year 2014 and 2015

During this program besides sending teachers to various schools for teaching, the students from various schools of various classes also visited the campus. The career counseling session is being arranged for these students. Students are under a lot of pressure – pressure to perform academically, pressure to be popular, pressure to ultimately, make a good life. The one thread that touches upon all these is the choice of one’s career. It is a decision that is often taken under parental or societal duress. However, one must seek proper career counseling and guidance to make the right decision. Career counseling is really beneficial for students. Keeping in view this the sessions are arranged which will help the students to choose their right career path and stream. Under this program following schools visited the campus.
Table 2: Statistics of School Visits to College under Mission Shiksha

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<th>School Name</th>
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<td>18-12-15</td>
<td>Seth J P &amp; L S High School, Kera, Ta. Bhuj</td>
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<td><strong>TOTAL</strong></td>
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</table>

6 FUTURE ENHANCEMENTS IN THE PROGRAM “MISSION SHIKSHA”

Since HJD Institute is a dynamic organization with a challenging mission which committed to the philosophy of offering technology centered education routed in the ideas of charity and humanity so in future we plan to offers classes to school students on a module basis, with evening and weekend classes as well as in-house week-long workshops during April-May under this program. The Institute will also engages in involving youths in field trips, tours, demonstrations, talks, and science camps, and career guidance sessions. Further we plan to have workshops for the school teachers which will help them to enhance their teaching capabilities. Also the students from the Institute can help in this program by taking courses in their school to junior mates. These programs stem from a strong commitment of HJD Institute to motivate students of region to learn, and in the process improving academic standards at grassroots level.

REFERENCES

A STUDY ON RESEARCH ORIENTED TEACHING AND LEARNING

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Abstract: Business schools are being challenged by industries to produce students who possess competent skills and outstanding understanding of business operations. However, the current curriculum design of B-schools produce professionals who possess high score cards but low practical understanding. This paper studies the present scenario of teaching and learning which is traditional and proposes the new insight about teaching and learning using research aspect. Research and development are most crucial departments of any big company. Every field is coming with new inventions and developments which is ultimately outcome of research and experimentation. It is very important today that we connect these two end points i.e. education and research. Learning and teaching by traditional method is being challenged by new methods of Research Enhanced Learning and Teaching tools. I have tried to study the need and importance of research based curriculum design in this paper. For that purpose survey of students and teachers is conducted regarding use and understanding of research in education.

Key Words: Research, Teaching, Learning, Education

1. INTRODUCTION

There is growing awareness in colleges that traditional method of teaching students is becoming outmoded. Such awareness is heightened by comments received by industry about failure of graduates to see beyond the boundaries of their narrow spectrum. These types of concerns are indicative of approaches that current education system is no longer appropriate. Generally all the streams of education consist of various subjects which is known as Common Body of Knowledge (CBK) approach, where irrespective of their interest students are supposed to study all the subjects. In such curriculum where no choice is offered regarding subjects to study, teachers and students follow the traditional way of teaching and studying which is studying the concepts stereotypically and students mug up them for the exam purpose. In this method those students who can memories or cram up well win the battle irrespective of their analytical ability. The developmental level of a student varies as per the grade he studies in. It is presented in Following diagram.

![Developmental Level and Student Traits](source: Hodge et al. (2008))

2. PRINCIPLES OF RESEARCH ORIENTED LEARNING

1. Observation

The first step is to indulge your curiosity. What do you observe about your students and/or your teaching that makes you wonder? For example, do you wonder whether students work harder when they are allowed to choose their own groups or when you assign them to groups?
Have you observed a change in student attendance when you put more materials online?

2. Question
Pose a question. The question should be meaningful, doable and measurable. An example is found in the title of Mark Dinnen’s awarded national grant - Is participation in technology enhanced Model United National Conferences the employability skills solution for learners?

3. Hypothesis
Form a hypothesis. Justify that hypothesis through conducting a review of the literature. What are the key findings of other research studies posing similar questions?

4. Objectives
What do you aim to accomplish through this research? As an example, in the awarded national grant on postgraduate student experience, Kinash and Crane outlined the following aims – The project aims are: (i) to undertake a comprehensive analysis of the broad experiences of Australian coursework postgraduate students, and the relationship of these broad experiences have to learning; and (ii) to establish evidence based recommendations, including best practice guidelines, that can be used to impact and enhance Australia’s postgraduate students’ broad experiences. Note that these aims define a specific topic of research and identify the intended application and impact of the research.

5. Method
Education researchers use qualitative, quantitative and mixed-methods research methodologies. Some of the commonly used approaches are: • Design-based research • Quasi-experimental research • Survey analysis • Phenomenology • Critical theory • Ethnography
It is important that the method suits the question and context. One way that many researchers decide which method/s to use is by reading published research that posed similar questions. Which method/s did these researchers use and what were the strengths, limitations and outcomes produced?

6. Results (Data and Analysis)
The next step is to record and report the data and then analyse that data. Data is often presented through tables and figures. Quantitative data can be analysed through descriptive statistics and sometimes through correlations. Validity and reliability are important to establish. Are your conclusions accurate based on the data you have collected? If another researcher was to follow the same approach you described would she/he derive the same results? What if the research were conducted with another class? Qualitative data is often analysed by themes. What were the salient themes and what do they indicate? How do these themes apply beyond those included in your research?

7. Discussion
The researcher now considers the data with respect to the posed research question/s. What conclusions can be drawn based on the results? What further questions were provoked? Was there anything surprising? Was your hypothesis confirmed? Do your results align with the results of published research studies? Why or why not? What are the implications and applications?

8. Conclusion (Application, Limitations, Dissemination, Engagement, Impact)
One of the differentiating characteristics of learning and teaching research is that it is usually applied rather than pure. The reason you are conducting learning and teaching research is
often to inform improvements to your own teaching and your own students’ learning. Perhaps you want to know whether there is evidence that an innovation you have implemented is actually making a measurable difference to student learning. You might have an idea that you believe will improve higher education overall and you want evidence so that you can convince others to adopt this approach. It is therefore important that you discuss the application. In addition, it is important to clearly depict limitations. For example, should readers be cautious about application of your findings given the small number of people interviewed? Dissemination through publication, presentation and facilitation of professional development will heighten the impact of your learning and teaching research. Improving the learning experience of your own students is important; sharing your successes with others will heighten the impact.

3. LITERATURE REVIEW

Curriculum Design and Teaching-Research Relations

We have found the framework developed by Griffiths (2004) effective in supporting staff/faculty to examine both their current courses and institutional policies and practices and in adapting innovations from elsewhere. According to Griffiths teaching can be:

- Research-led: where students learn about research findings, the curriculum content is dominated by faculty research interests, and information transmission is the main teaching mode;
- Research-oriented: where students learn about research processes, the curriculum emphasises as much the processes by which knowledge is produced as learning knowledge that has been achieved, and faculty try to engender a research ethos through their teaching;
- Research-based: where students learn as researchers, the curriculum is largely designed around inquiry-based activities, and the division of roles between teacher and student is minimised.

Healey (2005) has expressed these differences diagrammatically using two axes. One classifies approaches to linking teaching and research according to the extent to which students are treated mainly as the audience or as participants, while the second axes classifies the approach as emphasising research content or research processes and problems. He identifies a fourth category ‘research tutored’ where students learn in small group discussions with a teacher about research. A variant of this model is shown in (Fig 1).

![Diagram of teaching and research relations](image)

Source: Healy (2005, 97)
Jenkins, Blackman, Lindsay and Paton-Saltzberg (1998) carried out focus-group discussions with undergraduate students in a range of disciplines at Oxford Brookes University, and then replicated the study with postgraduates (Lindsay, Breen and Jenkins, 2002). Students who perceived staff members’ involvement in research as being incorporated into their teaching tended to see their courses as current and as stimulating intellectual excitement. However, many students did not see themselves as stakeholders in staff research – university research was seen as quite separate from them.

(Turner et al., 2008) A questionnaire of the awareness, experiences and perceptions of final year undergraduate students at the University of Gloucestershire (Healey et al., forthcoming) was taken up by the University of Alberta and Royal Holloway. Although students at all three universities agreed that being involved in research activities was beneficial, they did not perceive that they had developed their research skills.

(Hunter et al., 2007, 69) Generally students at the more research intensive universities were more aware of the research that went on in their institutions, but there was no significant difference in the experience they had of undertaking research themselves. “Overwhelmingly, students define UR as a powerful affective, behavioral, and personal discovery experience whose dimensions have profound significance for their emergent adult identity, sense of career direction, and intellectual and professional development”

Paradigm Approach

<table>
<thead>
<tr>
<th>(1) Teaching</th>
<th>Telling students what they need to know</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2) Learning</td>
<td>Engaging students in</td>
</tr>
</tbody>
</table>

Source: Hodge et al. (2007, 3)

4. RESEARCH GAP/ PURPOSE

Research gap is the main purpose for conducting the research. In this study the main objective is to study the “Effectiveness of Use of Research in Teaching and Learning”. Traditional method of teaching and learning is examination oriented where things are taught in the classroom and students learn them and they are assessed on the base of their performance in exam. In this paper I have tried to study what teachers and students perceive about research to be used instead traditional methods.

5. OBJECTIVES

In this Research paper I have tried to fulfill the following objectives.

1) To know about the current system of teaching followed by teachers.
2) To understand the various view points and aspects of Research and applications of research in curriculum development.
3) To analyze the teachers’ perspective regarding project and research based teaching.
4) To study the basic understanding of research according to participants.
5) To learn the benefits of research based teaching and learning.
6) To know the reasons behind limited use of research based curriculum.
6. RESEARCH METHODOLOGY

Research Design:

The purpose of this research is to study the teaching and learning methods used by academicians. Research design used in this study is exploratory design. Researcher has enquired academicians and students regarding the method used by them in their curriculum and analysed the obtained outcomes.

Sample size and sampling method:

Sample of 100 was analyzed to study research oriented teaching and learning effectiveness. Out of 100 persons, Survey consisted of 50 teachers teaching at post graduation level and 50 students of MBA. Sampling method used here was non probability convenience sampling.

Data Analysis:

Data obtained by 100 questionnaires is analyzed in which participants were, teachers and students, divided into group of 50 each. Questionnaire was structured differently for teachers and students therefore analysis is presented differently for both, part A being the respondents from teachers and part B being the respondents from students.

1. Gender of participants

<table>
<thead>
<tr>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>30</td>
</tr>
<tr>
<td>Female</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
</tr>
<tr>
<td>Male</td>
<td>35</td>
</tr>
<tr>
<td>Female</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
</tr>
</tbody>
</table>

2. Methods used in classroom study

In this question respondents were asked to answer about which methods they use in classroom study in their current curriculum.

(A) Teachers

(B) Students
2. Do you find link between new chapters learnt/taught and previously learned unit?

This question aims to know about participants’ viewpoint regarding their new learning and current knowledge. Generally in traditional method of teaching and learning, which is found to be exam oriented rather than object oriented, there is no much relevance of topics learnt in various subjects.

<table>
<thead>
<tr>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>19</td>
</tr>
<tr>
<td>No</td>
<td>21</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
</tr>
</tbody>
</table>

3. Have you tried to test the validity of the content taught/learnt by you?

Here testing the validity of content learnt means that whatever topics teachers teach or students learn in their curriculum are accepted by them without any proof or tests. In traditional method the syllabus given in curriculum is grasped without questioning the content or without getting it proved. It is only accepted unlike research where assumptions are tested for validity.

4. What do you understand by research?

Here basic understanding of “Research” is known from respondents. What do they think about research? According to them how the research is seen is answered here.
5. When did you undertake your first research?

To know about the current scenario of research this question was asked. Following data shows the sluggish use of research by teachers as well as students.

![Graph of Teachers and Students]

6. The content studied by problem formulating and data analysis be learned and grasped in better way compared to only accepting the given data?

<table>
<thead>
<tr>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>45</td>
</tr>
<tr>
<td>No</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
</tr>
</tbody>
</table>

7. Why you think that research is necessary instead traditional method of teaching/learning?

| (A) Teachers | |
|--------------|
| To make the concepts clearer | 12 |
| To develop better understanding for students | 7 |
| To provide practical learning | 18 |
| To test analytical ability of students | 13 |
| Total | 50 |

| (B) Students | |
|--------------|
| To learn something new | 9 |
| To understand tough concepts quickly | 8 |
| To discover 1st hand info / new info | 20 |
| To be prepared for future research in corporate world | 13 |
| Total | 50 |

8. What type of research do you prefer?

| (A) Teachers | |
|--------------|
| Quantitative | 10 |
| Qualitative | 15 |
| Experimental | 11 |
| Causal | 9 |
| Other | 5 |

| (B) Students | |
|--------------|
| Quantitative | 20 |
| Qualitative | 11 |
| Experimental | 5 |
| Causal | 9 |
| Other | 5 |
9. Which part of Research do you find more complicated?

Research process consists many various parts such as Literature review, problem statement, sampling, data collection, hypothesis testing, data analysis and deriving conclusions. This question analyses which of these parts is seen as complex among respondents.

7. FINDINGS

1. It is observed that methods more used in classroom are lecture method and note taking. Projects and assignments are not used as widely by students.

2. Maximum number of teachers and students agree that they do not find link between the new topic learnt/taught and previous knowledge acquired by them.

3. 79% of students and 42% teachers agree that they do not test the validity or truthfulness of data.

4. Understanding of research varies among teachers and students. Most of the students perceive research as doctoral study thesis whereas 30% teachers view research as problem solving tool.

5. It is observed that participants undertook their first research mostly after graduation. Among teachers 40% of them undertook research in their post graduation whereas among students, first research was undertaken by them in post graduation. 30% of students confessed that they have never conducted research yet.
6. In spite of low usage of research at present, more than 80% respondents agreed that concepts can be studied well if they studied the topic by problem formulating and data analysis.

7. Benefits and necessities according to teachers and students differ. Teachers think research based study is useful in practical learning and enhancing analytical ability of students.

8. Qualitative research is more preferred among teachers and Quantitative research is preferable in students.

9. 36% of teachers find hypothesis testing as most complicated part and 40% of students find sampling as most difficult part of research.

10. Reasons for not using research in present curriculum are mainly time consumed and lack of understanding of research.

8. CONCLUSION

Traditional methods of learning include note taking, lectures and group activities. Use of Research enhanced learning & teaching (RELT) is very limited in present curriculum. This paper elaborates reasons on why the research should be given boost and also states some limitations and difficulties due to which research is not widely used. We can spread more awareness regarding learning based on research. Teachers should be provided with timely training and they should motivate students by increasing use of self learning and analysis. Research and development are the core needs of present era. Education cannot be kept limited to exams and high scores obtained by students. Discovery of new knowledge should be promoted equally in this competitive age. To many research is just collecting data and playing with the information gathered. Researchers forget the correct process of building a research, it shouldn’t be questions and then a hypothesis, it should always be a hypothesis 1st. The objective of the research should be clear from the word go and the elements should be built around that.

Also while analyzing data one need to be clear of the processes and precautions to be used, also data filtering is important so that no outliers occur and the plot isn’t hampered. These basics are often forgotten while the students are being informed on how to make a proper research, which further hampers their ability to design, execute, analyze and produce results.

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FACTORS AFFECTING RESEARCH PRODUCTIVITY: AN EMPIRICAL STUDY OF MANAGEMENT ACADEMICIAN IN GUJARAT

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Abstract: Research is vital and necessary part of modern university education; universities are producers of new knowledge. Role of universities is different from the 19th century; demands of the 21st century are enormously higher. Faculties at new capacity building institutions of higher education in India are subjected to strong engagement to participate in academic research productivity. Research highlights new problems, collects data or information about those problems draw conclusions and make recommendations. Research Productivity is one step ahead in research where individual research has some impact or contribution by their usefulness to the society as well as researcher. Measuring the research productivity of faculty is a complex issue, with many contributing factors, in this paper Author has tried to find out the factors affecting research Productivity among faculty of management in Gujarat. On the basis of past researches by various research scholars, 4 main factors as parameters were developed for the study namely Knowledge, Research inclination, Institutional support, and work environment. Research productivity score was calculated on the basis of the API score calculation format of the UGC. The purpose of this study was to determine the factors that explain the research productivity of management academicians in Gujarat.

Keywords: Research productivity, Knowledge, Research inclination, Institutional support, and work environment.

1. INTRODUCTION
"If the core activity of the scholarly and academic professions is the advancement of knowledge, the criterion for determining who belongs to these professions is research productivity". Research is a continue process, in which we search for truth or try to reach near the reality. Research highlights new problems, collects data or information about those problems draw conclusions and make recommendations. Researcher carefully investigates data, analyze data, explain data and verify the facts, research corrects the mistakes, research add and advance the knowledge. Knowledge gained through research is always objective and scientific. Research based knowledge is always logical, rational and based on experience. Rashid (2001), Research is a conscious effort to collect information, to verify the information and to analyze the information. Research is an organized effort to solve the complex and teasing problems. Research Productivity is combination of two words “Research” and “Productivity. “Research” means very careful, observant, and vigilant study or investigation of phenomena, particularly to search and find out new particulars, information and facts. While “Productivity” means production or output, produced in duration of time. Both the words means different to different people. With reference to higher education, research
productivity means, publications of papers in professional journals, in shape of books or presentation of research papers in conference proceedings. To work on projects, publication of monographs, development of experimental designs, production of artistic or creative works. Research productivity and research activity are interrelated. Research means to conduct research, collecting data, analyzing data, productivity means writing, reading and publication of research reports in professional referred journals, displaying on the web or to make it known to public through any other mean, in shape of books or making its presentation on the television or radio. According to Creswell (1986), Research Productivity includes research publications in professional journals and in conference proceedings, writing a book or chapter, gathering and analyzing original evidence, working with post-graduate students on dissertations and class projects, obtaining research grants, carrying out editorial duties, obtaining patents and licenses, writing of monographs, developing experimental designs, producing works of an artistic or creative nature, engaging in public debates and commentaries.

2. DEFINING AND MEASURING RESEARCH PRODUCTIVITY

Measuring the research productivity of faculty is a complex issue, with many contributing factors. Productivity has been measured at a variety of levels, including at the level of individual faculty, at the unit level (for example, the department), and at the institutional level (Dundar and Lewis 1998). Research productivity has been measured as the quantity and/or quality of the artifacts produced by faculty scholarship (Athey & Plotnicki, 2000; Brocato & Mavis, 2005; Dennis et al., 2006; Dundar & Lewis, 1998; Meho & Spurgin, 2005; Park & Rigg, 1993). The criteria that have been used in measuring productivity vary by institution and discipline, and faculty promotion and tenure is typically based in part on those criteria. (Bunton & Mallon, 2007; Dennis et al., 2006; Youn & Price, 2009).

Every profession has a system that is used to evaluate its members. In higher education, past and recent studies have shown that research productivity plays a major role in attaining success in academia as it relates to promotion and tenure, salary, and the fringe benefits of the profession. Studies have also shown that research productivity varies widely from institution to institution depending on the emphasis that is placed on

These faculty members are seen as more powerful educators and often serve as a frame of reference for junior faculty members or others who are developing their own research agenda (Levine, 1997). The factors influencing faculty research productivity have been studied for decades (Lotka, 1926). University generated ideas based on research are important in promoting innovations for economic growth and competitiveness of industrialized economies (Jaffe, 1989; Mansfield, 1991).

3. LITERATURE REVIEW

Magolda (1999) explained the importance of research as a constructive development pedagogy … (in which) teachers model the process of constructing knowledge in their disciplines, teach that process to students, and give students opportunities to practice and become proficient at it. In the process of obtaining and disseminating knowledge numerous characteristics impact faculty research productivity but the academic strength of the faculty and the decision maker leadership characteristics were confirmed as necessary for high levels of research productivity (Bland et al., 2002; Bland et al., 2005). Teodorescu (2000) explained the positive influence between faculty research productivity and faculty
involvement in discipline affiliations such as membership in professional societies and attendance at professional conferences. Brocato (2001) found that individual faculty’s characteristics, such as motivation and demographic uniqueness, were highly correlated with research productivity.

The Dundar & Lewis (1998) study found that faculty research productivity was primarily associated with two attributes: (a) individual attributes that were relate to personal traits and environmental experiences and (b) institutional and departmental attributes that entailed variables related to leadership, culture, structure, and policies. Finkelstein (1984) suggested the highest terminal degree within a field, early publication habits, and sufficient times allocated to research were the critical motivation variables that predicted faculty publication rates. Gomez-Mejia & Balkin (1992) described peer recognition or career advancement was the primary motivation behind research publications. However, researchers debated if intrinsic motivation for research and/or innate urge towards solving research puzzles were crowded out by the extrinsic motivations like career advancement or financial gains. University faculties are the primary actors in research production systems and ultimately, it is their motivations and incentives that influence their output of academic research.

4. FACTORS AFFECTING RESEARCH PRODUCTIVITY

The 1990s was a decade of increased productivity of published research in higher education (Sax, Astin, Korn, & Gilmartin, 1999). Several variables have been reported to be related to research productivity. One key variable is the involvement of faculty with graduate student research. Kelly and Warmbrod (1986) found that the number of doctoral committees chaired successfully resulted in higher faculty research productivity. This was supported by Dundar and Lewis (1998) when they reported that high ratios of graduate students to faculty also correlates with productivity, and the percentage of graduate students that were hired as research assistants correlated highly with research production. Age has been included in several studies with conflicting results. Bland and Berquist (1997) observed that the average productivity of faculty seems to drop with age, however, many senior faculty members remain quite active in research activities and their products are comparable to those of younger faculty members. They also reported that there is no significant evidence that age determines a drop in productivity, but increased workloads and shifting emphasis is to blame.

Gorman and Scruggs (1984) reported that age was related to research productivity. Blackburn et al. (1991) stated that the relationship between age and research productivity had been addressed in many studies and that little if any, and sometimes contradictory, correlations have been found. Gorman and Scruggs (1984) and Vasil (1992) found that the number of years of professional employment was related to faculty productivity. Pfeffer and Langton (1993) reported that total years in the profession had a major impact on total research, but an insignificant effect on recent research productivity. Again, Blackburn et al. (1991) stated that the relationship between educational experience and research productivity had been addressed in many studies and that little if any, and sometimes contradictory, correlations have been found. Faculty members’ confidence in their research abilities is related to faculty research productivity.

Bean’s (1982) model of faculty research productivity included the perceived level of legitimacy in one’s research as an explanatory factor. Increases in ability and self-efficacy were also related to increased research
productivity in studies conducted by Vasil (1992, 1996). Several studies reported the relationship between research productivity and salary (Jacobsen, 1992; Pfeffer & Langton, 1993; Rebne, 1989; Tornquist & Kallsen, 1992). Since salary often reflects research productivity levels, this was expected. Paying attractive salaries in return for performance may serve as an incentive for higher productivity from faculty members. Higher salaries may also attract productive faculty while at the same time minimizing the possibility of losing active faculty to other institutions (Pfeffer & Langton, 1993). The enhancement of the freedom to collaborate results in increased research productivity (Bland & Berquist, 1997). Landry et al. (1996) found that collaboration of all kinds may increase researchers’ productivity.

Pfeffer and Langton (1993) found that collaboration was reduced by wage dispersion. Finkelstein’s early model of research productivity is useful because it provides an initial picture of the attributes of a successful researcher at the individual faculty level. However, Finkelstein’s model does not clearly articulate the institutional factors that affect faculty research productivity. Creswell’s model begins to account for some institutional factors affecting faculty research productivity. He described successful researchers as those who tend to hold a senior professorial rank, spend at least one-third of their time on research activities, publish early in their careers, receive positive feedback from peers for research efforts, and maintain regular and close contact with colleagues on and off campus who conduct research on similar topics. Creswell’s model extends beyond individual characteristics by acknowledging that faculty researchers are more productive when they are employed by a major university that rewards research and assigns sample time for faculty to conduct research. Thus, Creswell’s model acknowledges the importance of the institution and the research culture within that institution on an individual faculty’s research productivity. Teodorescu proposed an international model of faculty research publication productivity. Teodorescu’s model asserted that individual achievement variables and institutional characteristic variables would predict faculty research productivity across national boundaries. In a test of this model across ten nations, Teodorescu found that, although correlates of faculty research productivity varied across national boundaries, faculty involvement in disciplinary affiliations (such as membership in professional societies and attendance at professional conferences) was significantly related to research productivity across all countries. A fifth model by Brocato proposed that faculty research productivity in the context of medical school family practice departments is related primarily to the broad factors of early research socialization, individual faculty’s psychological and demographic characteristics, and the institutional and departmental research environments. He found that individual faculty’s characteristics, such as motivation, professional networks, and research training, were highly correlated to research productivity. He also determined that institutional, departmental, and disciplinary characteristics had a much lower impact on faculty research productivity, especially in relation to the individual faculty’s characteristics.

In the Bland et al. (2002) model, faculty research productivity is highest when a faculty member has specific individual qualities, works in an institution that is highly conducive to research, and is led by someone who possesses essential leadership qualities and uses an assertive–participatory management approach. Further, the Bland et al. (2002) model suggests a hierarchical order to these three sets of qualities. That is, the individual characteristics are essential, but they have more or less power in assuring faculty research productivity depending on how research-conducive the faculty member’s institution is. Finally, the impact of the institution is mediated by the qualities and style of the leader.
Bailey (1992) found that rank is a significant predictor of research productivity. Dundar and Lewis (1998) found that departments with higher ranked faculty had higher research productivity. Vasil reported that rank is a significant predictor of research productivity (1992). Kelly and Warmbrod (1986) stated that “Perceived institutional and departmental support for research are seen as the most important enablers to research productivity” (p. 31).

Panthupa (1997) observed that average research productivity seemed to drop as age increased. But Kotrlik et al. (2002) reported that there was no significant evidence that age determined a drop in research productivity. Jitpitak (1989); Pabhapote (1996); Blackburn & Tien (1996); Dundar & Lewis (1998) and Sax et al. (2002) found that academic position was a significant predictor of research productivity. But Kotrlik et al. (2002) and Williams (2003) stated that there was no relationship between them. It was noticeable that age and academic position were significant factors affecting research productivity in Thai culture, but not in western culture.

Jitpitak (1989), Pabhapote (1996) and Panthupaus (1997) model of research productivity indicated that the researcher ship had total effect and direct effect on research productivity. Researcher ship factors consisted of four indicators, namely 1) thinking factor 2) research mind 3) volition and control, and 4) meeting of international standard. Faculty members’ confidence in their research abilities was found related to faculty research productivity. Pabhapoteus (1996) model of faculty research productivity included research competence factor. Increased ability to do research was also correlated with increased research productivity according to the study conducted by Panthupaus (1997). Research competence factors consisted of five indicators i.e. research skills and techniques, research fund, research management, communication skill, and networking and team working. Faculty members’ confidence in their research abilities was found related to faculty research productivity.

Perceived institutional supports for research work were the most important factors enhancing research productivity. Several studies had confirmed these significant effects on research productivity (Jitpitak, 1989; Panthupa, 1997; Chagsrisang, 2002; Hughes, 1995 and Dundar & Lewis, 1998). Those research references employed several indicators measuring institutional and departmental supports for researchers. The most important indicators were institutional policy that encouraged instructors to do research, institutional library budget and computing facility. (Panthupa,1997; Dundar & Lewis, 1998; Kotrlik et al., 2002;Ratanit, 1993)

5. RESEARCH METHODOLOGY

The research was performed using single cross-sectional descriptive research design. Management academician from different management colleges of Gujarat were considered as sampling units. Convenience sampling method was adopted to reach the respondents. 136 valid questionnaire were taken in to the study. On the basis of past researches by various research scholars, 4 main parameters were developed for the study namely Knowledge, Research inclination, Institutional support, and work environment. Research productivity score was calculated on the basis of the API score calculation format of the UGC.
6. DATA ANALYSIS

Multicollinearity
The issue that needs careful consideration during the data screening process is multicollinearity, defined as the condition in which “intercorrelations among some variables are so high that certain mathematical operations are either impossible or the results are unstable because some denominators are close to zero” (Kline 1998, p.77). SMC (Squared multiple correlations) were carried out to identified the any evidence among the variables. The SMC Scores which are shown in table are below cut of point 0.90 which reveals the lack of multicollinearity among the variables.

Table 1 Squared Multiple Correlations

<table>
<thead>
<tr>
<th></th>
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<td>0.59</td>
<td>0.54</td>
<td>0.71</td>
<td>0.41</td>
<td>0.82</td>
<td>0.51</td>
<td>0.88</td>
</tr>
<tr>
<td>ri1</td>
<td>ri2</td>
<td>ri3</td>
<td>ri4</td>
<td>ri5</td>
<td>ri6</td>
<td>ri7</td>
<td>knw1</td>
<td>knw2</td>
<td>knw3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.69</td>
<td>0.58</td>
<td>0.63</td>
<td>0.59</td>
<td>0.48</td>
<td>0.75</td>
<td>0.65</td>
<td>0.84</td>
<td>0.68</td>
<td>0.46</td>
</tr>
</tbody>
</table>

Outliers
Outliers are the extreme value that inversely affect the analysis and draw towards the wrong conclusion. For the assessment of the multivariate outliers Mahalanobis Distance test was performed. This statistic measures the distance in standard deviation units between a set of scores for one case and the sample means for all variables. P1 value below the 0.05 indicate that particular cases are the potential multivariate outliers. Table shows that nine cases found value below 0.05 which are removed from the further analysis.

Table 2 Mahalanobis Test

<table>
<thead>
<tr>
<th>Observation number</th>
<th>Mahalanobis d-squared</th>
<th>p1</th>
<th>p2</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>71.371</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>62.321</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>62</td>
<td>57.684</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>64</td>
<td>55.114</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>57</td>
<td>47.717</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>39</td>
<td>47.016</td>
<td>0.001</td>
<td>0</td>
</tr>
<tr>
<td>23</td>
<td>43.225</td>
<td>0.002</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>42.269</td>
<td>0.003</td>
<td>0</td>
</tr>
<tr>
<td>75</td>
<td>40.904</td>
<td>0.004</td>
<td>0</td>
</tr>
</tbody>
</table>

Construct Reliability
Reliability is defined as the level of the consistency between the measurable items of a variable’s scale. Three methods were used in this study to evaluate internal consistency of the scale; Cronbach’s alpha, item to correlation and inter item correlation.
Cronbach’s alpha is generally used to measure the internal consistency of the entire scale of the construct. The standard value of the standard value of coefficient alpha is 0.7; above 0.7 indicate the higher reliability. In this study four scales were used and coefficient alpha of that scale are 0.918, 849, 0.908, 0.892 which all are above the cutoff point.

Inter item correlation and item to total correlation also found more than their cutoff point 0.3 and 0.5 respectively which also indicate the good reliability of the scales.

**Confirmatory Factor Analysis**

The constructs were subjected to confirmatory factor analysis (CFA) to verify that the manifest variables load upon the proposed constructs and are indeed indicative of these constructs. The combination of CFA and construct validity assessments allows the researcher to evaluate the quality of their measures within a measurement model prior to testing the structural model. Maximum likelihood estimation procedures are used to estimate the parameter of the full measurement of the model. Figure provides the graphical presentation of the full measurement model. It consist of the 4 latent variables and 21 indicators.

**Measurement Model Validity**

To assess the fit between data and the model the measurement model is run in the Amos software. Not only chi square but one incremental fit index and one absolute fit index researcher should provide for the evidence of the model fit. Table provides the summary of the key measurement of fit for the model.
All the fit indices provide the poor fit for the model. CMIN/DF known as Normed chi-square value below 2 indicate good fit and between 2 and 5 also acceptable, in our case it is 4.115 which is acceptable but other fit indices GFI, CFI and NFI are very low from their cutoff point 0.9 and RMSEA also very high from its standard value 0.08 so it is poor fit.

Modification indices and different estimation like correlation and covariance estimation are closely examines and it provides the evidence of the misspecification of the model. One latent variable (Knowledge) is creating problems in the model. Closely review of the literature also provide the evidence that experience or the qualification like prior PhD and post PhD has impact on the research productivity but not as direct. In our study Knowledge is refers to as the subject and research knowledge which is very strongly correlate to the experience and the qualification. So removing it from model the full measurement model is run again.

It improves the fit index but yet not well for the model fit. Modification indices how many discrepancies go down if two particular variables correlated with each other and standardized residual covariance matrix also is helpful in the model fit. Covariance between two variables one or more indicate the poor fit of the variable in the model. These two modification indices and standardized residual covariance matrix indicate poor fit of the some of the indicator in the model which are removed from the model.

The measurement of the fit indices of the final model of the research productivity measurement are shown in the below table.

<table>
<thead>
<tr>
<th>Table 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMIN/DF</td>
</tr>
<tr>
<td>4.115</td>
</tr>
</tbody>
</table>

Normed chi-square is 2.002 which is acceptable. The RMSEA fit assessment remains significant and indicated the acceptable fit of the model. In the incremental fit all the GFI, TLI, NFI, CFI measurement above cut of 0.9 which provides the evidence for the acceptable fit. All the fit measurement provides the supports for the model fit.

**Construct Validity**

Reliability refers to the accuracy of the internal consistency where the construct validity refers to “how they should be interpreted?” The reliability of the constructs was addressed previously and is a necessary condition for validity; however a construct whose scale is reliable does not automatically make it a valid construct.

Content validity refers to an analysis “of the correspondence of the variables to be included in a summated scale and its conceptual definition” (Hair et al. 2010, p. 125) and is conducted through a subjective assessment rather than an empirical test. The pilot survey
from the highly qualified and experienced professor was done which provide the face validity evidence.

In confirmatory factor analysis, convergent validity is apparent when there is a high degree of shared common variance among the indicators of a construct (Hair et al. 115 2010). Tables show the unstandardized regression weights as well as their associated standard errors and critical ratios. Given that all of the p-values are less than 0.001, the unstandardized factor loadings are statistically significant.

### Table 5 Regression Weights: (Group number 1 - Default model)

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>S.E.</th>
<th>C.R.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>ri4</td>
<td>Research_Inclination</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ri5</td>
<td>Research_Inclination</td>
<td>0.888</td>
<td>0.103</td>
<td>8.61***</td>
</tr>
<tr>
<td>ri6</td>
<td>Research_Inclination</td>
<td>1.044</td>
<td>0.094</td>
<td>11.087***</td>
</tr>
<tr>
<td>ri7</td>
<td>Research_Inclination</td>
<td>1.002</td>
<td>0.098</td>
<td>10.241***</td>
</tr>
<tr>
<td>is6</td>
<td>institutional_support</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>is4</td>
<td>institutional_support</td>
<td>1.021</td>
<td>0.063</td>
<td>16.133***</td>
</tr>
<tr>
<td>is1</td>
<td>institutional_support</td>
<td>0.777</td>
<td>0.069</td>
<td>11.194***</td>
</tr>
<tr>
<td>we1</td>
<td>Wrok_envionment</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>we2</td>
<td>Wrok_envionment</td>
<td>1.056</td>
<td>0.103</td>
<td>10.264***</td>
</tr>
<tr>
<td>we4</td>
<td>Wrok_envionment</td>
<td>0.937</td>
<td>0.101</td>
<td>9.255***</td>
</tr>
</tbody>
</table>

The standardized factor loading of each indicator in the model is used to determine the convergent validity. The ideal cut-off value of the factor loading is 0.7, but 0.5 also provides the sufficient evidence of the convergent validity. The factors loading for each scale are shown in the table. The minimum factor loading is 0.706 which is higher than the minimum value. All the factors loading are above the cut-off value which indicates the acceptable degree of convergent validity. Even though the factor loading provides the strong supports for the convergent validity, two additional assessments AVE and CR are conducted to provide the further evidence.

The average variance extracted (AVE) is the average of how much variation in a scale is explained by the latent variable and Construct reliability (CR) measure the same but also takes into account the error variance for the construct.

### Table 6 Standardized Regression Weights: (Group number 1 - Default model)

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>ri4</td>
<td>Research_Inclination</td>
</tr>
<tr>
<td>ri5</td>
<td>Research_Inclination</td>
</tr>
<tr>
<td>ri6</td>
<td>Research_Inclination</td>
</tr>
<tr>
<td>ri7</td>
<td>Research_Inclination</td>
</tr>
<tr>
<td>is6</td>
<td>institutional_support</td>
</tr>
<tr>
<td>is4</td>
<td>institutional_support</td>
</tr>
<tr>
<td>is1</td>
<td>institutional_support</td>
</tr>
<tr>
<td>we1</td>
<td>Wrok_envionment</td>
</tr>
<tr>
<td>we2</td>
<td>Wrok_envionment</td>
</tr>
<tr>
<td>we4</td>
<td>Wrok_envionment</td>
</tr>
</tbody>
</table>
Table provides the reports of the both AVE and CR measure the three construct in the model.

<table>
<thead>
<tr>
<th>Table 7 Average Variance Extracted and Construct Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
</tr>
<tr>
<td>Research_Inclination</td>
</tr>
<tr>
<td>institutional_support</td>
</tr>
<tr>
<td>Wrok_envionment</td>
</tr>
</tbody>
</table>

The inspection of the AVE score and CR analysis indicate that all the loadings are exceeding the cut off value 0.5 and 0.7 respectively. All the measurement provides the substantial evidence of convergent validity.

**Discriminant validity**

Discriminant validity refers to the degree in which a construct being measured in the study is not similarly measured under a different construct and is therefore unique from other constructs. To provide evidence of this type of validity, researchers typically conduct a comparison of squared values of the estimated correlations between the constructs and the average variance extracted (AVE) from each construct. If the variable’s AVE value is higher than the square of the estimated correlation between it and another variable, then there is evidence to support an acceptable degree of Discriminant validity between these variables.

The overall results from comparing AVE estimates to their corresponding inter-construct squared correlation estimates were indicative of Discriminant validity among these variables.

<table>
<thead>
<tr>
<th>Table 8 Discriminant Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
</tr>
<tr>
<td>Research_Inclination</td>
</tr>
<tr>
<td>institutional_support</td>
</tr>
<tr>
<td>Wrok_envionment</td>
</tr>
</tbody>
</table>

**Nomological Validity**

The correlation among constructs should be grounded in and remain consistent with existing theoretical research. This consistency is generally referred to as nomological validity and can be determined by an assessment of the correlation values between constructs within the CFA model that has set the constructs’ variance to 1.0 (Hair et al. 2010).

<table>
<thead>
<tr>
<th>Table 9 Correlations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research_Inclination</td>
</tr>
<tr>
<td>Research_Inclination</td>
</tr>
<tr>
<td>institutional_support</td>
</tr>
</tbody>
</table>
The correlations among the variables are positive and significant which provides the strong evidence of the nomological validity.

The path analysis model in figure 1 shows the standardized regression coefficients which depicts the amount of impact one latent variable has on research productivity. Institutional support, research inclination and work environment all three variables were influencing positively and significantly on the research productivity. Impact of the work environment was found more significant compared to the other two variables.

7. CONCLUSION:

Research is endless process where one end will give the new beginning. This study was proposed to find out the factors affecting research productivity in inclination with Management academicians of Management colleges in Gujarat. On the basis of past researches by various research scholars, 4 main factors as parameters were developed for the study namely Knowledge, Research inclination, Institutional support, and work environment. Research productivity score was calculated on the basis of the API score calculation format of the UGC. As result shown Institutional support, research inclination and work environment all three variables were influencing positively and significantly on the research productivity. Impact of the work environment was found more significant compared to the other two variables. These three parameters give positive impact on research productivity while on parameter named knowledge is not statically positive in this research.
REFERENCES:


Entrepreneurship and Innovation in Engineering Education to Meet Recent Changes in the World

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Abstract: Recent changes in the world and engineering present both challenges and opportunities to engineering education. Engineering education is changing to meet these challenges. More and more engineering programs attempt to include entrepreneurship and innovation. Aim of this paper is to discuss whether computer knowledge is necessary for all engineers to contribute to modern lifestyle development and if it is, how to teach latest technology, use of software in daily life, easier execution for non-technical people.

The paper reflects on academic work culture in technical institutes or organizations, aimed to develop and test an educational model for teaching engineering students. Findings showed that use of computer knowledge group oriented teaching may contribute to training communicative skills. It is necessary to start with the teachers' roles, training them in demonstrating social dimensions in professional situations.

It also could be of great value to invite engineers from various workplaces to act like role models within the education programme. Authors present their view on teaching entrepreneurship to engineers and describe their experience to introduce entrepreneurship in engineering education.

Keywords: Entrepreneurship, Innovation, Breakthrough products, Software business, Technology sales.

1. INTRODUCTION
An entrepreneur is a person that takes a risk to start and operate a business. Not everyone is cut out to be an entrepreneur. You need to have entrepreneurship, which is the ability and willingness to take the risk to develop and operate a business for profit or a non-profit organization to serve the needs of a particular group.

The reason that there are few jobs to be found in academics is not because there are too few colleges, universities, departments, or programs. Rather, there are too many. The problem is that the bulk which apply for these jobs are far too huge. Now- a- days there are simply too many PhDs produced every year for the higher education establishment to absorb them all, but the quality has certainly deteriorated. Today, businesses are looking for innovative solutions from the academia to help meet their business needs of higher productivity and lower costs, yet increase efficiencies. As far as talent in India is concerned, attention needs to be paid towards technical and management resources as these are crucial to knowledge-based industries. A market-driven approach to higher education has to be fostered in order to encourage manpower development from the grass root level itself.

Reasons behind the Gap between Academia and Industry
1. Academicians and industrialists have a different mindset; therefore both have different perspectives and expectations.
2. The curriculum is static in nature while its application is dynamic.
3. Both academicians and industrialists are pursing different goals entirely. The academic is striving for recognition from his or her peers. The Industrialist is striving to survive.
4. Lukewarm attitude of lecturers to surrender themselves for trainings and workshops.
5. Industry thinks in terms of short range goals whereas academic has a long range perspective.
6. Industry prefers proven solutions with a low risk, whereas academia is interested in creating new solutions with a high innovation rate.
7. Industry seeks the minimum solution to minimize their risk, whereas academia strives for a maximum solution to maximize their recognition.

Following points are important for teaching professionals in engineering colleges, medical colleges and other professional institutions:
- Reasoning and inferential skills
- Accurate and fluent reading skills
- Use of strategies to improve situations
- Enhance interests in tasks and material
- Analyzing the weakness of students
- Better understanding the concepts
- Developing better communication skills
- Inculcate confidence

Barriers in Communication
Skilled teaching professional considers the following barriers while teaching:
- Unwillingness to say things differently
- Unwillingness to relate to others differently
- Unwillingness to learn new approaches
- Lack of enthusiasm
- Voice quality
- Prejudice
- Language and vocabulary level
- Lack of self awareness.

2. TECHNICAL EDUCATION IN INDIA
In the current academic year only 40% seats are filled by ACPDC and 63% seats are filled up by ACPC in which some colleges recorded only 3 to 6 students enrolled and forced to shut the door for new admission. Such a situation prevails all over states of India as here only 23% to 45% seats of engineering are filled up and this trends are continuous since last five years. This is due to poor quality and under-employment of engineering graduates. According to AICTE Chairman’s statement at a seminar on “National Vocational Quality Education Framework” Graduate Enrolment Ratio in India is still much lower than that of the developed countries and it is even lower than that in China. On the contrary many HR managers of large companies complain that they are not able to get talented engineers. Owing to this it has come to the notice that AICTE is going to reduce the 1-Lac seats of Engineering all over India due to poor quality of engineering graduates and inability to control by Universities from academic year 2016-17. It’s a good step, if taken by the Decision Makers but at the same time at least 20,000 seats should be raised at ME/MTECH with new concept of incentives based and Pro. Vice Chancellor condition, conditionally those Universities have project and candidate / students are willing to work on that project. Again they are free to move on another project returning the all incentives they have drawn against previous project .Universities may also give admission twice a year (June / December) to distribute the project work and fasten the ripe out time. If the facilities created in various states, are to be used optimally, universities will have to understand why the statements of Policy Makers seem to be odds with the
situation. Universities should keep their syllabi continuously updated and to involve industries and businesses in estimating the requirements during the next decade. It also requires a continuous stress on practice-orientation and skill development as an integral part of the syllabi. Along with it, the Faculty Members will have to be provided opportunities to obtain better practical experience through better equipped laboratories and workshops to work in industries.

**Design Based and Project Based Learning System:** Gujarat Technical University started the process of updating its syllabi on design – based learning system from July 2013 and open ended problems were included in the practical work. Experts in design engineering from all over the county were invited to present their views to permeate design engineering into the whole of the engineering syllabi. It was a good effort by GTU to give the vision and a new dimension to the engineering filed but not a final solution.

### 3. KEY POINTS FOR ENGINEERING EDUCATION IN RELATION TO BUSINESS

**Global Markets, National policies and the competitive Advantages of firms:** This point examines the opportunity and risk that firms face in current global world. Also this provides conceptual tools for analyzing how governments and social institutions nurture economic competition among firms in different national settings. Public policies and institutions that shape competitive outcomes are examined through cases and analytical readings on different companies and industries operating in both developed and emerging markets.

**Managing Technological Innovation and Entrepreneurship:** It focuses on challenges inherent in attempting to take advantage of both incremental or scheduled innovation and more radical or world-shattering changes in products and processes. Highlights the importance of innovation to both new ventures and to large established firms and explores the organizational, economic and strategic problems that must be tackled to ensure innovation is a long term source of competitive advantage.

**How to Develop "Breakthrough" Products and Services:** Firms know they must develop major innovations to do well but they don't know how. Recent research into the innovation process has solved the puzzle and made it possible to develop "breakthroughs" systematically. Subject presents several practical concept development methods, explains how and why each works, and the conditions under which each is effective.

**The Software Business:** Seminar-style subject for those interested in founding or growing an enterprise or consumer software company (products, services, or both), or working as a software company manager, product or program manager, or industry analyst. Examines approaches used for organization and product development at successful companies ranging from Microsoft and IBM to a variety of relatively new companies. History of software as a business as well as key trends in different software markets. Student-teams help teach weekly sessions and analyze "interesting companies" selected by students, which form the basis for team projects.

### 4. ROLE OF UNIVERSITY FOR RESEARCH AND DEVELOPMENT

Whatever measure may be used for the research outcome of a University, we have to accept the facts that even our best university are much less innovative than even a middle-level university in the previous world. There are many reasons for these lacunae. One reason is that our university structure are not designed for facilitating research work, nor are these designed to promote excellence in “teaching methods” by using today’s tools. Functionally the university system in South Asia is designed
for organizing a centralized examination system, which can deliver passport (degree certificates) for government jobs.

In India, the statutes of universities have no provisions for a Pro, V. C. (Research). Even state universities cannot add such a facility, since the Acts, under which the universities are established, do not leave much of authorities with the universities for being able to create their own administrative structure for adapting and equipping themselves to be able to cater the needs of the dynamic world of today.

This can only be done by changing the statute of the universities by the legislature, the society comprises of association of universities teachers, courts and popular governments are in-active to create a more conductive set of service conditions for incentivizing research. Due to the insufficient understanding of the needs of the universities of today, the government fails to provide the necessary facilities / financial autonomy to their state universities.

All universities should be highly stimulating and generate many useful ideas, products and processes to sustain such communities, governments, trusties and industries jointly should start the set up for supporting research at universities. Universities should be responsible to create environment where a Faculty Member cannot survive without doing meaningful research. Administratively, every university should have the office of the Pro Vice-Chancellor (Research). The core components of the office are Intellectual Property Rights (IPR) cells and Entrepreneurship unit which should facilitates the university community to access the resources for research.

Many universities have associated incubators. Such incubators are usually independent entities; Board of University Incubators should be chaired by Researchers. The activities under a Researchers Community seem an essential requirement for a university and should be accepted by everyone concerned in the developing countries. As the competition among the nations has become more intense, the discussion should be about strengthening the office of the Pro Vice Chancellor further.

The following points summarize the role of university in research and development.

1. University should set up an incubator where various policies should be discussed, debated and should be put under pilot testing mode; their policies should be related to student start-ups in general and other similar areas, the policy incubator should hold dialogues, discussions and conferences to assemble wider perception and learn from best practices. It should develop the next practices for student entrepreneurship across all universities.

2. University should bring pedagogical interventions like permeating design thinking into the entire syllabi of all its courses and innovation & entrepreneurship programs in practice mode. The universities should facilitates start – up process by seamlessly integrating the incubation value chain into the academic programs in order to have early exposure of incubation value chain to potential student start-ups.

3. A student or a Faculty Member should be permitted to apply for approval of a special elective, designed by the students or the faculty members. This will help the student – entrepreneurs of scalable start – ups to opt for special elective subjects on innovation entrepreneurship and other relevant subjects, as required by these entrepreneurs.

4. University should create a collaborative online platform for linking student start-ups so that they may be able to share their challenges, to link with suitable mentors and to catalyze cross pollination of innovative ideas and to leverage complementary resources and skill sets.
5. **TECHNOLOGICAL ENTREPRENEURSHIP**
Overview of the field of entrepreneurial theory and practice for development and growth of technology-based new enterprises is essential. Weekly lectures by academic and practitioner faculty engaged in the TBI Entrepreneurship Program, supplemented by presentations by and discussions with leaders of TBI entrepreneurship-related activities, e.g. Technology Licensing Office, Venture Mentoring Service, as well as successful entrepreneurs and venture capitalists. Fig. 1 gives an idea of increased diversity and complexity of new product instructions.

**Strategies for technology based New Business development:** This course explores strategic and organizational issues in the development of new technologies and new business areas for existing firms. Issues are examined from the perspectives of both large corporations and emerging, technology-based enterprises. Linkages between internal and external sources of technology in major new business development are discussed. Internal entrepreneurial ventures, alliances (especially between large and new companies), joint ventures, acquisitions, corporate venture capital investments, and contract product development as alternative approaches are examined. Through lectures by faculty and outside speakers, the course offers a brief overview of issues faced in developing technology strategies and plans.

**Commercializing Emerging Technologies:** Students participate in a hands-on experience evaluating commercial feasibility of innovative research emerging out of grants to School of Engineering faculty for Technological Innovation, as well as faculty research projects. Student projects cover critical aspects of commercialization such as developing an intellectual property strategy, performing competitive analysis, selecting the target application and market for the technology,
identifying the appropriate business model for commercialization, designing a go-to-market-plan, and choosing the sales approach to garner initial customers.

Lectures expose students to the key issues of technology transfer, new venture creation, commercialization & develop strong skills in communication and working as teams. Resume and application including brief statement of objectives are required before registration to enable best match of students with projects. However the permission of instructor/project guide is required.

6. TECHNOLOGY AND ENTREPRENEURIAL STRATEGY
This point focuses on building a technology strategy in start-up organizations in new industries. It outlines tools for formulating and evaluating technology strategy in entrepreneurial start-ups, including an introduction to models of technological evolution, models of new-firm strategy development, and models of organizational dynamics and innovation. This include the strategy for: making money from innovation; competition between technologies; strategies for competing against established incumbents; organization of R&D; technology portfolio development; and theories of diffusion and adoption. Figure 1 shows the courses in the learning institution to build a firm foundation for a productive engineering career in a manufacturing, design and product realization.

Designing and Leading the Entrepreneurial Organization:
This subject is about building, running, and growing an organization. Subject has four central themes: (1) How to think analytically about designing organizational systems, (2) How leaders, especially founders, play a critical role in shaping an organization’s culture, (3) What really needs to be done to build a successful organization for the long-term; and (4) What one can do to improve the likelihood of personal success. Not a survey of entrepreneurship or leadership; subject addresses the principles of organizational architecture, group behavior and performance, interpersonal influence, leadership and motivation in entrepreneurial settings. Through a series of case studies, lectures, readings and exercises students develop competencies in organizational design, human resource management, leadership and organizational behavior in the context of a new, small firm.

Digital Innovations: Digital Innovations is a spring seminar surveying the blossoming arena of social software, particularly applications based on smart phones. It explores the possibilities of this technology through research test beds, which are systematically deployed research lab prototypes that attempt to shape human behavior and communication in organizations while systematically observing the (often unexpected) social consequences. All students are expected to:
(a) participate in the exploratory phase of one of the technology test bed projects, (b) form teams to design novel experimental tools/artifacts and/or applications, (c) run at least one rigorous experiment, and (d) write a summary project report. In the past these projects have been the basis for future research, publications, and spin-off ventures.

Technology Sales and Sales Management: Nothing happens until a sale is made. That simple point underlines the critical importance of sales to the entrepreneur. Almost every business plan "assumes" a certain amount of sales, but that assumption is the tipping point. Without sales, the entire business model is an exercise in frustration.
Figure 1. Increased diversity and complexity of new product instructions.

Figure 2. The courses in the learning institution build a firm foundation for a productive engineering career in a manufacturing, design, and product realization.

A modern organizational interlinked management network shown in Fig-3 that describes the best and suitable function of entrepreneurship and innovation in engineering education. Sales are the one function that can't hide behind the veil of corporate doubletalk; sales goals are either made or not made. Every entrepreneurial activity leverages off that single fact. Markets are not totally rational organizations and the firms with the best sales teams usually will win.

7. CONCLUSION

The entrepreneur must not only understand the sales process, but also embrace the fact that the ability to sell is the single most critical success factor of any new enterprise. This course does not approach sales from the vaunted perspective of 'strategy.' It gets right into the very practical and tactical ins and outs of how to sell technical products to a sophisticated marketplace. Then it moves into the more complex subject of how to build and manage a sales force and covers subjects such as building compensation systems for a sales force, assigning territories, resolving disputes, and dealing with channel conflicts.

In a larger sense, the entrepreneur has to "sell" his vision to prospective employees, to angel and venture investors, and to strategic partners. This course focuses directly on selling to customers, whether that is through a direct sales force, a channel sales force, or building an OEM relationship.

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A NOVEL METHOD FOR CONVERTING COMPLETE DTM RASTER DATA TO ANSYS WORKBENCH

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Abstract: A novel method has been proposed for converting complete digital terrain model (DTM) raster data to the file format which is compatible to ANSYS Workbench. The recommended algorithm is relatively simple and can be used for converting any Geographic Information System (GIS) raster data to ANSYS Workbench irrespective of its size. Design tools namely ArcGIS and SolidWorks are used for importing and manipulating the GIS raster data and their instructional file in ANSYS Workbench for generating the computational mesh. The process of creating computational mesh is straightforward and enables the Computational Fluid Dynamics (CFD) modeling in simple as well as geometrically complex environmental sites in all fields of engineering for safety analysis. The stated method has been verified on a realistic case study of Srinagar City in India with area ranging over 450 square kilometers and elevation varying up to few kilometers.

Keywords: Raster data, ArcGIS, SolidWorks, CFD, ANSYS Workbench

1. INTRODUCTION
Precise and consistent Computational Fluid Dynamics (CFD) simulations of wind flow over natural complex terrain are essential for a broad range of applications including dispersion of pollutants, emissions from vehicles traversing the streets, odor dispersion from livestock production, wind energy resource assessment and ship maneuvering in channels and near harbors. CFD models are capable of fully resolving the wind velocity profile and pollutant distribution and are often used as a tool in public health and safety analysis, and emergency readiness.

In the past few decades, a very large number of CFD studies of wind flow over hills with simple and complex terrain have been performed. Integration of geospatial technologies and CFD models will help to quantitative analysis of environmental factors, such as terrain, buildings, wind direction, wind speed, solar radiation and so on. Zolfaghari (2009) used GIS raster-based data models to model topographical features in a cell-based system that provides a framework for implementing many geographically referenced seismic factors into seismic hazard modeling. Hong et al. (2011) developed an aerodynamic model to qualitatively predict odor dispersion originating from livestock production facilities on their surrounding communities. Zafar and Cutchright (2014) used ArcGIS to create a maximum extractable depth raster for both maximum well depth and maximum extractable depth in regions of Texas. The thermal energy in place is then derived through integration of the geothermal gradient raster over the block volume defined by the maximum depth raster to estimate thermal energy in place. Ion et al. (2014) provided a data porting tool to build hexagonal raster using information from a rectangular raster data in GIS format which involves a computational algorithm and an open source software. The algorithm allows one to build the hexagonal raster with a cell size independent from the geometry of the rectangular raster. They validated the method by analyzing errors in some theoretical case studies followed by other studies with real terrain elevation data. Barnes et al. (2014) presented processing raster digital elevation models (DEMs). They modeled the flow by superimposing a gradient away from higher terrain with a gradient towards lower terrain resulting in a drainage field exhibiting flow convergence, an improvement over methods which produce regions of parallel flow. Watson et al. (2015) addressed the cultural and technical challenges associated with the application of information derived from 3D geological
framework models by hydrogeological process models. They presented a tool, SurfGrid, by which a user can generate 3D grids (voxels) of parameterized data from a series of geological surfaces. The procedures and tools described offer the ability to re-use expensively created assets by providing user friendly techniques that enable multidisciplinary scientists to extrapolate property distributions from geological models. Jacobson et al. (2015) introduced a new tool, GE Grids that created an interactive user-specified binary grid laid over Google Earth's high-resolution imagery. Using GE Grids, they identified anthropogenic land conversion across East Africa and compared that against available land cover datasets. Blocken et al. (2015) studied the assessment of complex mean wind-flow patterns and the funnelling effect by the natural complex topography on the wind by the 3D steady RANS approach with the realisable k–ε model.

The extensive usage of numerical models has enabled various earth-system models for the successful exploration the large-scale datasets for scientific research and engineering applications. This requires the capability of efficient storage, retrieval, integration and visualization of these large datasets. Geographic data files are normally very large due to the high degree of accuracy needed to produce the high quality authoritative cartographic and topographic maps, data and services for the respective applications. The efficiency in terms of both storage space and speed needs to be increased with the increase of easiness for capturing large volumes of high-precision spatial data and the subsequent reliance on automated methods for handling such data. Now days, the graphic data are mostly captured in raster instead of vector format. The raster model has a number of advantages over the vector model in terms of simplicity, low cost and speed, together with suitability for proximity analysis, modeling and simulation, intervisibility, and boolean operations. There are many raster algorithms available to perform a wide range of tasks. Peuquet (1979) presented an algorithm for the modification of cartographic or any similar type of raster-formatted line drawing data which operates on rasters exclusively. Belch (1987) analyzed the raster based 2D vector graphics system having reduced resolution with the possibility of smooth fractional zoom, maintaining constant line width, with automatic detail addition and increased magnification. It was resulted from the display's ability to traverse quickly a large host-loaded display file, applying 2D transformations, clipping to a viewpoint, and drawing into double-buffered pixel memory. Chauveau and Chin (1991) described the use of computer graphics interface to support raster virtual devices by integrating the output primitive functions and the raster operation functions in order to draw pictures on raster virtual devices. Maguire (1992) proposed the raster GIS design model that supports a wide variety of typical GIS data capture, checking, manipulation, analysis, and display functions. Plumb (1993) presented a compression technique which incorporates the spatial nature of the raster data with then existing methods for compressing text (ASCII) files. Poynton (2003) introduced a compressed image with reduced storage or transmission requirements for the raster image data. Chu et al. (2005) discussed the dispersion characteristics of emissions from vehicles traversing the streets for different wind speeds and wind directions. Antoniou and Tsoulos (2006) have addressed the transformation of raster data into XML format and their subsequent visualization through SVG in order to give an overview of the steps which can be followed to embody open standards and XML technologies in the raster domain. Yu et al. (2012) developed a comprehensive GIS-based data management and publication framework (GMPF) and applied that to the use, representation, and analysis of hydrodynamic modeling results of Hamburg Port, Germany. However, there are no raster algorithms available in open literature for analyzing very large geographical data files. The present paper proposes a novel methodology for converting complete digital terrain model (DTM) raster data to the file format which is compatible to ANSYS Workbench. Authors used SolidWorks as the intermediate software between ArcGIS and ANSYS Workbench for manipulating GIS raster data. The present research work is based up on an area of 10 km × 10 km at Srinagar City in India. The advantage of this method is that it can be used for any DTM raster data irrespective of its size.

2. PROCEDURE FOR CONVERTING DTM RASTER DATA TO ANSYS WORKBENCH

GIS model is a mathematical representation of geographic objects or surfaces as data that offers
powerful technologies for use in various integrated calculations. The vector data model represents geography as collections of points, lines, and polygons whereas the raster data model represents geography as cell matrices that store numeric values; and the Triangulated Irregular Network (TIN) data model represents geography as sets of contiguous, non-overlapping triangles. The algorithm for converting DTM raster data to Ansys workbench has been represented in Figure 1.

The DTM Raster data can be transferred from ArcGIS to SolidWorks in WRL format as graphics body, surface body and solid body. However, authors have chosen the solid body format as it has the best compatibility in terms of maintaining the surface topology (texture) that has to be used for modeling in SolidWorks. But the transformation from ArcGIS to SolidWorks comes out with the distortion of the domain when the domain size is large. To the authors’ knowledge, no techniques are available in open literature for transferring larger domain.

In the present paper, authors have proposed the clipping of the complete DTM raster data to subparts in ArcGIS and subsequently re-assembling them in SolidWorks in order to achieve the complete domain with intact surface topology. In Figure 2, the GIS data of Srinagar city in India obtained from Google Earth has been presented.

The total area of the selected region ranges over 450 square kilometers and elevation varies up to few kilometers. The elevation of a selected region of 10 km × 105 km area from the total GIS raster data over sea level is presented in Figure 3.

3. CONVERTING DTM RASTER DATA TO TIN AND TIN TRIANGLES

![Figure 1: Algorithm for converting DTM raster data into ANSYS Workbench CFD model.](image1)

![Figure 2: GIS raster data for Srinagar City in India as obtained from Google Earth.](image2)
Figure 3. Elevation of a selected region of 7.5 km × 7.5 km area over sea level.

As the size and texture of the DTM raster data gets distorted when directly transferred to SolidWorks, authors have suggested for clipping of the complete DTM in ArcGIS to sub-parts and subsequently reassembling in SolidWorks that will permit the size and texture of the complete domain to be maintained. The sectioning of the DTM raster is shown in Figure 4.

First, the raster data is transferred to TIN data and subsequently to TIN triangles with the use of ArcMap (a part of ArcGIS tool). The TIN triangles are then clipped into several subparts by using ArcScene (a part of ArcGIS tool). The TIN triangle files are exported as WRL file format to SolidWorks (CAD Software). The multiple clips which are created in ArcScene are reassembled in SolidWorks. Then a CAD file either in the form of Parasolid or STEP or IGES formats are exported to ANSYS Workbench. The complete conversion of DTM raster surface to TIN surface to TIN triangles and finally to raster surface in ANSYS has been presented in Figure 5.

Figure 4. Clipping of the total area into subparts.

Figure 5. Complete transformation of DTM raster surface to raster surface compatible in ANSYS Workbench.

4. CONCLUSION

The complete DTM raster data is transferred to file format compatible with ANSYS Workbench with the help of ArcGIS and SolidWorks. There are no loss in the texture of the surface from the DTM raster data to the data file in Ansys Workbench. Irrespective of the extent of the DTM raster surface, the converted file into ANSYS Workbench has the scope to perform the CFD analysis of toxic gas dispersion in the nearby areas of any industries in the city. This can be used for better planning of any city from safety point of view of major habitants. The effect of solar radiation and the wind flow in any particular region can also be addressed for any particular of the year.
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DEVELOPING MORE CAREER OPPORTUNITIES FOR ENGINEERING STUDENTS THROUGH PROJECTS

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Abstract: Project for undergraduate students are very important in realistic learning of engineering and technology. Here, students are free to choose their domain where they can transform their ideas into realities. They involve themselves by choice and hence good scope of learning is possible. The project provides many aspects of learning like design thinking, experimental work, development work, programming, computer aided design and analysis, analytical approach, literature review, report writing etc. Gujarat Technological University focuses on research and development through undergraduate projects and hence all students pass through mandatory patent study and patent draft exercise.

This paper focuses on developing more options of project domains, which will help them to develop their career in the selected domains. These domains are developed according to need of the common man, hence it is also helpful to society. The level of research and development which is expected from undergraduate students as mass activity is not justified. All individual students have variable intellectual level hence, according their interest they should take up various aspects of research not whole research as a project. They should be involved in the areas like conceptualization of ideas, detailed design, various production aspects including experimental work, and further improvement aspect.

Keywords: Project, Problem Based Learning, Project outcomes

1. INTRODUCTION

Project work is an important element for undergraduate students. Here, students get an opportunity to transform their ideas into realities. Students get huge exposure of applying engineering principles during project development. Many times it has been observed that projects are helpful to students to get a good placement. Students may get good start-up advantage from the project, if it is successful development. Many times Computer and Information Technology students are transforming their projects in to business ideas and developing their professional career. Same is difficult for hard core engineering disciplines since, they require huge investment and manpower. The project is always a team work, hence sometimes they get opportunity for interact in the groups or outside the groups, which helps them to learn human resource and management along with technical learning of the concepts.

Engineering students have major two options after graduation in all branches of engineering. The first option is further study and second is placement in any industry. Since, Gujarat Technological University is making good attempts to develop research attitude in engineering students at graduation level as well as post graduate level. Research is basically very intellectual activity and which is difficult to carry out in higher population. Hence, project may be either prototype development of any idea or measurement, evaluation, experimentation or improvement of any existing system.

Gujarat Technological University has integrated following activities for
undergraduate students through curriculum for the development of research aptitude.

- Development of Design thinking process in Design Engineering course.
- Freedom to select Industrial Defined Problems and extending help to industries for technical support.
- Understanding societal needs and transforming them to canvas board activity.
- Developing business model through canvas board activity.
- Providing platform to represent innovative ideas through project work.
- Introduction of Active Learning activities to update students with modern technology.
- Introduction of Open Ended problems for thinking out of the box exercise.

Master Degree courses:

- Learning and understanding research methodology.
- Promoting literature review through mandatory tutorials in several courses.
- Promoting self study through seminar course.
- Detailed, progressive and exhaustive evaluation of dissertation work.
- Orientation towards mathematical thinking by specific course.

All these activities are appreciable, and really worth for interested students. But such intellectual work should not be expected from every individual student. All students have variable intellectual quotient, and hence mentoring such a large population for very high expectation is very difficult. Only formal introduction of such concepts will leads to follow as per instruction by students and faculty members. But, this way we are reducing its importance. All student mass should not be diverted towards research, but more optional career opportunities needs to be developed. Hence, further more directions needs to be identified as career opportunities through project work.

Figure 1: Common task for every one

2. OBJECTIVES:

The objective of this paper is to open-up more domains for the project work for the under graduate students. This paper discovers various domains which are useful to select the project for the students. It also validates that the problem based learning is better approach for learning purpose students.

3. RESEARCH METHODOLOGY:

Various logical domains are identified in which students can contribute for the development, or improvement of technical applications. The ideas are developed by brainstorming and interactions with various students.

4. LITERATURE REVIEW:

S Chandrasekaran (2012) has classified the students project in to three groups namely university projects, industry projects and community projects. Community projects provide a unique opportunity to extend student learning and broaden experiences beyond the academic environment. He has stated that learning through projects has a positive effect on student content knowledge and the
development of skills such as collaboration, critical thinking, and problem solving which increases their motivation and engagement. It is a challenging task for academic staff to implement a project-based approach and integrate technology into projects in meaningful ways. He has also mentioned that the benefits of learning through projects include enhanced students' participation in the learning process (active learning and self-learning), enhanced communication skills, addressing of a wider set of learning styles, and promotion of critical and proactive thinking skills.

Mushtak Al-Atabiandand S.B. Chin (2007); have mentioned a case study of flow visualization (fluid mechanics) in the project work. They observed that better knowledge and understanding of fluid turbulence, Reynolds number and the characteristics length of a given problem were achieved in the process. Besides gaining better understanding of fluid mechanics, the students exhibited a great deal of enthusiasm and ownership in the course of project that is constructing and testing the channel. Students’ enthusiasm and motivation were observed apparent throughout the course.

Eric Constans and Dr. Jennifer Kadlowec (2011) have suggested one important change in the curriculum of engineering students that the increase in time allotted for project-based learning in each of the core areas: thermal-fluid sciences, mechanical design, and system dynamics/control. This suggestion is accepted by the university and it is implemented in curriculum. Finally, they got positive outcomes in terms of students’ development.

Noel Entwistle’s paper describes the ways in which learning outcomes have been, or will be, investigated within the Technology Learning Research Programme (TLRP) projects in higher education. It introduces the term ways of thinking and practising which has been used in one of the projects to describe the intentions of staff in higher education. This analysis led, first, to a classification of the projects in terms of different kinds of learning outcome and then to an exploration of the use of the contrasting metaphors of ‘acquisition’ and ‘participation’ to understand the nature of the differences in the ways ‘outcomes’ have been conceptualized.

Joseph Hitt (2010) has elaborated on Problem Based Learning (PBL) approach. Problem-Based Learning (PBL) is an educational approach that is learner focused. The focus shifts from a method of instruction that is teacher driven and led to one where the student is empowered to conduct self-directed learning. The learner is mentored and encouraged to conduct research, integrate what is learned, and apply that learning to develop a viable solution to an ill-defined problem. PBL is a learner focused educational approach where the student extends previous knowledge to new problems through self-directed reflection, research and practice in solving a problem.

Lawrence E. Carlson and Jacquelyn F. Sullivan have concluded that the new Integrated Teaching and Learning Laboratory culminates the vision and years of planning and risk-taking by a dedicated team, beginning with the concept of a revitalized curriculum. Both the curriculum and the laboratory are dynamic, evolving entities. Now that the laboratory is in its second year of full-time operation, the driving force for all of those involved continues to be same as for the students the excitement of learning by doing.

Mills and Treagust (2003) has mentioned the benefits of Problem-based learning also results in better communication and teamwork skills, helps to understand professional practice; and guides how to apply learning to solve problems. PBL starting with medical education in the 1960s have had widespread appeal in engineering education. The efficacy of a fully integrated PBL program such as the one at Aalborg University is debatable in part
for the lack of conclusive evidence and in part for the hierarchical structure of engineering education.

Mills (2002) had been proposes PBL to promote the integration of knowledge in structural engineering. She states that the traditional “chalk and talk” techniques remain the dominant form of instruction in engineering.

Lizabeth Thompson Schlemer, Sema E. Alptekin, and Karen Bangs have mentioned in his article that Integrating three courses (one sophomore level, two senior level) through Project Based Learning (PBL) within the Industrial Engineering curriculum.

Gwen Solomon has mentioned in his article that when students are challenged to get to work solving real-life problems, the whole world becomes a classroom. Here we offer a guide for getting started. In project-based learning, students work ingroups to solve challenging problems that are authentic, curriculum-based, and often interdisciplinary. Learners decide how to approach a problem and what activities to pursue. They gather information from a variety of sources and synthesize, analyze, and derive knowledge from it. Their learning is inherently valuable because it’s connected to something real and involves adult skills such as collaboration and reflection. At the end, students demonstrate their newly acquired knowledge and are judged by how much they’ve learned and how well they communicate it.

5. STRATEGIES FOR MANAGEMENT OF PROJECT:

1. Problem based Learning: Engineering is very vast. Every product involves different engineering concepts, mechanisms, principles, and material behaviour. Hence, problem based learning is better strategy. Students may select any problem and they may try to design and develop with little innovation. The execution of project through problem based learning will help to learn.

2. Promotion of innovations: Applying innovative ideas to existing products is another approach of learning. Innovation in design and manufacturing will affect the performance of the product.

3. Improvement aspect: Identifying alternative to existing methodology is an improvement aspect of engineering. Students may try to observe the existing manufacturing methodology and they may identify any better alternative of manufacturing the product by reducing input, reducing cycle time, reducing rejection and improving quality of the product. There is always a better way to do some work. Students may take-up any project for engineering improvement in existing system.

6. DEVELOPING MORE PROJECT DOMAINS:

Undergraduate students are doing project work in their final year according to curriculum of university. They are free to choose any project either Industry Defined Problem (IDP) or User Defined Problem (UDP). Also they have enormous options for selecting domain and title of the project. It is observed that students are continuously wavering for selection of project and deciding the problem statement. Due to lack of specific alternatives students are sometimes misguided by external agencies for getting their projects done.

Following approach may be helpful them to decide their project domains and this will also help them to select their career for professional life.

This approach of classifying students projects in more specifically and exhaustively.
Table 1: More Project domains

<table>
<thead>
<tr>
<th>Domain</th>
<th>Exp. &amp; Software Development</th>
<th>Retrofitting of conventional machines</th>
<th>Domestic life Engineering</th>
<th>Industrial Automation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing Experimental set-up</td>
<td>Design Engineering</td>
<td>Rural Development</td>
<td>Hardware and Sanitary</td>
<td>Computer Integration</td>
</tr>
<tr>
<td>Product Innovations</td>
<td>Instrumentation &amp; control</td>
<td>Agriculture Development</td>
<td>Kitchen Engineering</td>
<td>Education systems</td>
</tr>
</tbody>
</table>

**Experimental Innovations:** In modern trends, students are more oriented towards, computer aided analysis. More number of experimentation should be promoted by introducing new test rigs to test products. There is good scope of developing computerized test rigs for performance of several equipment and machinery. Many numbers of ideas are possible for the development of automatic inspection and testing of products or components. Example may be development of small universal testing machine for plastic and nylon wires.

**Developing Experimental set-up:** There exists a considerable scope to develop simple and low cost set-up for demonstrating the basic principles of Engineering & Technology. Experimental work should be promoted for learning of science and technology in education system. Example may be development of an experimental set-up to bearing performance.

**Product Innovations:** There are many successful products in the market by several manufacturers. Students may attempt for little modification and betterment features of such products. They may also identify newer ideas for new product development.

**Software development:** The modern era is a computer age, where many activities may be carried out with the use of computer and web technology. There are several functions like communication of information, accumulation of data base, maintaining data record, developing web portals for several applications, etc. The use of computer and software for such functions will accelerate the performance of engineering activities, and definitely it will enhance the accuracy level and saving of time and other resources. Knowledge of budding engineers should be used for the development of computer integrated systems.

**Design Engineering:** Focuses is mainly on innovation. Any new idea for product for customized application can be through design engineering. Use of general purpose products have many limitations, hence special application products may be designed and promoted. Engineering machine elements like couplings, clutches, brakes, flywheels, hooke’s joints, plummer block, journal bearings, material handling accessories etc. have infinite engineering applications. These elements may be designed in customized way for specific applications. The students may work for innovative design aspect of engineering machine elements.

**Instrumentation & control:** Measurement through instrumentation and control is very important domain for technical
parameters. There are many applications possible where measurement of parameter can be made and same can be controlled during application. Many analogue controls may be transferred to digital control for better accuracy. Many ideas are possible such as industrial measurements of mechanical and electrical parameters, bio-medical applications, mechatronics projects, design and development of new measuring instruments with appropriate sensors and transducers. Few applications may be developing measuring device for measurement of available power in dry cell battery and button cell, measurement & digital output of speed, feed, depth of cut on machine tools, development of any device for blood pressure measurement etc.

**Retrofitting of conventional machines:**
In current trend, use of conventional machinery is reducing due to lower dimensional accuracy and less productivity. Hence, conventional machines may be transformed to numerically controlled machinery by retrofitting is good alternative for upgrading of existing machineries. Students may be involved in design and development of jigs, fixtures for mass production of several components. Students may work for enhancing the capabilities of the machine tools with development of newer mechanisms and attachments.

**Rural Development:**
In the present time, migration of people from rural to urban area is major issue. These people are migrating because of fewer facilities and opportunities available in rural area. If, this process will continue for many number of years, than society will become unbalance and rural areas will become less populated. Many small villages may be centrally supported by one town for their health, education and entertainment domains. Budding engineers should develop new ideas to reduce the distance between rural and urban area. They may develop many computer and internet based applications for better connectivity.

**Agricultural Development:** Agriculture land is continuously divided amongst the family members, and finally very less people are involved in the agriculture. This is because of scarcity of labourers, uncertainty of rain, many factors. Budding engineers should be involved in the development of automation of agriculture methodology. Agriculture should be carried out like professional industries. More number of employees may be recruited for enhancement in the crop. Young generation may adopt agricultural career by their interest.

**Domestic life Engineering:** Our own domestic life is full of engineering. Refrigerators, microwave ovens, washing machines, air-conditioners, motor pumps, mixtures, fans, televisions, flour mill etc. are now necessities of our domestic life. More number of engineers should work for improvement and betterment of domestic life.

**Hardware and Sanitary:**
The building hardware components, sanitary materials have huge market. Here, small industries are manufacturing these products, but still there is big scope of design improvement, change of raw materials, and quality improvement. Few examples may be rust free shower, kitchen furniture, curtain accessories, improved bathroom articles, etc.

**Kitchen Engineering:**
The cooking articles like pressure cooker, gas stove, frying pan, chimney, etc. have huge domestic market. Scope of better design of stainless steel vessels, energy saving cooking articles, kitchen furniture, is always possible. Simple machines may be developed to make green salads, onion skin removal, etc.

**Industrial Automation:** Modern trend is of automation of industries. There are shortage of labours, fluctuation of demand and many other
issues; hence automation is best solution for survival and development of engineering industries. Adding automation will add accuracy, consistency and regularity of production process. The processes like small material movement, inspection, verification of defects, etc processes may be developed in automation mode using sensors, camera image, image analyser etc. Existing systems may be upgraded with newer technology through projects. Like one can add sensor in shearing machine, to avoid accidents.

**Computer Integration:** Engineering students are very compatible with computers and related activities. Students may use computer aided technology like modelling, simulation, and analysis for this innovative design engineering. Example may be innovative shape and size of any product.

**Education systems:** Engineering education is very important for the development of society. Training huge mass of engineers is also challenging. All young generation must be trained in better way during their study. Education system consists of two segments, viz. Information and knowledge. Huge information is available on finger tip from internet, but this is not important until it is transformed to knowledge. Young engineers should be mentored for selecting education as a their professional career.

**7. CONCLUSIONS:**

1. Many researchers have mentioned that Problem-Based Learning (PBL) is an educational approach that is learner focused. The focus shifts from a method of instruction that is teacher driven and led to one where the student is empowered to conduct self-directed learning. So, project based learning is beneficial to students.
2. Problem-based learning results in better communication and teamwork skills, helps to understand of professional practice; and guides how to apply learning (theory) to solve problems.
3. Project should be selected according to intellectual level and capabilities of students. All should not be given a task of research and development type of activity. Every student may not target patent registration. Project may be part of research activity.
4. Project work can be further classified in many domains and students may select any domain out of this. The classified domains will help them to identify their interested problem definition. Students’ project should be designed in any specific direction like experimental project, society project, industry project, and analytical project etc.
5. Projects should not be study for the purpose of completion, but innovative ideas should be promoted. Repetition of existing concepts should be avoided.
6. Knowledge and learning gained while undergoing Engineering Projects helps students for their placement in industries.
7. The projects are also helpful to start-up for students to establish their own business idea (entrepreneur). This is more observed in computer and IT disciplines, where huge infrastructure is not required.

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SUSTAINABLE BUILDING MATERIALS USED IN GREEN BUILDINGS

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Abstract: Use of the sustainable material is a part of the sustainable development. The word was popularized in Our Common Future, a report published by World Commission on Environment and Development in 1987. Sustainable development is the development which meets the needs of the present without compromising the ability of future generations to meet their own needs. In 1992 the principles of sustainable development were formulated at the United Nations Conference on Environment and development in Rio de Janeiro, Brazil. Three bottom line concept of sustainability model given by John Elkington also explained to economic development, social equity and environmental protection. In this context green buildings are sustainable building are sustainable or green. The components of the green building include material efficiency, water efficiency, energy efficiency, indoor air quality efficiency, waste reduction, HVAC design and sustainable site planning. An attempt has been made in this paper to describe the characteristics of the green material as material efficient and the environmental philosophy behind each of this characteristic.

Key words: Material efficiency, Green buildings, reusable, recyclable, Regional material, Materials Reuse

1. INTRODUCTION
India is the second largest country in population in the world. At present the cost of infrastructure and expansion of cities in India is haphazard. In order to extricate from the present scenario India must follow the principles of sustainability. There is a dire need to protect the environmental resources. Green building is one of the important solutions of sustainable development.

The sustainable building incorporates many strategies during design, construction and operation of a building project. Using “green building materials “in construction is said to be “sustainable design”. The green materials are environmentally responsible materials as they help in reducing environmental impact.

A green building is defined as the high performance building which uses less water, energy, generates less waste, maintains indoor air quality for the occupants and uses efficient building materials. Rick Fedrizzi, Chairman of World Green Building Council has said that the green building has inspired countless material product and process innovation that have speeded up the adoption of green building design, construction, and operation across the globe. Today green building is a half-trillion dollar industry in the United States and more than a trillion dollar industry worldwide. (Rick Fedrizzi in Forward of The business case for Green
Building) Green building design aspects are site planning, building envelope design, building HVAC design, indoor environmental quality (thermal, visual comfort, and air quality), and use of ecological sustainable, high recycled and renewable materials. World shortage of power, water and environmental factors are the factors, encouraging building industry's focus on green building. Buildings annually consume more than 20% of the electricity used in India. (Soni et al, 2013)

Fig.1 Typical Green Building, Source: http://www.ecochicliving.ca/reno.html

2. COMPONENTS OF GREEN BUILDINGS
According to GRIHA, building activities contribute an estimated 50% of the world’s air pollution, 42% of its green-house gases, 50% all water pollution, 48% of all solid wastes and 50% of all Chlorofluorocarbon CFCs to the environment. (GRIHA Manual Volume-1, 2010)

Green design and construction aims at using resources more efficiently. The main objective of green building is to enhance positive impacts on the environment. If all urban buildings were green, our nation could have saves more than 8400 MW of power a year.

Following components of green building needs to be studied
1. Material efficiency (using sustainable construction materials and such other strategies)
2. Water efficiency (using low flow plumbing fixtures, roof top rain harvesting, porous paving system and such other strategies)
3. Energy efficiency (using energy conservation Building Code ECBC 2007, Smart lighting fixtures with control and renewable strategies)
4. Indoor environment quality (using microbial resistant materials, heating & cooling system ensuring ventilation and such other strategies)
5. Waste management (using green architecture standards, producing less amount of waste, harvesting waste and reusing material, deconstruction and such other strategies)
Green Building Materials
A green building needs special materials and systems to adapt sustainability compared with a conventional building. In line with the growing trend of green building development the industry of green building materials and services is also developing in India. The sustainable building incorporates many strategies during design construction and operation of building project. Using green building material is one of the sustainable design construction and operation strategies. The green materials are environmentally responsible materials as they help in reducing environmental impacts (Greenomics).

The sustainable building materials should have resource efficiency, indoor air quality energy efficiency and affordability. Green building rating for integrated habitat assessment GRIHA also recommends selection of ecological sustainable material. Ecological sustainable materials are those which have high recycled content, rapidly renewable resources with low emission potential. For example, low volatile organic compound (VOC) pint is a sustainable material. Similarly, door frames and flooring tiles made using recycled materials are the examples of sustainable materials.

While planning green buildings, modular plan should be used. Dimensional planning is an important material strategy of green buildings For example, designing interiors of rooms in such a way that the module follows standard sized plywood as well as wall board will eliminate cut construction cost. Dimensional planning and other material efficiency strategies are used to reduce the construction cost. (Materials and Resources)

3. IDEAL GREEN BUILDING MATERIALS
Ideal green building material is a material which has no negative environmental impacts. Possibly it should have positive environmental impacts. Further such material should be infinitely reusable or recyclable. But such ideal materials are rarely available. However materials which can eliminate or reduce negative impacts can be considered as green building materials.

The acid test for considering the materials to be green building materials should satisfy following criteria:
- The material should be renewable and resource efficient.
- The material should support environmental health. In other words, it should provide healthier environment to public. Indoor air quality should be excellent.
- The material should be appropriate for application for which it is proposed to be used and should be economical to use.

Extensive research is required to decide on the above criteria of the green building materials. The research needed considering the impact of the material throughout its life cycle. At each stage in life cycle of the product, it should not show any significant impact on environment.

Materials for Enhancing Indoor Environmental Quality
The indoor environmental quality can be achieved using less toxic interiors, adhesives, paints and composite wood.

Life cycle analysis (LCA) is said to be analysis of building products. It is ‘Cradle to Grave’ analysis- from raw material to the ultimate disposal point. The stages include selection of raw materials, manufacturing, distribution and installation to ultimate reuse or disposal.
In case of green materials, life cycle should not exhibit that any stage the material
- does not emit volatile organic compound (VOC) or emit minimal VOCs
- has low emission of toxic or carcinogenic or irritant chemicals
- free of toxic materials such as chlorine, lead, mercury, arsenic, chromium, cadmium, asbestos, chlorinated polyethylene and chloro-sulphonated polyethylene, Chlorofluorocarbons (CFC), polyvinyl chloride (PVC), halogenated flame retardants, phthalates, creosote, penta-chloro phenol, petrochemical fertilizers and pesticides as well as formaldehyde

In short the indoor air quality is enhanced by utilizing the materials which are simple, non-toxic, non-carcinogenic and low VOC materials. Though the materials do not cause toxicity about the air quality for the occupant of building, it can still carry toxicity risk for construction workers and manufacturing workers.

4. CHARACTERISTICS OF GREEN BUILDING MATERIALS

In general, following characteristics of the building materials are considered ‘green’ and research can be avoided if materials are quickly required to be selected (Quick Guide)

Rapidly renewable materials
Rapidly renewable materials are natural, non-petroleum-based building materials (petroleum based materials are non-renewable) that have harvest cycles under 10 years. The duration could be maximum 10 years. (Rapidly renewable material)

The philosophy to use rapidly renewable material is to save trees. Deforestation of long renewable material is responsible for loss of diversity and destroying the habitat and earth’s land animals and plants. Fewer forest means larger amount of GHG entering environment as forest act as carbon sink absorbing CO₂.

![Fig. 2 Rapidly renewable materials, low emitting materials, certified wood and regionally-sourced materials](http://www.jetsongreen.com/2010/09/fossilized-bamboo-floor-indestructible.html#post/0)

Although the renewable materials have the ability to grow back, the time it takes to reestablish the ecosystem increases the GHG. For these reasons, 10 year life cycle is considered as rapidly removable materials. (Rapidly Renewable Materials | Poplar Network)

A component of sustainability includes the distance traveled from extraction to manufacturing to the project site. Transporting materials requires energy and contributes greenhouse gas emissions. The further the distance traveled, the more energy used and greenhouse gas emitted. In order to minimize these environmental impacts, the local or Regional Materials within 500 km of the project site is given credit by GRIHA and LEED rating systems. The goal of using regional materials is to support use of indigenous resources, help the local economy, and reduce transportation impacts.

Utilization of rapidly renewable materials includes bamboo flooring and veneers, wool carpets, strawboard, cotton ball insulation (made from denim scrap), genuine linoleum flooring etc.
Using rapid renewable materials helps the use and depletion of finite raw material. Thus it conserves the resources.

The USGBC defines “rapidly renewable” as a material that’s able to regenerate itself in 10 years or less. That includes bio-based products made from plants harvested on a 10-year (or shorter) cycle. The goal of using rapidly renewable content is to reduce the number and quantity of products made from fossil-fuel derivatives. Rapidly renewable materials include linseed, straw, cotton, wheat, sunflowers, natural rubber, bamboo, and cork. These feed stocks are often used in green building products, like linoleum, straw bales, wheat board panels, bamboo cabinetry, cork flooring.

The green buildings are required to reduce waste in landfills. This is possible by recycling metal, glass, paper, plastic and cardboards. Reusing the material or reusing the recycled material is innovative and highly effective and is known as sustainable design. Reusing the material found at the existing site or adjacent to the site such as the elements like trees, structures, paving all are said to be acceptable green strategy in India.

Concrete, steel, metal, glass, brick and some types of plastics are common building materials and used after recycling. This can be used as a part of built environment by architects in India.

**Use of waste material in construction**

Construction waste can be recycled and used in other projects. The philosophy behind using waste material in construction is to ensure that the load at the landfill is reduced. Material if not reused or recycled will go to landfill or incinerators. This needs to be changed by green buildings. In India fly ash disposal is an important environmental issue.

The waste materials in construction that can be used are as under

- Partial replacement of clinker or Portland cement by slag, fly ash, straw silica fumes.
- Partial replacement of natural materials that require little processing such as pozzolana calcined clays
- Use of rice husk ash in concrete
- Palm oil shell aggregate for light weight concrete

**5. FLY ASH AS CONSTRUCTIONAL MATERIAL**

Concrete can recycle fly ash from coal fired plants and slag from the blast furnaces of steel production. But these materials may contain toxins like mercury. The toxins should not be directly exposed to occupants.
At present there are more than 40 thermal power plants in the country producing over 5 million tonnes of fly ash per annum. The ash content of coal is found to be ranging from 17% to 45% at most of the plants. Indigenous fly ashes for partial replacement of cement as an admixture for concrete have already been successfully exploited IS 3812-1981.

Fig. 4 Green building product from fly ash
Source: http://designtoimprovelife.dk/green-building-products-from-flyash/

India produces about 70 million tons of coal ash per year from burning 200 million tons of coal per year for electric power generation. Extensive research work is carried out for developing appropriate technology for disposal and utilization of fly ash. IIT Kanpur has developed a technology wherein almost 10% of ash is utilized in dyke construction and land filling. 3% is used in other industry. So to say 80% or more fly ash in India is not utilized properly. In developed countries, the fly ash can be used in manufacturing bricks, cellular concrete blocks, road construction, land fill application, ceramics etc. As per IIT Kanpur report currently one acre per MW of land is required for ash disposal. It has been successfully demonstrated that fly ash can be utilized in major infrastructural projects such as dams, ash dyke, roads and pavements; bricks manufacture cement tiles and paint industry. A law has been enacted in 1999 projecting 100% utilization of flyash within a stipulated period and making it mandatory to use fly ash for the purpose of road construction, bricks etc within a radius of 50 km from coal based thermal power plant. (SAVE SOIL, USE FLY ASH, IIT Kanpur)

IS 10153-1982 is a guidelines for utilization and disposal of fly ash. Fly ash is a suitable raw material for a variety of products and may be utilized for the production of:

- Portland pozzolana cement using fly ash as pozzolana
- Cement – fly ash concrete and ready mixed ash concrete
- Precast fly ash concrete building unit
- Sintered fly ash light weight aggregate and concrete
- Lime – fly ash cellular concrete
- Cement/lime/silicate bonded and clay – ash building bricks
- Portland cement clinker, cement

For road and airfield pavement construction using:

- Lime fly ash concrete
- Lean cement fly ash concrete,
- Cement fly ash concrete
- Lime fly ash soil stabilization
- Lime – fly ash bound macadam

It can also be used:

- As fill material in embankment construction,
- As filler material in bituminous concrete and
- Insulating and semi – insulating bricks

Fig. 5 Concrete made with fly ash
Source: http://www.recycleworks.org/greenbuilding/gbg_concrete.html
The particulars are all given in IS 10153-1982. All these uses are considered as ‘green’ as it conserves natural resources.

**Constructional waste materials**
Most structural steel contains 90% recycled content can be considered as green building material. The use of waste products is not only partial solution to environment and ecological problems but it significantly improves microstructures and consequently durability of concrete is achieved. (Satish Chandra)

Reusing elements of previously constructed building help in conserving resources. By reusing floors, roofs, walls green building can help diverting the million tons of waste materials otherwise reaching the landfills. It is always desirable to use demolition or renovated building materials rather than using new housing materials.

**Material Reuse**
The material reuse means using reused materials, salvaged or refurbished materials. This will obviously reduce the requirement of the virgin market. This will not only reduce the waste but also reduce the stress on the environmental resources. Material reuse is thus different from material recycled or reused. It is the material that is salvaged or waste once reused is again used in its original form.

**Energy efficient in use**
The discarded tiers of vehicles constitute solid waste and are disposed of into landfills. This can be reused –the tire rubber particles partially replace natural aggregates used in the production of concrete. Using recycled coarse aggregate concrete is another example of energy efficiency in use.

By using waste materials rather than new materials, the producer can save the cost of processing, transporting the material and thereby saving on energy.

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*Fig 6 Block to be used as walling material manufactured using ash. Source https://civilsolution.wordpress.com/tag/aerocon-blocks/*
Low embodied energy

Embodied energy is the total energy required for the extraction, processing, manufacture and delivery of building materials to the building site. Energy consumption produces CO₂, which contributes to greenhouse gas emissions, so embodied energy is considered an indicator of the overall environmental impact of building materials and systems. Recycled “secondary” aluminum has 90% less embodied energy than virgin primary aluminum. It is desirable to use such recyclable material.

Other considerations

- Thermal insulated roof
  Moreover, green building material practices should take into following considerations:
  - Building landscape to minimize grading and retain native soils and vegetation and turfing

Pervious paving which allows rain water to pass through the ground below for recharging the ground water. Pervious concrete has started getting acceptance in India very recently

6. SUMMARY

One of the principles that are adopted is using materials that are sustainable or green. As per IGBC “A green building uses less energy, water and natural resources, creates less waste and is healthier for the people living inside compared to a standard building.”
The components of the green building include material efficiency, water efficiency, energy efficiency, indoor air quality efficiency, waste reduction. From the above it is crystal clear that all efforts made for conservation of environmental resources is considering a step forward towards Green and sustainable materials. The rating systems -GRIHA or LEED certification therefore demands the use of sustainable materials.

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QUASI Z SOURCE INVERTER BASED WIND ENERGY CONVERSION SYSTEM WITH VARIOUS CONTROL TECHNIQUE

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Abstract: This paper presents the quasi z source inverter (QZSI) as an alternate converter system for the wind generation system. As QZSI inherits the main advantages of traditional Z source inverter which replaces the conventional PWM inverter in the system with some of its additional utilities as well. This system will monitors the wind generator output and adjusts the inverter shoot-through duty cycle employing various boost control technique as per desired value. Thus, the whole system is modeled and verified through simulation where the system can provide stable voltage through proper selection of boost factor and has the suitability of maintaining the terminal voltage at desired level for the direct-driven wind power system.

Keywords: PMSG; Shoot through state; QZSI; Wind energy.

1. INTRODUCTION

The adaption of the renewable energy sources have been very important nowadays because of many reasons and among all one of them is that the environmental impacts caused by the gases which is emitted by burning of fossil fuels used in conventional power stations which can be avoided, which will threat the ability to continue producing electricity using it because it can deplete any time in future, renewable energy sources are always available for utilization in electrical energy generation and storage[1].

The main drawbacks of renewable energy generation are the complexity, increased cost, reduced efficiency and the reduced reliability of the renewable energy conversion system so, researchers are working on reducing all such drawbacks by developing a new types of converters and machines with high efficiency and reliability.

Presently there are mainly three drive systems available for wind power. They are 1. Squirrel cage induction generator, 2. Doubly fed induction generator and the mostly recent used 3. (PMSG) Direct driven synchronous generator. PMSG based wind power generation system is been considered to be one of the mainstream systems in today’s variable speed constant frequency wind generation technology area due to its lower weight and volume, high efficiency and stability, etc.[2].

However, the traditional VSI is a buck converter, whose input dc voltage must be greater than the peak ac output voltage. Therefore, the voltage of VSI needs to be designed high enough, leading to high voltage stress and capacity of devices. Now to solve this issue, the boost circuit is been usually added in DC link to keep the DC bus voltage constant and reduce the inverter stress, especially in the situations that the ranges of dc source voltage are relatively wide. Whereas, it will increase the cost as well as reduce the efficiency of wind power generation system [3].

The primary need of wind energy system is to maintain a constant voltage across load terminal consistently using minimum circuitry. One recent application for permanent magnet generator with ac series regulator is proposed in [5], but the control circuit looks complex in nature [3].
Now, Impedance source inverter proposed has replaced the conventional inverter which has the both buck and boost capabilities of impedance source inverter with inclusion of z-network which will compensate both the generator output and load variations. In respect to the recent advancements of z-source inverter, this paper proposes QZSI that will replaces the traditional inverter system and the suitability of the system is studied for effective conversion of single phase wind power source into a grid-quality three phase power [4].

2. BASIC PRINCIPLES OF QZSI

The QZSI is claimed to have several additional merits like lower passive component ratings, continuous input DC current and a common dc rail between the source and inverter, and also voltage stress on capacitor is reduced which ultimately lower the voltage stress on the inverter as compared to the traditional ZSI. QZSI has an impedance network consisting of two capacitors and two inductors coupled between the converter and the dc source with a common ground between source and the load [6].

![Figure 1 Quasi z source inverter](image1)

![Figure 2 Equivalent circuit of QZSI (a) Non shoot through state (b) Shoot through state](image2)

The equivalent circuits of QZSI in two basic operation modes which are illustrated in Figure 2.

In Figure 2 (a), the input DC voltage is available as DC link voltage input to the inverter, which makes the QZSI behaves similar to a VSI. This mode will make the inverter operate in one of the six active states and two traditional zero states, which is referred to as the non-shoot through state.

In Figure 2 (b), switches of the same phase in the inverter bridge are switched on simultaneously for a very short duration. The source however does not get short circuited when attempted to do so because of the presence LC network, while boosting the output voltage. The DC link voltage during the shoot through states, is boosted by a boost factor, whose value depends on the shoot through duty ratio for a given modulation index [6].
3. CONTROL TECHNIQUES

A. Simple Boost Control

In this method three modulating signals with 120 degree phase shift is when compared with frequency carrier triangular signal it will generates the switching pulse. The shoot-through for quasi z source inverter is been generated by comparing two straight dc lines with the carrier signal. The magnitudes of these dc lines are \(+V_{sh}\) and \(-V_{sh}\) are shown in the figure 3. Now when the carrier signal is greater than \(+V_{sh}\) or less than \(-V_{sh}\) it will generate shoot-through pulses [7]. Now actual switching pulses for QZSI are then OR between conventional switching pulses to produce the modified pulses and the invert pulses.

The advantage of this PWM technique is that it is simple to implement but the main disadvantage is that the total zero switching state is not utilized during shoot through so the voltage stress across switch is more as compared to other techniques. As all the switches turn ON during the shoot-through state so the switching loss are more.

![Figure 3 Modulating signal of simple boost control](image)

B. Maximum Boost Control

The disadvantage of Simple Boost Control is been overcome by introducing the Maximum Boost Control (MBC) method. In this case of MBC the traditional zero state is totally converted into shoot-through state as a result the voltage stress across the switch is reduced as compared to SBC.

Now the shoot-through states for MBC are generated by comparing the carrier signal with the maximum value and minimum value of modulating signals. So at any instant when the carrier signal is greater than the maximum value of modulating signal, shoot-through will generate. Similarly when the carrier signal is less than the minimum value of modulating signal, shoot-through will generate which are shown in the figure 4. The advantages of this MBC PWM technique are that the output voltage is maximum as the boost factor is maximum [8][9].

\[D_o = 1 - M\]

Boost Factor is obtained by introducing shoot-through of minimally one pair of the inverter arm for a short period of time which is called as shoot through time.

\[B = \frac{1}{1 - 2D_o}\]

Where: \(T_o = \text{Shoot Through Time}\)

\(T = \text{Switching Period}\)

\(D_o = \text{Shoot through Duty Ratio}\)

\(G = \text{inverter gain}\)

\[G = BM = \frac{M}{2M-1}\]

The peak phase voltage of the QSZI is given by

\[V_{ac} = M \times B \frac{Vin}{2}\]
Thus the circuit will be in the shoot through state when the triangular carrier wave is either greater than the maximum curve of the references or smaller than the minimum of the references. The shoot-through duty cycle varies each cycle and the shoot-through state repeats periodically in every $\frac{n}{3}$ degrees [7][10]. So assume that the switching frequency is much higher than the modulation frequency; the average shoot-through duty ratio over one switching cycle in the interval, can be expressed as

$$D_o = \frac{2\pi - 3\sqrt{3}\pi}{2\pi}$$

The Boost factor ($B$) can be written as,

$$B = \frac{1}{1 - 2D_o} = \frac{\pi}{3\sqrt{3}M - \pi}$$

Similarly voltage gain ($G$) can be written as,

$$G = MB = \frac{M\pi}{3\sqrt{3}M - \pi}$$

Therefore, the switching device voltage stress is derived as

$$V_S = BV_o = \frac{3\sqrt{3} G - \pi}{\pi} V_o$$

Here in Figure 5 Overall system block diagram has been represented where various conversion of energy takes place where a wind turbine with permanent magnet synchronous generator (PMSG) is selected here and the three phase output voltage which is normally variable in nature is been rectified to DC and is connected with the inverter through the quasi z-source network which will provide continuous output voltage.

4. SIMULATION RESULTS

Simulation is carried out for the proposed system under SIMULINK environment. Now in this simulation, the wind turbine and QZSI parameters are taken as per values given in the below table.

Now, as the boost factor decreases the oscillations becomes smaller, system becomes faster and larger power is been injected and also higher rectifier output voltage is obtained until reaching optimum value smaller than it degradation in results starts occurring and thus the simulation is performed at 3 different wind speed 14, 12,10m/s.
Table 1 Simulation Parameters

<table>
<thead>
<tr>
<th>System parameter's</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Power of PMSG</td>
<td>2kW</td>
</tr>
<tr>
<td>Pole pairs</td>
<td>4</td>
</tr>
<tr>
<td>Stator resistance</td>
<td>0.9585Ω</td>
</tr>
<tr>
<td>Armature inductance</td>
<td>0.00525H</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>10Hz</td>
</tr>
<tr>
<td>QZSI Inductance $L_1 = L_2$</td>
<td>5mH</td>
</tr>
<tr>
<td>QZSI Capacitance $C_1 = C_2$</td>
<td>20μF</td>
</tr>
<tr>
<td>$R_{load}$</td>
<td>77.45Ω</td>
</tr>
<tr>
<td>$L_{load}$</td>
<td>1.82H</td>
</tr>
</tbody>
</table>

Here, the below waveforms are for the simple boost control technique.

![Figure 6 QZSI simple boost control result](image1)

Similarly, the below waveforms are for the maximum boost control technique.

![Figure 7 QZSI maximum boost control result](image2)

The obtained results in below table matches the theoretical analysis with high accuracy. It can be seen that at each wind speed $V_{dc\text{link}} = V_{c1} + V_{c2}$, $V_{diode} = - (V_{c1} + V_{c2})$ when reverse biased, and $V_{in} = -V_{c1} - V_{c2}$. 

-9th International Conference on Engineering and Business Education (ICEBE) & 6th International Conference on Innovation and Entrepreneurship (ICIE)
Table 2 Comparison result at various speed of SBC and MBC

<table>
<thead>
<tr>
<th>Wind speed (m/s)</th>
<th>Simple Boost Control</th>
<th>Maximum Boost Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$V_{in}$ $V_{dc link}$ $V_{diode}$</td>
<td>$V_{in}$ $V_{dc link}$ $V_{diode}$</td>
</tr>
<tr>
<td>14</td>
<td>34.8 332.2 -333</td>
<td>217.3 810 -815</td>
</tr>
<tr>
<td>12</td>
<td>22.5 217 -218</td>
<td>163.6 600 -610</td>
</tr>
<tr>
<td>10</td>
<td>11.6 106.16 -108</td>
<td>100.5 360 -375</td>
</tr>
</tbody>
</table>

5. CONCLUSION

A permanent magnet synchronous generator wind power generation system based on quasi-Z-Source inverter is presented in this paper and with the help of traditional SPWM technique make it suitable for the special shoot-through characteristic of QZSI. With the use of properly selected controllers, the DC-link boost control and the AC-side output control are designed to reduce the effects of voltage fluctuations on the load. The effectiveness of the proposed controllers has been verified by simulations and thus result shows that MBC has higher boost value and also lower voltage stress than SBC. Thus, the presented system illustrates a significant method to reduce voltage fluctuations compared with the traditional wind power generation system.

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DOING BUSINESS: INDIA V/S CHINA

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Abstract: The World Bank creates an annual index of 189 countries, naming it “Ease of Doing Business Report”. Doing Business sheds light on how easy or difficult it is for a local entrepreneur to open and run a small to medium-size business when complying with relevant regulations. This index investigates the regulations that enhance the business activity and those that constrain it. Doing business is concerned with major regulations affecting 11 areas of the life of a business like starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts, resolving insolvency and labor market regulations. India and China, the two neighboring countries, are also the two most emerging economies in the present times. The two are in the battle for global manufacturing, FDI and rank closely in many global indices. Though China is a major competitor, India beats it on several frontiers. The author tries to analyze the pros and cons of both the nations and by this comparative study attempts to identify in which economy doing business is smooth. The paper traces the reforms undertaken by both the nations in the last 5 years to improve their business conditions and recommends the further reforms the countries need to take.

Keywords: World Bank, Doing Business Report, India, China, Regulations, Starting Business, etc.

1. INTRODUCTION:

Doing Business sheds light on how easy or difficult it is for a local entrepreneur to open and run a small to medium-size business when complying with relevant regulations. It measures and tracks changes in regulations affecting 11 areas in the life cycle of a business: starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts, resolving insolvency and labor market regulation.

In a series of annual reports, Doing Business presents quantitative indicators on business regulations and the protection of property rights that can be compared across 189 economies, from Afghanistan to Zimbabwe, over time. The data set covers 47 economies in Sub-Saharan Africa, 32 in Latin America and the Caribbean, 25 in East Asia and the Pacific, 25 in Eastern Europe and Central Asia, 20 in the Middle East and North Africa and 8 in South Asia, as well as 32 OECD high-income economies. The indicators are used to analyze economic outcomes and identify what reforms have worked, where and why. Economies are ranked on their

- Ease of doing business, from 1–189, where rank 1 means the regulatory environment is more conducive to the starting and operation of a local firm and the higher the rank the worst the performance. The rankings are determined by giving equal weight to each topic.
- The distance to frontier score which shows the distance of each economy from the best performance observed on each of the indicators across all economies. This allows users both to see the gap between a particular economy’s performance and the best performance at any point in time and to assess the absolute change in the economy’s regulatory environment over time. An economy’s distance to frontier is reflected on a scale from 0 to 100, where 0 represents the lowest performance and 100 represents the frontier. For example, a score of 75 in DB 2015 means an economy was 25 percentage points away from the frontier constructed from the best performances across all economies and across time.

1.1 Parameters Of Judgment – What They Measure:

1. **Starting A Business** :

   Procedures to legally start and operate a company (number), preregistration procedures, post registration (for example, social security registration, company seal), time required to complete each procedure (calendar days); cost required to complete each procedure (no bribes); Paid-in minimum capital (% of income per capita).

2. **Dealing With Construction Permits** :

   Procedures to legally build a warehouse (number), submitting all relevant documents and obtaining all necessary clearances, licenses, permits and certificates, submitting all required notifications and receiving all necessary inspections, obtaining utility connections for water and sewerage, registering and selling the warehouse after its completion, time required to complete each procedure (calendar days), cost required to complete each procedure (% of warehouse value), building quality control index (0-15).

3. **Getting Electricity** :

   Procedures to obtain an electricity connection (number), submitting all relevant documents and obtaining all necessary clearances and permits, completing all required notifications and receiving all necessary inspections, obtaining external installation works, time required to complete each procedure (calendar days), cost required to complete each procedure (% of income per capita), excludes value added tax. It includes the reliability of supply, duration and frequency of outages, tools to restore power supply, transparency and accessibility of tariffs, price of electricity (cents per kilowatt-hour).

4. **Registering Property** :

   Procedures to legally transfer title on immovable property (number), preregistration (for example, checking for liens, notarizing sales agreement, paying property transfer taxes), post registration (for example, filing title with the municipality), time required to complete each procedure (calendar days), cost required to complete each procedure (% of property value), no value added or capital gains taxes included, quality of land administration index (0-30).

5. **Getting Credit** :

   Strength of legal rights index (0–12) Rights of borrowers and lenders through collateral laws Protection of secured creditors’ rights through bankruptcy laws Depth of credit information index (0–8) Scope and accessibility of credit information distributed by credit bureaus and credit registries Credit bureau coverage (% of adults) Number of individuals and firms listed in largest credit bureau as percentage of adult population Credit registry coverage (% of adults) Number of individuals and firms listed in credit registry as percentage of adult population.
6. **Protecting Minority Investors:**
Extent of disclosure index (0–10), review and approval requirements for related-party transactions; disclosure requirements for related-party transactions, extent of director liability index (0–10) ability of minority shareholders to sue and hold interested directors liable for prejudicial related-party transactions; available legal remedies, ease of shareholder suits index (0–10), access to internal corporate documents; evidence obtainable during trial and allocation of legal expenses, extent of shareholder rights index (0-10) shareholders’ rights and role in major corporate decisions, extent of ownership and control index (0-10) governance safeguards protecting shareholders from undue board control and entrenchment, extent of corporate transparency index (0-10), corporate transparency on ownership stakes, compensation, audits and financial prospects, strength of investor protection index (0–10).

7. **Paying Taxes:**
Tax payments for a manufacturing company (number p.a.), total number of taxes and contributions paid, including consumption taxes (value added tax, sales tax or goods and service tax), method and frequency of filing and payment, time required to comply with major taxes (hours per year), computing the tax payable, completing tax return forms, filing with proper agencies, arranging payment, preparing separate tax accounting books; total tax rate (% of profit before all taxes); corporate income tax, social contributions and labor taxes paid by the employer, property and property transfer taxes, dividend, capital gains and financial transactions taxes, vehicle, road and other taxes.

8. **Trading Across Borders:**
Documentary compliance – cost (USD) & time (hours), obtaining, preparing and submitting documents: - during transport, clearance, inspections and port or border handling in origin economy, required by origin, destination and transit economies, covers all documents by law and in practice, border compliance – cost (USD) & time (hours), customs clearance and inspections, inspections by other agencies, domestic transport loading and unloading of shipment, obtaining, preparing and submitting documents during domestic transport, traffic delays and road police checks while shipment is en route.

9. **Enforcing Contracts:**
Time required to enforce a contract through the courts (calendar days), time to file and serve the case, time for trial and to obtain the judgment, time to enforce the judgment, cost required to enforce a contract through the courts (% of claim), attorney fees, court fees, enforcement fees, quality of judicial processes index (0-18), court structure and proceedings (0-5), case management (0-6), court automation (0-4), alternative dispute resolution (0-3).

10. **Resolving Insolvency:**
Time required to recover debt (years) measured in calendar years, appeals and requests for extension, cost required to recover debt (% of debtor’s estate) measured as percentage of estate value, court fees, fees of insolvency, administrators, lawyers’ fees, assessors’ and auctioneers’ fees, other related fees, outcome whether business continues operating as a going concern or business assets are sold piecemeal, recovery rate for creditors, present value of debt recovered, strength of insolvency framework index (0-16).

2. **OBJECTIVES OF THE STUDY:**
- To understand the Doing Business Rankings and its parameters
- To compare the 2 emerging nations, India and China
- To understand the pros and cons of each nation with respect to doing business
- To decide which nation is better than the other from different viewpoints and identify future prospects

3. LITERATURE REVIEW:

Doing Business 2016 – Economy Profile of India and China

Published by The World Bank in 2016, it is a wholesome annual report giving an insight how a business functions in India and China, measuring its lifecycle on each of the above mentioned 10 parameters. It discusses each step at length with relevant data and comparing them with different economies and giving rank simultaneously.

Catching the dragon – The Economist Report

Published on 9th Feb 2015 in Mumbai edition of The Economist, this article measures the GDP growth rate of India and China and states that India’s economy is growing faster than China according to The World Bank, The IMF and Goldman Sachs. This rise has been accounted to various factors like PM Modi’s pro-growth government, booming stock market and RBI’s various policies.

Pay-off time for Modi: India displaces US, China as the top FDI destination in 2015 – Financial Times Report

Published by business magazine Financial Times on 30th September 2015, this article claimed that India has emerged to be the leading destination for FDI leaving behind US and China in the first half of 2015, where India stands at $31 billion, China at $28 billion and US at $27 billion, all due to the government policies and improvement in investment climate.

4. ANALYSIS

Table 1 : Current Scenario - India & China

<table>
<thead>
<tr>
<th>Points</th>
<th>India</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region</td>
<td>South Asia</td>
<td>East Asia &amp; Pacific</td>
</tr>
<tr>
<td>Income Category</td>
<td>Lower Middle Income</td>
<td>Upper Middle Income</td>
</tr>
<tr>
<td>Population</td>
<td>1,267,401,849</td>
<td>1,364,270,000</td>
</tr>
<tr>
<td>Doing Business Rank 2016</td>
<td>130</td>
<td>84</td>
</tr>
<tr>
<td>Doing Business Rank 2015</td>
<td>134</td>
<td>83</td>
</tr>
<tr>
<td>Distance To Frontier 2016</td>
<td>54.68</td>
<td>62.93</td>
</tr>
<tr>
<td>Distance To Frontier 2015</td>
<td>52.67</td>
<td>62.81</td>
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Table 2 : Doing Business Parameters Comparison

<table>
<thead>
<tr>
<th>Parameter</th>
<th>India</th>
<th>China</th>
<th>Winner</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting A Business (Rank)</td>
<td>155</td>
<td>136</td>
<td>China</td>
<td>19</td>
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<tr>
<td>- Distance To Frontier Score</td>
<td>73.5</td>
<td>77.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dealing With Construction Permits (Rank)</td>
<td>183</td>
<td>176</td>
<td>China</td>
<td>7</td>
</tr>
<tr>
<td>- Distance To Frontier Score</td>
<td>32.4</td>
<td>48.29</td>
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<td></td>
</tr>
<tr>
<td>Getting Electricity (Rank)</td>
<td>70</td>
<td>92</td>
<td>India</td>
<td>22</td>
</tr>
<tr>
<td>- Distance To Frontier Score</td>
<td>74.5</td>
<td>68.66</td>
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</tbody>
</table>
Registering Property (Rank) - Distance To Frontier Score
<table>
<thead>
<tr>
<th>Rank</th>
<th>Distance</th>
<th>Score</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>138</td>
<td>50.2</td>
<td>75.02</td>
<td>China</td>
</tr>
<tr>
<td>43</td>
<td>65</td>
<td>50</td>
<td>India</td>
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</table>

Getting Credit (Rank) - Distance To Frontier Score
<table>
<thead>
<tr>
<th>Rank</th>
<th>Distance</th>
<th>Score</th>
<th>Country</th>
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<tr>
<td>42</td>
<td>73.3</td>
<td>43.33</td>
<td>India</td>
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<tr>
<td>79</td>
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Protecting Minority Investors (Rank) - Distance To Frontier Score
<table>
<thead>
<tr>
<th>Rank</th>
<th>Distance</th>
<th>Score</th>
<th>Country</th>
</tr>
</thead>
<tbody>
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<td>157</td>
<td>132</td>
<td>India</td>
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<tr>
<td>134</td>
<td>56.1</td>
<td>64.46</td>
<td>China</td>
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Paying Taxes (Rank) - Distance To Frontier Score
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<th>Rank</th>
<th>Distance</th>
<th>Score</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>157</td>
<td>56.4</td>
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<td>China</td>
</tr>
<tr>
<td>132</td>
<td>4</td>
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<td></td>
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</tbody>
</table>

Trading Across Borders (Rank) - Distance To Frontier Score
<table>
<thead>
<tr>
<th>Rank</th>
<th>Distance</th>
<th>Score</th>
<th>Country</th>
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</thead>
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<td>32.4</td>
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<td>China</td>
</tr>
<tr>
<td>96</td>
<td>1</td>
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Enforcing Contracts (Rank) - Distance To Frontier Score
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<th>Rank</th>
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<th>Score</th>
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</thead>
<tbody>
<tr>
<td>178</td>
<td>32.5</td>
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<tr>
<td>7</td>
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</table>

Resolving Insolvency (Rank) - Distance To Frontier Score
<table>
<thead>
<tr>
<th>Rank</th>
<th>Distance</th>
<th>Score</th>
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</thead>
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<td>China</td>
</tr>
<tr>
<td>55</td>
<td>9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


4.1 Other Aspects:

- Communications
  
  Telecommunications
  China and India are equal when it comes to numbers of mobile phone users, however the advantage will eventually lie with India as its current penetration rate per user is considerably lower. Growth for mobile phones is higher in China, and call rates are far lower. India has jumped almost instantly from land lines to national wireless in the space of less than a decade, and they are both developing and buying the newest technology while keeping user costs low.

  Language
  English is a major, nationally spoken language in India, however the strength of local dialects and standard remain patchy. English language use in China is concentrated more in first-tier cities. Indian MBA graduates have a far better command of both oral and written English skills than their Chinese counterparts.

  Internet
  The downside of the Great Chinese Firewall in terms of damaging academia has yet to be assessed, however there is no doubt it is a major intellectual inhibitor in the country. India has no such issues and with a burgeoning IT sector, new applications are constantly available in a manner unimaginable in China.

Communications Advantage: India

- Infrastructure

  China is 15 to 20 years ahead of India in its infrastructure development. This means operational and logistics difficulties need to be calculated into business plans in India and carefully examined for bottle necks. China has done an amazing job in matching infrastructure to the needs of commerce over the past 20 years, but not without environmental degradation problems on a massive scale. India, being a democracy, doesn’t allow for that rapid pace of development. On the other hand, a great deal of amount is to be spent on infrastructure.
development in India in future. But for now, Chinese infrastructure remains ahead.

**Infrastructure Advantage: China**

- **Getting Visas and Work Permits**

**India**

India is taking steps to ease its visa restrictions, including the new addition of a visa on arrival service—something China does not provide. India immigration laws state that foreigners must register with the Foreigners Regional Registration Office within 14 days of his/her arrival if he/she intends to stay in India for a duration of more than 180 days in any 365 day period. Like China, the registration is automatically carried out when checking into hotels. In addition, all major airports in India have immigration service desks to help foreigners obtain visas and resident permits. Work visas must be obtained, like China, with documentation and authentication carried out by the Indian Embassy of the applicant’s home country, although this process too is being eased.

**China**

In China, an employment/work visa (“Z” visa) must be applied for and obtained prior to entry into China by way of submitting supporting documentation and obtaining governmental approval. Upon arrival, the Z visa holder must then obtain his/her proper work and residence permits. When applying for a work permit, the employer’s business license, organization code certificate, tax registration certificate and foreign invested enterprise approval certificate (if the employer is foreign-invested) must be provided on top of any other relevant documents (if any).

Obtaining a visa on arrival is still restricted in China and is not an option for most foreign nationals beyond a 72-hour stay in certain major cities (such as Shanghai). China also imposes work visa restrictions on foreign graduates (minimum of two years post-graduate work experience), something India does not do.

**Visa Advantage: India**

- **Establishing a Company**

Both India and China have very similar legal structures for foreign investors to utilize. Liaison offices (LOs) and representative offices (ROs) operate in essentially the same way in the two countries, as do wholly foreign owned enterprises (WFOEs) and joint ventures (JVs).

If you are familiar with China’s legal establishment procedures, then you will find that India’s is very similar. However, China tends to sub-divide categories more, such as even dividing WFOEs into a separate sub-category called “foreign invested commercial enterprises,” whereas India does not.

India, on the other hand, has the useful “project office” (PO) structure that China previously provided several years ago. POs allow a company to set up a temporary presence to fulfill a specific contract, and they are especially useful for foreign contractors involved in specific infrastructure projects that are completed when built. Please note that POs are not similar to WFOEs in structure or operations.

The overall registration process to set up a foreign entity in India is generally two to three procedural steps fewer than in China.

**Establishing a Company Advantage: India**

- **Becoming a Company Director**

**India**

In India, the procedures to become a company director include the notarization of your passport at the Indian Embassy in your home country, which tends to be an administrative hassle, especially for expats already based overseas. Foreigners also need to obtain a Permanent
Account Number (PAN) and a corresponding card if they wish to be named a director.

**China**

In China, there are no special requirements or procedures to be taken for foreigners to be named a company director. Foreigners are subject to the same eligibility requirements as Chinese citizens as long as they have a valid passport/visa and all of the relevant approvals and permits for working in China are properly finalized.

**Company Director Advantage: China**

- **Opening up a Bank Account**

**India**

The banking system of India has evolved since it was restructured as part of reforms, and provides a relatively positive framework for foreign investors to shape their businesses in India.

The banking process involves opening up an account with a commercial bank, but the typical documentation needed in India compared to that in China is far simpler. The banks require the following apostil and notarized documents: proof of address, copy of the applicant’s passport and certificate of incorporation and permanent account number (for registered Indian companies).

**China**

Foreign investors in China are restricted to having a basic RMB account in addition to a foreign currency capital contribution account. A FIE may have only one basic RMB account for its daily business operations in China, and the account is the only account from which the company can withdraw cash in RMB. The basic RMB account also often acts as the designated tax payment account.

Other types of foreign currency accounts may be opened up for different purposes, such as settlement accounts for the collection of payments given in a foreign currency, foreign debt special accounts (for receiving shareholder loans) and temporary capital accounts (used to hold capital and funds for the payment of expenses incurred prior to the establishment of an FIE, after which the funds can be transferred into the FIE’s capital account). Please note that an FIE must have a foreign currency capital contribution account to receive capital injections from foreign investors, and the FIE must receive the necessary approval from the State Administration of Foreign Exchange (SAFE) in order to open up this type of account.

To open up a bank account, an FIE typically needs to provide a foreign exchange registration certificate, any relevant company documents and an application form noting the specific type of account that it wants to open up. Foreign investors can open up any of the account types listed above through an international bank that has a local Chinese presence or through a Chinese banks.

**Bank Account Advantage: India (as the process is less cumbersome and time-consuming)**

- **Domestic Competition: Foreign Investors vs. State-Owned Enterprises**

A major difference between China and India is that the Indian government is not involved in business except in the strategic industries sector. To illustrate this, only about 10 percent of the companies listed on the Bombay Stock Exchange have some sort of government investment.

In China, the government is heavily involved in business, and some 90 percent of companies listed on the mainland Chinese exchanges are either partly or fully state owned. This means that coming up against government-backed competition is far more likely in China, and the
chance of having a level playing field is significantly reduced.

There is far less distinction in India politically between domestic and foreign-invested companies when it comes to impartiality, except for the corporate income tax playing field, which is not level (Indian companies are taxed at lower rates than foreign ones at 30 percent compared to 40 percent). Tax reform is on the agenda in India to equalize this, but has not yet been passed.

This ultimately means that both India and China may not provide a level playing field for investors, but at least India’s is more transparent since company details (such as balance sheets and shareholder information) are available on the public domain. However, the actual competitive nature of business in the Indian marketplace for foreign investors is far less discriminatory than in China, as the Indian government is not involved in their state owned enterprises to the same extent as the Chinese government.

State Influence Advantage: Neither – China currently has better income tax rates than India in terms of the treatment of foreign companies. However, state-owned monopolies dominate and manipulate the Chinese market in ways that do not occur in India.

• Regulatory Protectionism

Neither countries have historically great track records with regard to protectionism, but both are members of the World Trade Organization. However, there is one difference: India is improving in this regard, while China is not.

Part of the reasons as to why are to do with the differing political regimes: certain industries in China are off-limits to foreign investors as the Communist Party wishes to limit external influences on its own population. Examples here are the education and media and entertainment sectors, all of which are heavily sanctioned by China in a way in which they are not in India.

With the Chinese states and government also heavily involved in commerce, the likelihood of beating out a state-owned business in China’s competitive arena is drastically reduced. In addition, regulatory barriers are coming down in India, and we have recently seen foreign ownership in key industries raised to up to 75 percent, which has led to several MNCs buying equity from their Indian partners.

In China, key areas such as the finance, banking and insurance all need additional foreign investment. Unfortunately, China’s governmental structure at present precludes any major restructuring in these areas. Fortunately, that is not the case in India, which recognizes its need for FDI in all areas of its economy and continues to push reforms to make this happen.

Regulatory Protectionism Advantage: India

• Intellectual Property

China is signatory to the many international conventions that govern and standardize the protocols of applying for and registering trademarks and patents. In theory, these protocols should provide some additional international protection if your mark/invention is registered in five or more of these signatory nations, although, in practice, Chinese courts often have a hard time taking cases under this structure as they do with any legal documentation that is either not in Chinese or legally registered in China. This is exactly the reason why it always makes sense to register your intellectual property (IP) rights in China even if you have international protection by way of multiple registrations according to the protocols guidelines.

On the other hand, India is not a signatory to these conventions, and registering trademarks and patents in India has to be done within the
guidelines of India’s own system (which is actually not that different compared to the rest of the world). There are moves for India to switch and join the Madrid, Nice, Paris and other conventions to bring the country in line with global standardization, however this is still a ways off.

**Intellectual Property Advantage: India.** Theoretically this should be China, as it is a signatory to various internationally agreed upon protocols. However, India has proven to be better at upholding its own IP protection, even while being outside of the global protocols. Where India does score big over China is in IP theft – it has a far better attitude towards acknowledging intellectual property ownership than China does, assisted by the fact that the Indian Courts of Law are independent from government.

- Cross-Border Internal Tariffs

China previously imposed tariffs on the movement of goods across different provinces and cities, but these tariffs were abolished about 17 years ago.

On the other hand, some Indian states still impose tariffs on the movement of goods across state borders. This, too, should be abolished, but doing so will be a hard political battle to win as it raises local state revenues. In the meantime, these tariffs add another layer of research to do when looking to establish a presence in certain Indian cities, having to know what these duties are and the administrative costs in having to deal with them.

**Cross-Border Internal Tariffs Advantage: China**

- General and Operational Tax Treatment

Over the past 20 years, China has done a good job of standardizing the types of taxes and tariffs applicable across the country. There are variations, but these tend to be minimal. An exception, however, is the calculation of payroll related issues – such as mandatory welfare payments – as these are linked to the performance of the local economy and not the national economy.

The main problem with operating in China is, therefore, working out the mandatory welfare payments. That aside, China’s treatment of general operational taxes (i.e., value added taxes, etc.) is uniform across the nation.

It is, however, totally different in India. In addition to the cross-border tariffs mentioned above, India’s individual states still operate as quasi-independent business units in their own right with a uniform national standard income tax (rather similar to the different regional tax rates and policies in the United States of America). An example is the national habit of imposing “CESS” – a type of tax on taxes paid. Often used to subsidize education, in addition to other smaller surcharges, it also varies from state to state and can be difficult sometimes to pinpoint due to occasionally arcane definitions of what should be included. This is the reason why common questions over operational taxes do not elicit a straight answer in India.

The short answer is, taxes in India depend upon location, cross border issues and even the type of product being sold.

**Tax Treatment Advantage: China, as the national tax and tariff system is far easier to navigate. Much of the issues concerning India’s bureaucracy and difficulties in understanding India come from this area alone.**

- Audit

Both China and India maintain their own audit standards, but both are relatively straightforward to navigate once familiarity with the local
differences is obtained. India has rather smaller
taxes and surcharges than China does, meaning
unobservant accountants may miss things on
occasion, but generally speaking both are at
about the same levels of both competency and
administrative ease. Experienced international
accountants will be able to consolidate both
Chinese and Indian financial reports into their
group accounts.

The only black spot is with China’s Ministry of
Finance, which has declared the accounts of its
state-owned enterprises to be “state secrets” and
therefore essentially unverifiable by all but
Chinese auditors and the state itself. As a result,
Chinese companies may in the future find
themselves unwelcome on major international
bourses.

Audit Advantage: Neither, but China’s MOF
interference with the transparency of Chinese
SOEs audited accounts is a worrying
development.

- Repatriating Profits

India

The remittance of funds out of India involves
structured procedures with a valid and
authorized banking channel – the remitter is
required to furnish the details of the earned
income in addition to an accompanying relevant
certificate noting the proper deduction of taxes
along with a request form.

 Corporations can remit their earned profits out
of India by way of dividends on the shares held
by the parent company, or by the interest on the
loans or debentures held by the parent company
in India. They also have the option to remit
profits out of the country as royalties paid for
software or other related products as provided by
the parent company in their home country.

China

China employs strict currency regulations that
are designed to prevent large amounts of
currency moving out of the country. China
controls and monitors the amounts of money
coming into and out of the country through the
SAFE. In order to legitimately take money out
of China (typically in the form of a wire
transfer), an application needs to be submitted to
the SAFE, with the relevant documents noting
that the proper income taxes have been paid in
China in addition to details of the overseas bank
account to which the funds are to be wired. The
onus is on the applicant to demonstrate that the
money was legitimately earned and that the
proper taxes have been paid on it.

Corporations that issue dividends overseas also
face additional taxes.

Fund Remittance Advantage: Neither – the
repatriation of profits overseas is taxable at
high rates in both countries. However, if
India’s tax reform gets passed (it is currently
under debate) the tax rate advantage will pass
to India.

- Economy and FDI

The present times show that the Indian economy
is neck to neck with the Chinese economy and
giving it a tough competition. Reports from the
World Bank, The IMF and Goldman Sachs
reveal that the Indian economy has surpassed
the Chinese economy in terms of GDP in 2015
saying that the Indian GDP growth rate has been
somewhere between 7.5 – 8% and the Chinese
GDP growth rate only little back at around 7%.
The Financial Times also reported that in 2015,
India has reportedly grabbed the highest share of
FDI as compared to China with India being at
$31 billion and China at $28 billion.

Economy Advantage : Both, as until 2015 it
was China and now India is in the lead.
4.2 Reforms Undertaken By Both Economies:

1. Starting A Business

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Year</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>India eased business start-up by establishing an online VAT registration system and replacing the physical stamp previously required with an online version.</td>
<td>2013</td>
<td>China made starting a business less costly by exempting micro and small companies from paying several administrative fees from January 2012 to December 2014.</td>
</tr>
<tr>
<td>2015</td>
<td>India made starting a business easier by considerably reducing the registration fees, but also made it more difficult by introducing a requirement to file a declaration before the commencement of business operations. These changes apply to both Delhi and Mumbai.</td>
<td>2015</td>
<td>China made starting a business easier by eliminating both the minimum capital requirement and the requirement to obtain a capital verification report from an auditing firm. This reform applies to both Beijing and Shanghai.</td>
</tr>
<tr>
<td>2016</td>
<td>India made starting a business easier by eliminating the minimum capital requirement and the need to obtain a certificate to commence business operations. This reform applies to both Delhi and Mumbai.</td>
<td></td>
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</tr>
</tbody>
</table>


2. Dealing With Construction Permits

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Year</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>India reduced the time required to obtain a building</td>
<td>2013</td>
<td>China simplified the process of obtaining a construction permit by establishing strict time limits for preconstruction approvals.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>China made starting a business easier by eliminating both the minimum capital requirement and the requirement to obtain a capital verification report from an auditing firm. This reform applies to both Beijing and Shanghai.</td>
</tr>
</tbody>
</table>


3. Getting Electricity

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Year</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>In India the utility in Mumbai made getting electricity less costly by reducing the security deposit for a new connection.</td>
<td>2015</td>
<td>China made getting electricity less costly by reducing the security deposit for a new connection.</td>
</tr>
<tr>
<td>2016</td>
<td>The utility in Delhi made the process for getting an electricity connection simpler and faster by eliminating the internal wiring inspection by the Electrical Inspectorate. The utility in Mumbai reduced the procedures and time required to connect to electricity by improving internal work processes and coordination.</td>
<td></td>
<td>NA</td>
</tr>
</tbody>
</table>


4. Getting Credit

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Year</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td></td>
<td></td>
<td>China improved its credit information system by introducing credit information industry regulations, which guarantee borrowers’ right to inspect their data.</td>
</tr>
<tr>
<td>2014</td>
<td></td>
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</table>

5. **Protecting Minority Investors**

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Year</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>India strengthened minority investor protections by requiring greater disclosure of conflicts of interest by board members, increasing the remedies available in case of prejudicial related-party transactions and introducing additional safeguards for shareholders of privately held companies. This reform applies to both Delhi and Mumbai.</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>


6. **Paying Taxes**

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Year</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>India reduced the administrative burden of paying taxes by abolishing the fringe benefit tax and improving electronic payment.</td>
<td>2011</td>
<td>China’s new corporate income tax law unified the tax regimes for domestic and foreign enterprises and clarified the calculation of taxable income for corporate income tax purposes.</td>
</tr>
<tr>
<td>2012</td>
<td>India eased the administrative burden of paying taxes for firms by introducing mandatory electronic filing and payment for value added tax.</td>
<td>2015</td>
<td>China made paying taxes easier for companies by enhancing the electronic system for filing and paying taxes and adopting new communication channels within its taxpayer service, changes applying to both Beijing and Shanghai. In addition, China made paying taxes less costly for companies in Shanghai by reducing the social security contribution rate.</td>
</tr>
</tbody>
</table>


7. **Enforcing Contracts**

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Year</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>2014</td>
<td>China made enforcing contracts easier by amending its civil procedure code to streamline and speed up all court proceedings.</td>
<td></td>
</tr>
</tbody>
</table>


5. **FINDINGS**

With reference to the Doing Business context, the following things can be noted:

- China is better than India at 7 parameters and India beats China at 3.
- India needs serious reforms in terms of registering property, enforcing contracts, dealing with construction permits and trading across borders.
China needs reforms in areas of starting a business, protecting minority investors and dealing with construction permits.

India ranks very well in protecting minority investors globally and China is good at enforcing contracts.

Apart from the above, other aspects of business studies show:

China has done a better job than India and has more business friendly environment. This is partly to do with China’s reforms having occurred earlier than India embarked upon its own policies of reform.

China has also benefited from having a one party state that can enact reform without the need for mass political debate, and this has driven much of the streamlining of administration when it comes to commercial activities. However, countered against this are serious issues with legal enforcement, and with State interference in competition.

India, meanwhile, generally has no interest in its state-owned industries competing with foreign investors and its rule of law, being independent from government, upholds this by keeping the government at arm’s length. It is a market-based economy, albeit one that still needs significant reform.

The main area of Indian bureaucracy comes when dealing with documentation relating to the importation of goods. Indian customs officers are eagle-eyed and insist on documentation accuracy over common sense at times. India as a collection of states is also more complex to deal with than China due to the fact they tend to operate under local laws with little national uniformity. However, proposed Indian legislation will bring in much needed changes, and the country will become a far easier place to do business if, as part of these reforms, the bureaucratic nature of dealing with different States can standardized.

The Indian economy has shown great increase in attracting investments and provides a more investor friendly environment with the new government reforms. The Chinese economy right now looks difficult to hold on to investors.

6. CONCLUSION:

Therefore, my views are that China and India are probably about equal in terms of their frustrations. They remain different, however, and China’s longer term problem is that its weakness – state control – is systematic, whereas India’s weaknesses are not and can be resolved through reform. Yes, China looks attractive at present but India may overtake China in ease of doing business in the next 10 years, but for now both remain equally difficult – albeit in different ways. It is a good news for India to be ranked better in Ease of Doing Business. But political weakness may spoil the entire gain. When the two countries are compared, it is easy to forget that India began its economic reforms more than a decade later than China did. As India opens up further to foreign direct investment, we might well discover that the country's more laissez-faire approach has nurtured the conditions that will enable free enterprise and economic growth to flourish more easily in the long run.

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   ease-of-doing-business-to-introduce-business-identification-number-for-companies/articleshow/50963352.cms
11. http://www.doingbusiness.org/reforms/overview/economy/india
ITÔ- STRATONOVICH SDE RELATIONSHIP AN INNOVATION AND CREATIVITY IN ENGINEERING SCIENCE AND FINANCIAL MATHEMATICS

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Abstract: This paper is about the Itô-Stratonovich stochastic differential equation (SDE) relationship for stochastic dynamical systems. In this paper we discuss three examples of different dynamics of engineering science and financial mathematics and the numerical simulations of stochastic differential equations demonstrate the relationship between Itô SDE and Stratonovich SDE.

Keywords: Itô-Stratonovich SDE relationship, Engineering Science, Financial Mathematics

1. INTRODUCTION

Recently, theory of stochastic differential equation and stochastic control has been used extensively in literature of engineering and finance that is an innovation and creativity in these fields see (Jazwinski, 1970; Kloeden and Platen, 1991; Mortenson, 1969; Schuss, 2010, Stratonovich, 1963). Itô-Stratonovich SDE relationship is stochastic approach in lieu of deterministic approach for stochastic systems. For sustainable development of technology and economics it's very important to studies Itô-Stratonovich SDE relationship.

Generally Itô interpretation is used for financial systems and Stratonovich interpretation is used for physical and biological systems in stochastic framework. In stochastic framework process noise can be white noise process or coloured noise process and process noise coefficient can be state dependent or state independent. The Itô-Stratonovich SDE relationship is meaningful when state dependent process noise coefficient is present in stochastic systems.

The main intent of this paper to explain Itô-Stratonovich SDE relationship for dynamical systems with simulation of their stochastic differential equations. The reminder of the paper is organized as follows. Section II Explain Itô-Stratonovich SDE relationship for scalar and vector SDE. Section III is discussed application of Itô-Stratonovich SDE relationship for different dynamics. Section IV is about numerical simulations V discusses concluding remarks.

2. ITÔ-STRATONOVICH SDE RELATIONSHIP

The scalar Itô stochastic differential equation,
\[ dx_i = f(x_i, t)dt + G(x_i, t)dB_t, \]  
(1)

The scalar Stratonovich stochastic differential equation,
\[ dx_i = f(x_i, t)dt + G(x_i, t) \circ dB_t, \]  
(2)

The vector Itô stochastic differential equation,
\[ dx_i = f_i(x_i, t)dt + \sum_{\phi} G_{i\phi}(x_i, t)dB_{\phi}, \]  
(3)

The vector Stratonovich stochastic differential equation,
\[ dx_i = f_i(x_i, t)dt + \sum_{\phi} G_{i\phi}(x_i, t) \circ dB_{\phi}, \]  
(4)

In scalar form Stratonovich SDE to Itô SDE conversion,
\[ dx_i = (f(x_i, t) + \frac{1}{2} \frac{\partial}{\partial x_i} G(x_i, t))dt + G(x_i, t)dB_t, \]  
(5)

In scalar form Itô SDE to Stratonovich SDE conversion,
\[ dx_t = (f(x_t, t) - \frac{1}{2}G(x_t, t) \frac{\partial}{\partial x} G(x_t, t) dt + G(x_t, t) \circ dB_t, \quad (6) \]

In vector form Stratonovich SDE to Itô SDE conversion,
\[ dx_t = (f_t(x_t, t) + \frac{1}{2} \sum_{\beta \neq \phi} G_{\phi\beta}(x_t, t) \frac{\partial G_{\phi\beta}(x_t, t)}{\partial x_j} dt + \sum_{\beta \neq \phi} G_{\phi\beta}(x_t, t) dB_t, \quad (7) \]

In vector form Itô SDE to Stratonovich SDE conversion,
\[ dx_t = (f_t(x_t, t) - \frac{1}{2} \sum_{\beta \neq \phi} G_{\phi\beta}(x_t, t) \frac{\partial G_{\phi\beta}(x_t, t)}{\partial x_j} dt + \sum_{\beta \neq \phi} G_{\phi\beta}(x_t, t) dB_t, \quad (8) \]

where the terms \( \frac{1}{2} G(x_t, t) \frac{\partial}{\partial x_j} G(x_t, t) \) and \( \frac{1}{2} \sum_{\beta \neq \phi} G_{\phi\beta}(x_t, t) \frac{\partial G_{\phi\beta}(x_t, t)}{\partial x_j} \) are Wong-Zakai correction terms. Equations (1)-(8) shows the Itô stochastic differential equation and Stratonovich stochastic differential equation in scalar and vector format and conversion of these two identities. where \( f(x, t) \) is non-linear function, \( G(x, t) \) is the state dependent process noise coefficient and \( dB_t = w_t dt \), where \( B_t \) is Brownian motion process and \( w_t \) is Gaussian white noise process. 'o' Stratonovich linear operator for more detail see Mannella and McClintock, (2012).

3. EXAMPLES

1. Satellite orbital dynamics

One such model that arose from the problem of stabilizing a satellite in a circular orbit is following due to Sagirow, (1970).
\[ \ddot{x} + b(1 + a\xi) \dot{x} + (1 + a\xi) \sin x - c \sin 2x = 0, \quad (9) \]

where \( x \) is the radial perturbation about the given orbit, \( \xi \) is a Gaussian white noise and \( a, b, c \) are constants, with \( b \) and \( c \) positive. After applying phase space formulation to above equation, \( x_t = (x_1, x_2) = (x_t, \dot{x}_t) \). This can be written as a 2-dimensional Itô stochastic differential equation
\[ \begin{pmatrix} x_1 \end{pmatrix} = \begin{pmatrix} x_2 \\ b x_2 - \sin x_1 + c \sin 2x_1 \end{pmatrix} dt + \begin{pmatrix} 0 \\ -a b x_2 - a \sin x_1 \end{pmatrix} dB_t, \quad (10) \]

where \( B_t \) is the Brownian motion process.

To convert this equation in Stratonovich stochastic differential equation use equation

Wong-Zakai correction term become
\[ 0.5(ab)^2 x_2 + a^2 b \sin x_1. \] And Stratonovich stochastic differential equation become,
\[ \begin{pmatrix} x_1 \end{pmatrix} = \begin{pmatrix} x_2 \\ b x_2 - \sin x_1 + c \sin 2x_1 \\ -0.5(ab)^2 x_2 - a^2 b \sin x_1 \end{pmatrix} dt + \begin{pmatrix} 0 \\ -a b x_2 - a \sin x_1 \end{pmatrix} dB_t, \quad (11) \]

2. The Black-Scholes model

Black-Scholes used Itô formulation to derive the price of an option on a stock whose price dynamics are given by Itô equation, see Sethi and Lehoczky, (1981).
\[ dP_t = a \sigma P_t dt + \sigma P_t dB_t, \quad (12) \]

where \( a, \sigma \) are positive constants and \( P_t \) is the stock price. Wong-Zakai correction term to convert this Itô SDE to Stratonovich SDE is \( \frac{1}{2} \sigma^2 P_t \) so Stratonovich SDE become,
\[ dP_t = (a - \frac{1}{2} \sigma^2) P_t dt + \sigma P_t dB_t, \quad (13) \]

3. Power System Dynamics

The stochastic swing equation is great example in power system dynamics, for greater detail see Hirpara and Sharma, (2014).
\[
\frac{2H}{\omega_0} \frac{d^2 \delta}{dt^2} = P_m (1 + \lambda \xi_r) - P_e - \frac{K_D}{\omega_0} \frac{d\delta}{dt}
\]

\[
= P_m (1 + \lambda \xi_r) - \frac{E'_f v_i}{x_d} \sin \delta
\]

\[
= \frac{v_r^2}{2} \left( \frac{x_d - x_q}{x_d x_q} \right) \sin 2\delta - \frac{K_D}{\omega_0} \frac{d\delta}{dt},
\]

(14)

where the term \( H \) is the inertia constant and \( K_D \) is the damping coefficient. The terms \( \omega_0 \) and \( \omega_r \) are the rated and actual angular velocities of the machine in electrical radian per second in the fixed reference frame, on the other hand, \( \omega_r = \omega_r - \omega_0 \) is in the synchronously rotating reference frame. The notation \( v_r \) is the voltage magnitude of the infinite bus, \( E'_f \) is the transient emf and \( \delta \) is rotor angle of generator, \( x_d = X'_d + X'_l \) and \( x_q = X'_q + X'_l \), where \( X'_d \) and \( X'_q \) are direct-axis transient reactance and quadrature-axis transient reactance of machine respectively and \( X'_l \) is line reactance. The terms \( P_m \) and \( P_e \) are the mechanical input power and electrical power of salient pole machine. After applying phase formulation to equation (14), we get

\[
x_i = (x_1, x_2)^T = (\delta_i, \omega_r - \omega_0)^T = (\delta_i, \omega_r)^T,
\]

\[
G(x_i, t) = \left( 0, \frac{\omega_0 T}{2H} \right)^T,
\]

\[
f(x_i, t) = \left\{ \begin{array}{l}
\frac{\omega_0}{2H} P_m - \frac{K_D}{2H} x_2 \\
- \frac{\omega_0}{2H} \frac{E'_f v_i}{x_d} \sin x_1 \\
- \frac{\omega_0}{2H} \frac{v_r^2}{2} \left( \frac{x_d - x_q}{x_d x_q} \right) \sin 2x_1
\end{array} \right. \]

(15)

\[
d(x_1, x_2)^T = \left\{ \begin{array}{l}
\frac{\omega_0}{2H} P_m - \frac{K_D}{2H} x_2 \\
- \frac{\omega_0}{2H} \frac{E'_f v_i}{x_d} \sin x_1 \\
- \frac{\omega_0}{2H} \frac{v_r^2}{2} \left( \frac{x_d - x_q}{x_d x_q} \right) \sin 2x_1
\end{array} \right. \]

\[
\left( \begin{array}{c}
x_2, \frac{\omega_0}{2H} P_m - \frac{K_D}{2H} x_2 - \frac{\omega_0}{2H} \frac{E'_f v_i}{x_d} \sin x_1 \\
- \frac{\omega_0}{2H} \frac{v_r^2}{2} \left( \frac{x_d - x_q}{x_d x_q} \right) \sin 2x_1 \end{array} \right)^T dt
\]

\[
+ \left( 0, \frac{\omega_0 T}{2H} \right)^T dB_t.
\]

(16)

4. NUMERICAL SIMULATIONS

Here, for the numerical simulation of the stochastic problems of concern here, nice description about numerical simulation of stochastic differential equations can be found in a famous book authored by Kloeden and Platen, (1991). For first example we consider the following initial conditions and system parameters are,

\[
a = 0.5, b = 0.7, c = 0.3, x_1(0) = 0.2, x_2 = 0.6
\]

Figure 1: Comparison between three trajectories of state \( x_1 \)
For third example, we consider the following initial conditions and system parameters are,

\[ v_i = 1.0 \text{ pu}, \quad E'_{f} = 1.375 \text{ pu}, \quad K_D = 11.304 \text{ pu}, \]

\[ H = 3.1 \text{ MWs/MVA}, \quad X'_{d} = 0.33 \text{ pu}, \quad X_i = 0.2 \text{ pu}, \]

\[ \omega_0 = 2\pi 60 = 376.8 \text{ rad/sec}, \quad P_m = 1 \text{ pu}, \quad \sigma = 0.5, \]

\[ X'_{q} = 0.66 \text{ pu}, \quad X_i = 0.2 \text{ pu}, \quad x_q = 0.86 \text{ pu}, \quad x_d = 0.53 \text{ pu}, \]

\[ x_1(0) = 1 \text{ rad}, \quad x_2(0) = 2 \text{ rad/sec}. \]

In figures (4)-(5) the red line of trajectories of figures denote the state trajectories of noise free dynamics, the blue line of trajectories of figures denote the state trajectories with noise correction term in Stratonovich setting and green line denote of figures denote the state trajectories with noise correction term in Itô setting. Notably, in this case Itô and Stratonovich effect coincide due to state independent noise in system.
5. CONCLUSIONS

In this paper, we have achieved the Itô-Stratonovich SDE relationship for dynamical systems. This paper accomplishes the dynamical systems in stochastic setting and simulation of stochastic differential equation that exploits importance of stochastic processes in dynamical systems. Equations (9)-(16) will be useful for stochastic theory of engineering and financial systems. The Itô interpretation is theoretical interpretation and Stratonovich interpretation is practical interpretation for stochastic systems.

REFERENCES


COMMUNICATION OF CSR RESPONSIBILITY THROUGH PRESS RELEASES: ANALYSIS OF INDIAN AND MULTINATIONAL COMPANIES

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Abstract: Corporate Social Responsibility (CSR) communication in the contemporary business world is limited to annual reports and sustainability reports ignoring a crucial public relations (PR) tool, Press releases. The current study analyses press releases as a tool of corporate communication used by Indian and the Multinational companies (MNCs) in the Information and Technology (IT) sector in India and compares the similarities and differences in their communication approach. Press Releases of top 100 IT Companies operating in India were bifurcated into Indian and MNCs and used as data for analysis. Content analysis and a Document Term matrix was created to bring out the variance in the communication made by the Indian and the Multinational Companies. Findings indicate that the Indian and MNCs communicate their CSR differently to various stakeholders. Their focus of CSR activities for the same stakeholder also varies primarily because CSR communication is dependent upon the size, age, country of origin and composition of the board of the organization.

Keywords: Corporate Social Responsibility (CSR); Communication; Press Releases, Information and Technology

1. INTRODUCTION

The business context of the 21st century looks drastically different from the earlier millennia as the maladies afflicting the business arena had changed resulting in a parallel change in the aspirations and challenges of businesses. The current order has seen the evolution of new forces which were passive and powerless till late 20th century and has given way to the concept of stakeholders in business. As Freeman (1984) puts it, stakeholder is, “any group or individual who can affect or is affected by the achievement of the organization’s objectives”. The organizations therefore work towards associating with their stakeholder groups by communicating about their ‘organization’s achievement’. These achievements of the corporate include both financial and social responsibilities of the organizations. The financial responsibilities are more directly communicated to a specific stakeholder group, with the shareholders in mind. But corporate social responsibility (CSR) holds under its umbrella social activities which touch a diverse range of stakeholders – from the government to the non-governmental organizations, though four broad categories of stakeholders have been identified by researchers (Clarkson, 1995; Adams, 2002; Murthy, 2008; Dagiliene, 2010) such that social activities are symmetrically covered across broad and diverse affected parties. Varied channels are engaged to connect to these stakeholders ranging from annual reports, news papers, websites, banners etc. The channel employed for communication is a critical factor in deciding the impact of the communication on the stakeholders. To establish a positive relationship, credibility and faith in the communication is essential and press releases (PR) help serve this purpose. The key purpose of a PR is to report and reach out to the public at large regarding the activities, developments and progress which an organization makes. The PR is intended to inform the public and communication made
through the press, impacts the formation of the corporate image in the minds of the external groups who are often the stakeholders. The corporate have begun to use press releases (PR), as a tool for public relations (Lordan, 2005). As a result ethical and full disclosures of PR have gradually faded off on account of which PR are largely ignored by the academia. PR is perceived as ‘ephemeral document’ which lacks strategic importance and is understood as a mode of self publicity which lacks objectivity (Whysall, 2005). Since, corporate image is affected by the PR therefore they are studied to understand the focus of the organizations when they communicate about their CSR activities.

2. LITERATURE REVIEW

Press Releases have not been used extensively by academic researchers and therefore there exists a distinct gap in literature vis-à-vis the use of press releases. Added, the use of news papers for the purpose of communication of socially responsible activities has been limited and deserves to be paid attention to (Maria & Karolina, 2011). A few distinctive attributes about press releases is that it enjoys a very high degree of credibility amongst the readers. The newspaper readers consider the news reports as highly authentic and verified piece of information. But since public relations professionals use press releases extensively (Applegate, 2006) and inspite of the rapid changes in the message delivery system, press releases continue to be the main tool used for the public relations (Minnis and Pratt, 1995), the line between a press release and public relations has got diffused (Lordan, 2005). As a result corporate releases have begun to be perceived as self lauding accounts which may lack objectivity and neutral opinion. In India, the most regular feature of a corporate release in a news paper is the declaration of the financial results which is a part of the government mandate to publicly announce the financial results. Apart from the mandatory release of the financial results, most organizations have begun to use press releases as a communication tool to connect to a larger stakeholder body which is beyond just the shareholder. The news releases about CSR help in building a concrete meaning of CSR. Therefore, press releases are used for communicating the socially responsible activities of the organizations. *CSR Reporting and Press Release*

A content analysis of the press releases made between 2000-2009 in two leading English dailies in United Kingdom indicate that the newspapers play a critical role in constructing a meaning of CSR and the readers understand CSR through the press releases. Corporate activity when linked to CSR communicated through the news papers help in reinforcing the faith of the readers in CSR and the organization which strengthens the trust and belief in CSR and therefore Maria and Karolina (2011) strongly recommend press releases as a very crucial and a strategic tool of communication which must be employed for CSR communication. Bollinger in 2001 employed the ‘dynamic social impact theory’ (DSICT) to empirically validate the impact of press releases. The study was conducted in United States used a binomial scoring to conclude that press releases are a very important media tool which enjoys a deep impact and influence on the opinion making of the people at large.

Another study by Reinig and Tilt (2009) analysed the use of media releases by four major Australian national banks in communicating CSR. The findings indicated that majority of the banks used media as a channel for CSR communication and the most commonly discussed CSR issues communicated through press releases is community involvement followed by customers as a stakeholder.

In another study conducted by Seidler and Lebar (1982), which focused on the linguistic consistency in financial reports like annual reports and Form 10-K and financial press releases, found a high degree of consistency in use of information, quality of language and the timeliness was noticed between the press releases and 10-K.
3. METHODOLOGY

Social disclosures are measured using content analysis because they help in bringing out the quantity and the nature of the disclosure (Holsti, 1969; Krippendorf, 1980). Content analysis has been defined as, “a technique for gathering data that consists of codifying qualitative information in anecdotal and literary form, into categories in order to derive quantitative scales of varying levels of complexity” (Abbott and Monsen, 1979) while Krippendorff (1980) elaborated and emphasised upon the reliability and validity aspect as well as he defined content analysis as ‘a research technique for making replicable and valid inferences from data to their context’. As a technique it has been rampantly used especially in measurement of CSR studies (Abbott and Monsen, 1979; Ernst and Ernst, 1978; Gray et al., 1995b; Guthrie and Mathews, 1985; Zeghal and Ahmed, 1990; Williams and Pei, 1999). Units of analysis have been debated about and they range from words, phrases, characters, lines, sentences, pages or proportion of pages dedicated to various categories of social disclosure (Unerman, 2000). For the purpose of this study considering previous literature in mind which uphold and defend the measurement of volume of disclosure in terms of words arguing that disclosure can be recorded in greater detail. (Deegan and Gordon, 1996; ZeGhal and Ahmed, 1990 Deegan and Rankin, 1996). Therefore, individual words were used as a unit of measurement.

The content analysis of the downloaded reports was made.

To make a content analysis of the CSR related literature in the annual report; software named, “Concordance” was employed.

National Association of Accountants (NAA, 1974; Clarkson, 1995; Adams, 2002; Murthy, 2008; Sandhu and Kapoor, 2010; Dagiliene, 2010) identified four broad heads such that factors of corporate social activity are covered systematically and the key stakeholders are identified and crucial areas of CSD are identified – community development, human resources, services and product contribution and environment contribution. (NAA, 1974). The World Business Council for Sustainable Development (WBCSD, 2002b) has also identified human rights, employee rights, environmental protection and community involvement as the key components for CSD.

4. RESULTS AND ANALYSIS

The MNC have more than double the amount of CSR related disclosure through PRs than the Indian companies. But what is common between the two is that environment occupies the main focus and attention of both the Indian and the MNCs. 65.02% of the total MNC disclosure has been about the environment while 63.43% of the total Indian disclosure. There is a distinct shift in the focus of the company’s in their disclosures about CSR through PRs and annual reports (ARs). Human Resource (HR), as a stakeholder is the focus in the ARs while environment is the focus through the PRs. One of the reasons for this could be that PRs is one of the several tools of public relations and the purpose of public relations is creating and placing news-worthy
information … to attract attention to a person, product or service’ (Kotler, et.al, 1999) therefore corporate harness the attention of the public at large by focusing upon issues of common interest like environment and using PRs as a medium to achieve proactive publicity (Newman and Cullen, 2002). Further, the government agencies and the international business community are very particular and sensitive to the environment related issues and therefore the primary focus of the PRs is upon environment related issues. An example from the Indian and the MNC is given below which clearly reflects an attempt at corporate image building through the press release. Infosys Technologies … has been certified ISO 14001… is accredited third-party verification that Infosys’ environmental initiatives meet international standards. (Infosys).

Accenture is focused on conserving and reducing water consumption. In just one office with several thousand employees, we reduced water consumption by 7%. Rainwater is harvested and waste water is treated on-site for use in watering gardens. (Accenture).

<table>
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Table: 1 Disclosure of Various Stakeholder

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</tbody>
</table>

The MNCs’ news releases regarding the human resources carry a lot more words than the Indian Companies and the commonality that exists between the two is that the maximum disclosure amongst both the Indian and the MNCs is the category of benefits which the companies provide to their employees which are talked about in the press releases. The reason could be that the press releases are used as tools for image creation and reputation management and the MNCs are more insistent on creating an image of a positive employer both to retain the current human resources as well as to attract new talent. Most other categories do not carry as much focus because they address issues of internal concern which may not be of interest for general public.

An example of such a release is as follows.

`According to a survey result disclosed by Microsoft, remote working programs benefit employees and employers alike through productivity, reduced over head and happier workers ... and Microsoft has been steadily building technologies over the past few years specifically to enable remote collaboration (Microsoft, 2009).`

`‘It’s heartening to see iGate being named among the top three employers in India for the third year in a row by DQ-IDC Best Employer`

Table: 2 Disclosure of Human Resources
Survey.’ Said Dr. Srinivas Kandula, Global; Head Human Resource iGate. ‘We continue to invest in state of the art people management practices regardless of the economic condition and we are delighted that there is external recognition for the work we are doing’. (iGate, 2009)

The press releases are an external form of communication and therefore the society and community related issues are emphasized upon through them. The focus of both the Indian and MNCs is on development, services offered and empowerment as against just discussing marginalization and being disadvantaged. Therefore the focus is clearly upon finding solution and working towards sorting and serving the community as against just discussing and talking about it. But there is a difference of intensity on focus between the Indian and the MNC press releases targeted at society. Amongst the MNCs 70.42 % focus on development as against 50% Indian companies which is the reverse of what we notice in the annual reports where more Indian companies had focused development and fewer MNCs. One reason could be that the MNCs are more conscious of the target audience of the press releases would be members of the community and therefore such discussions in press releases could definitely be a more focused and targeted communication.

Discussion about the problem and the reference to words and phrases like ‘being marginalized’, ‘society’, ‘community’ etc., 17% Indian companies focus more upon them as 21.83% words in the MNC press releases had such references while 38.28% Indian releases had such words.

The involvement of non-governmental organizations in society related CSR issues is still very low and it is lower in the case of MNCs much more than the Indian companies.

Customers as a stakeholder don’t get a lot of attention through the press releases and the issues about CSR communicated through press releases are in sync with the focus of the companies hold in their annual reports. Use of words like, ‘customer satisfaction’ and ‘customer delight’ which do not convey much essence in terms of socially responsible activities but are phrases aimed at customers. Like the focus in the annual reports, the MNCs still communicate about their product quality and ways of standardization because 26.97% of the press releases aimed at customers refer to product quality. Unlike the communication of the Indian companies made through annual reports emphasized upon their low price products the press releases focused upon product quality and innovation which matches the MNCs because 18.11% of the Indian communication through press releases talks about product quality.

<table>
<thead>
<tr>
<th>Categories for Society/ Community</th>
<th>Indian</th>
<th>MNC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community Develop.</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Society</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>NGO</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total words</strong></td>
<td>11</td>
<td>18</td>
</tr>
</tbody>
</table>

Table: 3 Disclosure to Society

<table>
<thead>
<tr>
<th>Categories for Customers</th>
<th>Indian</th>
<th>MNC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promotion Comm.</td>
<td>19</td>
<td>23</td>
</tr>
<tr>
<td>Product</td>
<td>23</td>
<td>41</td>
</tr>
<tr>
<td>Price</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>Place</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Others</td>
<td>68</td>
<td>73</td>
</tr>
<tr>
<td><strong>Total words</strong></td>
<td>127</td>
<td>152</td>
</tr>
</tbody>
</table>

Table: 4: Disclosure of Customers
Environment as a stakeholder enjoyed maximum attention in the press releases and the word energy featured maximum followed by the green and green house. Focus on green reflects sync with the sustainability report where the Indian companies used the colour green extensively which is well complemented and substantiated by the use of the word green in the press releases. Most companies have highlighted their contribution to environment through the efficient energy management systems incorporated in the form of water management, green building, emissions control etc.

<table>
<thead>
<tr>
<th>Environment</th>
<th>Indian</th>
<th>MNC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freq.</td>
<td>%(*)</td>
<td>Freq.</td>
</tr>
<tr>
<td>Carbon Credits</td>
<td>6</td>
<td>1.13</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>12</td>
<td>2.27</td>
</tr>
<tr>
<td>Climate Change</td>
<td>6</td>
<td>1.13</td>
</tr>
<tr>
<td>Conservation</td>
<td>7</td>
<td>1.32</td>
</tr>
<tr>
<td>Emissions</td>
<td>71</td>
<td>13.42</td>
</tr>
<tr>
<td>Energy</td>
<td>218</td>
<td>41.21</td>
</tr>
<tr>
<td>Environment</td>
<td>69</td>
<td>13.04</td>
</tr>
<tr>
<td>e-waste Management</td>
<td>10</td>
<td>1.89</td>
</tr>
<tr>
<td>Green,Green House</td>
<td>102</td>
<td>19.28</td>
</tr>
<tr>
<td>Green House</td>
<td>1</td>
<td>0.19</td>
</tr>
<tr>
<td>Pollution</td>
<td>10</td>
<td>1.89</td>
</tr>
<tr>
<td>Recycle</td>
<td>1</td>
<td>0.19</td>
</tr>
<tr>
<td>Reuse</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sustainability</td>
<td>16</td>
<td>3.02</td>
</tr>
<tr>
<td>Total words</td>
<td>529</td>
<td>100</td>
</tr>
</tbody>
</table>

5. FINDINGS

There is very sparing use of press release for the disclosure of non-financial details. Financial press releases are a legal mandate and therefore all the companies publish their audited and unaudited financial statements in the leading national and regional daily.

The use of press releases is done more by the MNCs than the Indian companies. MNCs have 1278 words which is considerably higher than the amount of CSR related press releases than those made by the Indian companies which is 834 words.

Unlike the Annual reports, both the Indian and the MNCs focus most upon environment as a stakeholder than the Human resource and the emphasis of the MNCs upon environment is as good as the Indian companies. 65.02% of the total CSR communication made through press releases by MNCs is about environment as against 63.43% of the total CSR information communicated by the Indian companies.

The MNCs as well as the Indian Companies in CSR communication made through press releases focus upon employees as the second most focused upon group of stakeholders (MNCs – 20.19% & Indian Companies – 20.02%) and this focus reflects a consistency in the MNCs as well as the Indian Companies catering to the employees as a stakeholder group because in the annual reports also the employees were the second most focused upon category of stakeholders.

In CSR communication made through press releases, focus upon the customers has been the third most focused upon group of stakeholders (MNCs – 11.89% & Indian Companies – 15.22%) in case of both types of companies where as the society as a group of stakeholders has been the least focused upon category of stakeholders with negligible focus 2.90% by MNCs and 1.32% by the Indian Companies.

Unlike the MNCs there is a distinct lack in consistency to stakeholder target measured through CSR communication amongst the Indian companies. The order of stakeholder focus in annual reports of the Indian companies was Human Resource, Customers, Environment and Society respectively whereas through the press releases the order of stakeholder focus is Environment, Human Resource, Customers and Society. Amongst the MNCs, the order of stakeholder focus was Human Resource, Customers, Environment and Society while in the press releases Human Resource and Environment exchange positions and the order is Environment, Human Resource, Customers and Society.
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Refused Derived Fuel – An Emerging Processing Technology for Municipal Solid Waste Management

Prof Dr K N Sheth
Director (Operations) Adani Institute of Infrastructure and
Dean- Interdisciplinary research, Gujarat Technological University

Abstract: Solid waste management is a global issue to urbanization. Rapid urbanization and industrialization intensify the pressure on cities especially on their infrastructure. Keeping large city clean and reduce the health and environmental hazards caused by municipal solid waste is a huge task. The solid waste is collected and dumped in dump yard causes many environmental hazards. In accordance with Central Pollution Control Board, the typical composition of Municipal Solid Waste (MSW) in Municipal Corporations of India, 35-40% of the solid waste is easily degradable, 15-20% of solid waste is combustible (long term degradable) and 15-20 % of the solid waste is recyclables/combustibles (Other material contribute to 20-25%). Thus there is a large potential in MSW to reutilize either as compost or as a Refuse derived Fuel (RDF). RDF is an alternate fuel and can be used in boilers in place of fossil fuel or co-firing of coal and RDF. An attempt is made to evaluate the significance of RDF processing technology as a part of Integrated Solid Waste Management

Key words: RDF, Municipal Solid Waste, Municipal Solid Waste Management, pelletization

1. INTRODUCTION- SUSTAINABLE ENERGY
Providing adequate and affordable energy is essential for eradicating poverty, improving human welfare and raising living standards worldwide. The global demand for energy is rapidly increasing with increasing human population, urbanization and modernization. The growth in global energy demand is projected to rise sharply over the coming years and as such the world heavily relies on fossil fuels which are limited to meet its energy requirements. Therefore, other forms of energy which are sustainable need to be found.

Sustainable energy technologies are green, environmental friendly and renewable energy. (Dinesh and Romeela, 2011) ¹

TABLE-1 TYPICAL COMPOSITION OF MSW

<table>
<thead>
<tr>
<th>Sr</th>
<th>General waste component</th>
<th>Mass Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Easily degradable</td>
<td>35-40 %</td>
</tr>
<tr>
<td>2</td>
<td>Combustible/long term degradable</td>
<td>15-20 %</td>
</tr>
<tr>
<td>3</td>
<td>Recyclables/combustibles</td>
<td>15-20 %</td>
</tr>
<tr>
<td>4</td>
<td>Other materials</td>
<td>20-25 %</td>
</tr>
</tbody>
</table>

Source CPCB Report-2012

started paying attention to MSW to Waste –to-Energy (WTE) conversion. MSW can be processed and made for use as a coal equivalent is called Refuse Derived Fuel (RDF) (Sheth-2014) ²

Municipal Solid Waste Management is a global issue to urbanization. Rapid Urbanization and Industrialization intensify pressure on the cities especially on their infrastructure. Typical solid waste composition received by Municipal corporations in India is shown in the Table-1
The Table-1 shows the large potential of Indian MSW for re-utilization – either as compost or as potential RDF material. 20% of MSW need to be then safely disposed to landfills. RDF is an alternate fuel and can be used in boilers in place of fossil fuels. It provides an alternative means for safe disposal of garbage of the city. Improper disposal into landfill leads to pollution of air, water and land as well as reduces methane emission. It overcomes the hazards associated with poor garbage disposal system. This will help in the conservation of fossil fuels and enhances nation’s security for energy specifically when reserves of fossil fuels are depleting. It can generate direct or indirect employment.

The way in composing earthworm composting is more successful, the RDF is more successful in waste to energy technologies.

The term Municipal Solid Waste (MSW) normally is assumed to include all the wastes generated in a community with the exception of industrial process wastes and agricultural solid waste. According to Rule 3 XV of Municipal Solid Waste (Management & Handling) Rules, 2000, MSW includes the commercial and residential wastes generated in municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated biomedical waste.

MSW predominantly consists of non-liquid waste materials arising out of domestic, trade, commercial, agricultural and industrial activities. It is a combination of heterogeneous waste materials and these materials are commonly known as garbage, refuse, rubbish or trash. The MSW generated every day is 0.1 million tons (36.5 million tons annually). The calorific value of Indian solid waste is between 600-800 kcal/kg and the density of the solid waste is 330-560 kg/m3. Municipal Solid Waste (Management & Handling) Rules, 2000 – Schedule II (5) states as under:

“Mixed waste containing recoverable resources shall follow the route of recycling. Incineration with or without energy recovery including pelletization can also be used for processing wastes in specific cases.............”

Similarly, Municipal Solid Waste (Management & Handling) Rules, 2000 – Schedule IV (1) ‘Standards for composting, treated leachate and incineration’ states as under:

“The waste processing or disposal facilities shall include composting, incineration, pelletization, energy recovery or any other facility based on the state-of-art technology duly approved by CPCB”

Thus pelletization, thereby RDF ia an approved waste processing facilities in accordance with Municipal Solid Waste (Management and Handling) Rules, 2000. Pelletization under the Municipal Solid Waste (Management and Handling) Rules, 2000 has also been defined as under:

“Pelletisation - means a process whereby pellets are prepared which are small cubes or cylindrical pieces made out of solid wastes and include fuel pellets which are also referred as refuse derived fuel”

CPCB has reported that mechanical composting and vermin composting are more popular in India. Waste-To-Energy (WtE)

<table>
<thead>
<tr>
<th>Sr</th>
<th>State employing WtE plants</th>
<th>RDF</th>
<th>Power Plant</th>
<th>Biogas plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Andhra Pradesh</td>
<td>3</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Chandigarh</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Chhatisgarh</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Delhi</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Gujarat</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Kerala</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Maharashtra</td>
<td>-</td>
<td>-</td>
<td>19</td>
</tr>
</tbody>
</table>
plants have been set as shown in Table-2. From Table-2 it is clear that 8 RDF plants have been setup in 2011-12, AndhraPradesh-3, Chandigarh-1, Chhatisgarh-1, Delhi -1 and Gujarat-2

TABLE-2 WASTE - TO- ENERGY PLANTS IN INDIA OF 2011-12
Source CPCB www.cpcb.nic.in

2. RDF TECHNOLOGY

The process of conversion of garbage into fuel pellets involves primarily drying, separation of incombustible, size reduction and pelletization. The component is pulverized and used as fuel either independently or as supplementary fuel with other fossil fuels. The process flow diagram is depicted in Figure-1

The term MSW normally is assumed to include all the wastes generated in a community with the exception of industrial process wastes and agricultural solid waste. MSW thus will include residential waste, commercial waste, institutional waste, construction and demolition waste, and municipal services waste like street cleaning, parks and beaches cleaning and other recreational areas. It includes combustible and non-combustible parts. It may include food waste, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, tin cans, aluminum and other metals, ashes, bulky items like consumer electronics, white goods.

The fact sheet of MSW can be summarized as under:

- It is estimated that solid waste generated in small, medium and large cities and towns in India is about 0.1 kg, 0.3 – 0.4 kg and 0.5 kg per capita per day respectively.
- Studies carried out by National Environmental Engineering Research Institute (NEERI) indicated that the per capita generation rate increases with the size of the city and varies between 0.3 to 0.6 kg/day in the metropolitan areas, values up to 0.5 kg/capita/day have been recorded.
The estimated annual increase in per capita waste quantity is about 1.33% per year.

Solid waste generation in India is about 115,000 tons per day with a yearly increase of about 5%.

Commonly practiced waste disposal / waste management processes in India include composting, bio-methanation and incineration of Refuse Derived Fuel (RDF) pellets for power generation.

The 11th Five Year Plan has envisaged an investment of Rs. 2,212 crores for Solid Waste Management (SWM).

<table>
<thead>
<tr>
<th>Sr</th>
<th>Component</th>
<th>Ahmedabad in %</th>
<th>New Delhi in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Paper</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>metal</td>
<td>0.8</td>
<td>0.6</td>
</tr>
<tr>
<td>3</td>
<td>Glass</td>
<td>0.93</td>
<td>0.31</td>
</tr>
<tr>
<td>4</td>
<td>Textile</td>
<td>4.08</td>
<td>3.56</td>
</tr>
<tr>
<td>5</td>
<td>Plastic</td>
<td>0.69</td>
<td>1.46</td>
</tr>
<tr>
<td>6</td>
<td>Ash &amp; Dust</td>
<td>29.01</td>
<td>22.95</td>
</tr>
<tr>
<td>7</td>
<td>Others</td>
<td>10.39</td>
<td>7.52</td>
</tr>
<tr>
<td></td>
<td>Organics</td>
<td>48.95</td>
<td>57.71</td>
</tr>
</tbody>
</table>

**TABLE -3 TYPICAL COMPOSITION OF MSW IN AHMEDABAD AND NEW DELHI**

The general composition of MSW is given in Fig-2

3. THE FIRST STEP - SUN DRYING (SOLAR DRYING)

In this step MSW collected for disposal is tested for Moisture Content. Moisture is reduced by sun drying when adequate land is available i.e by uniformly spreading it on an open paved area and allowing it to sun dry. The duration is 1 to 2 days depending upon the garbage quality. In the process of spreading the garbage, manual inspection is carried out to remove debris tree cuttings, tires etc which are harmful to the d/s process.

**Vibrating Conveyor System**

Conveyors transfer waste from one location to another. Many kinds of conveying systems are available. Vibrating means oscillating – Vibratory conveyors advance material by repeatedly throwing it small distances. Material temporarily leaves the surface on the trough on each throw. They are normally designed to handle the granular materials.

System consists of 3 main elements-a carrying trough-a drive system- the drive is responsible for imparting vibrating motion to the trough. The drive here is mechanical type drive. It could be electromagnetic or pneumatic type drives and -a support structure.

4. SECOND STEP: PRE-SHREDDING (OPTIONAL)

Shredding is a unit operation for a size reduction using Hammer Mill or a shredder. This removes the large bulky items from the MSW. In operation the hammers in the hammer mill attached to a rotating element, strike the waste material as it enters and eventually forced through outlet of the unit.

Segregation- stage-1 Manual Segregation

Source: Dinesh Surroop and Romeela Mohee, 2011
This operation is manual removal of materials like bulky items, white goods, high value paper and card board.

5. THE THIRD STEP: ROTARY DRYING

Sun dried garbage is then uniformly fed into a rotary drying system i.e Hot Air Generation burning oversize garbage to further bring down the mc by 10-12 %. This level of mc is desirable to be maintained in the garbage for densifying into fine pellets. Rotary drum dryer is used for this purpose. It is composed of slightly inclined from horizontal through which the MSW to be dried and the hot air are passed simultaneously.

6. THE FORTHSTEP: MECHANICAL SCREEN

Garbage is passed through a screening equipment to separate sand/grit (below 8 mm), heavier combustible & ferrous materials which are abrasive in nature and may cause harm to the process equipment. The fine fraction having organic matter in it is proved to be useful as garden manure.

Screening is a unit operation used to separate mixture of materials of different sizes into two or more fractions by means of more screening surfaces. The basic aim of screening is removal of under-sized/over-sized material and separation of the waste into light combustibles and heavy non combustibles. This also ensures recovery of paper, plastics and other light combustible materials. Trommel is normally employed -Trommel is a rotary screen – also known as a rotary drum screen. Trommels are used to separate waste materials into several size fractions.  

7. THE FIFTH STEP: DENSITY SEPARATION

The dried and screened garbage is then passed through an air classifier (density separator) in which the light combustibles and dense fractions (e.g. stones, glass, etc.) over an air barrier are separated. Density separation is the unit operation used to separate light materials such as paper and plastic from heavier materials such as ferrous metals based on weight difference of the material in an air-stream. If materials of different weights are introduced into an air stream moving with sufficient velocity, the light materials will fall in the counter current direction. Air classification is used to separate light fraction –organic material from heavy fraction-inorganic material. For commingled glass and plastic A complete air classification system is comprised of the air classifier and cyclone separator used to separate material from air stream.

8. THE SIXTH STEP: MAGNETIC SEPARATION

The garbage is passed over a magnetic separation unit to remove (ferrous metals) magnetic materials. Magnets can be classified as either as (1) as electromagnets which use electricity to magnetize or polarize an iron core or (2) permanent magnets which utilize permanently magnetized material to create a magnetic material.

9. THE SEVENTH STEP: GRINDING

The light combustibles are ground to 10/15 mm particle size.

10. THE EIGHT STEP: MIXING ADDITIVES

The additives/ binders are mixed with the ground garbage in mixer/ conditioner before pelletizing. The pallets coming out from the pelletizer are cooled and stored in pellet storage yard for dispatch. The pellets so produced can be used in industrial boilers and thermal power plants as fuels. RDF can be used as (substitute) fuel for cement kilns and various industrial processes, in fixed grate, travelling grate, fluidized bed and multi fuel.
packaged boilers. The fuel pellets produced out of garbage combustibles are of cylindrical shape of different diameter up to 30 mm as required by the end users. The fuel pellets have distinct advantage over coal as Sulphur content of this derived fuel is only about 0.2-0.3% as against 3-4% in coal.

11. RDF PLANTS SUCCESSFULLY IMPLEMENTED

In the beginning, Pilot plant studies were carried out for processing 150 tonnes /d of MSW to 80 TPD pellets from the grant given by the Department of Science & Technology DST (Govt. of India). DST in collaboration with CMC Limited initiated a pilot project on Integrated Waste Management (IWM) in Mumbai in order to offer a technological solution for disposal of city garbage and provide options for making metropolitan cities of the country cleaner environmentally which is RDF project. Based on this technology, 350 TPD plant to produce 100 TPD pellets had been installed in Hyderabad through private sector participation.

In India, many RDF plants are in operation at Hyderabad, Guntur and Vijaywada in Andhra Pradesh State. The Hyderabad RDF plant was commissioned in 1999 near the Golconda dumping ground with a 1000 MT/ d capacity (but receiving only 700 MT/d at present). The RDF production is about 210 MT/d as fluff and pellets, and it is going to be used for producing power (about 6.6 MW).

The RDF plant at Deonar, Mumbai was set up in the early 1990s for processing garbage into fuel pellets. It is based on indigenous technology. However, the plant has not been in operation for the last few years and it is owned by Excel India at present.

A similar project has been established in Bangalore and has had regular production of fuel pellets since October, 1989, compacting 50 MT/day of garbage, converting into 5 MT of fuel pellets, which can be designed both for industrial and domestic uses.

12. MERITS OF RDF PLANT

- Successfully established for MSW
- High calorific value of pellets 3500-4000 kcal/kg (this is equivalent to E class coal) against that of unprocessed garbage i.e 800-1000 kcal/kg
- Pellets can be conveniently stored and transported
- Pellets can be used as supplementary fuel for combustion processes and utility boiler
- Clean fuel free from stones
- Low ash content
- Uniform size
- Regular trouble free supply

13. DEMERTS OF RDF PLANT

- The processing unit cannot be operated during rainy season as the garbage will be too wet
- High m c of MSW increases the cost of drying
- Consumes more energy than biological processes
- Uncontrolled burning of the pellets derived from MSW may lead to harmful emissions

14. SUMMARY AND CONCLUSIONS

Disposal of large quantities of garbage is a difficult job. The dumping grounds of such garbage are invariably polluted. It is estimated that about 25 human diseases are associated with solid wastes. Rats and flies flourish on the garbage heaps. Rats are the carriers of insects and other bio-organisms are responsible for spreading diseases like plague and cholera etc. The flies which may carry pathogenic organisms may cause diseases like dysentery, diaharrea etc. Studies reveal that
70000 flies can be produced in a one cubic foot of garbage.(Smiriti)

RDF technology provides an alternative means for safe disposal of garbage of the city. Improper disposal into landfill leads to pollution of air, water and land as well as reduces methane emission. It overcomes the hazards associated with poor garbage disposal system.

This technology provides another source of energy. This will help in the conservation of fossil fuels and enhances nation’s security for energy specifically when reserves of fossil fuels are depleting. Looking to the merits of the RDF more and more such plants must be set up for sustainable management of Municipal Solid Waste.

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Abstract: Various areas related to fixture are already described by renowned authors, but still there is an urgent need to apply all these research works to an industrial application. This paper presents design and development of rotary fixture for machining real industrial component - Flow TEE body of petroleum refinery. Actually HMC is the best solution for performing the required operations, but HMC costs around 12.5 million rupees whereas CNC turning centre costs only about 2.5 million rupees. Here the research work of this paper is proved. A fixture is designed & manufactured, which helps to accomplish required machining operations on CNC turning centre and hence 10 million rupees are saved in installation cost. Methodology for mass balance of rotary fixture developed by investigators mostly act as post-mortem tool. The present paper proposes a unique use of Pro/Mechanism and MATLAB to solve mass balancing problem for asymmetrical components like rotary fixture. Fixture being manufactured also; this paper sets the classical example of design for manufacturing.

Keywords: rotary fixture, mass balancing, design for manufacturing

1. INTRODUCTION
Mathematical software is very much useful in solving the analytical problems of engineering and is one of the most important tools in engineering analysis. It is tedious and time consuming task to solve the mathematical problems related to different engineering systems especially the mass balancing systems as stated by G. F. Simmons (2007). In general, researchers apply traditional mathematical and mechanics equations to solve such problems which involves a considerable amount of time and laborious efforts. The research objective of this paper is to provide on hand mathematical program and a pre-mortem tool to solve such mass balancing problems (P.V. O’Neil, 1995). Generally, the mathematical solution of these problems does not readily provide flexibility, accuracy, speed and sensitivity analysis. As a result, researchers find themselves uncomfortable with the entire process of solving these types of problems (F. Pietryga, 2005). As a matter of fact, developing a program is not an easy task and needs considerable programming skills as described by D. Ibrahim (2011). Mainly programs are developed using a high-level programming language such as FORTRAN, C++, PASCAL or BASIC to solve mathematical equations. The disadvantages of writing a program are (i) demands in depth programming skills, (ii) developing and testing is time consuming, (iii) modification and up gradation is possible at almost zero cost, (iv) dedicated program writing. An alternate is to solve engineering system using a commercially available package. This option can be classified into two categories: general simulation packages, and dedicated simulation packages. General simulation packages can be used to simulate and solve most of the engineering of different fields, such as Excel (J. Walkenbach, 2007), MATLAB (B. Hahn and D. Valentine, 2007), MatriXx, and so on. The advantages of general simulation packages are: (i) low cost, (ii) no Programming skills are required, (iii) easy to use.

MATLAB is a high-performance language for technical computing. The name MATLAB stands for MATrix LABoratory. It integrates computation, visualization, and programming environment. Furthermore, MATLAB is a modern programming language environment: it has sophisticated data structures, contains built-in editing and debugging tools, and supports object-oriented programming. All these factors prove MATLAB an excellent tool for research. MATLAB is a computer program that provides the user with a convenient environment for performing many types of calculations (S.C. Chapra, 2008). The use of MATLAB was limited to signal processing, symbolic computation, control theory,
simulation, optimization, solving differential equations and several other fields of applied science and engineering. In this paper, an innovative method of combined use of Pro/Mechanism and MATLAB is proposed to solve mass balancing problems of asymmetrical component like rotary fixture.

2. STATEMENT OF PROBLEM
Design & development of rotary fixture for machining flow TEE body on CNC turning centre. The operations to be performed are front facing, outside diameter turning, grooving, boring and back facing. The fixture being rotary in nature has to be mass balanced. Three set up of fixture are to be designed to perform required operations.

3. COMPONENT DETAILS
The methodology proposed for design of a fixture includes the realization of two stages. The first stage represents the knowledge of the objects like part geometry, machining process, functional and detailed fixture design and fixture resources. The second stage describes the inference process (design and interpretation rules) needed to obtain first solution for the machining fixture (Hunter, R, Vizan A, Perez J, Rios J., 2005). As a part of first stage, component geometry is discussed in this section. The component is Flow TEE body, made up mild steel, weighing 46.5 kg and is one of the components of petroleum refinery [Figure 1-3]. The component is used as a joint or coupler for pipes through which petroleum liquid products flow and gets mixed. The component in raw material form is forged, proof machined with 3 mm machining allowance on conventional lathe with 24 inch swing over diameter. The operations to be performed on component, using designed fixture set up, are front facing, outside diameter turning, grooving, boring and back facing.

4. DESIGN OF SET UP – I FIXTURE
Location & clamping of set up – I fixture is accomplished by using three V-blocks and latch clamp [Figure 4,5]. Elements of fixture assembly include V-block, latch clamp, base plate, vertical plate, adapter plate, locator and rib. The fixture uses three V-blocks to locate and a latch clamp to hold the component. The latch clamp consists of two M 6 bolts to directly clamp the workpiece. The chuck of CNC turning centre will be replaced with complete fixture set up using an adapter plate. The adapter plate holds the same dimensions of chuck plate. The locator locates the vertical plate in correct position with adapter plate. The base plate serves to hold the fixture assembly. The ribs are clamped to base plate and provide the holding arrangement for latch clamp. Fixture rotates with 550 rpm while performing operations on CNC turning centre. The specification of spindle nose of CNC turning centre used in this
work is A_{2.8}, which can carry weight of 450 kg. The fixture is directly mounted on spindle nose.

Fig. 4: 3D views of set up-1 fixture

Fig. 5: 2D drawing of set up-1 fixture

5. MASS BALANCING OF ROTARY FIXTURE USING PRO/MECHANISM AND MATLAB

Methodology developed by most of the researchers mostly act as post-mortem tool, calculating and determining unbalanced mass after fixture is manufactured followed by unbalanced mass removal or counterweight addition. The present volume of this paper proposes the unique method of use of Pro/Mechanism and MATLAB, which would enable prediction of unbalanced mass during design stage well before manufacturing. As the fixture is asymmetrical, it has to be mass balanced. The fixture rotates about one axis; hence it has to be balanced about other two perpendicular axis. x - axis is taken as axis of rotation in the present analysis work.

6. QUADRANT COMPUTER AIDED MASS BALANCING OF SET UP -1 FIXTURE

An innovative approach of use of Pro/mechanism is proposed to solve mass balancing problem in this section. Results of output of Pro/Mechanism are used as an input data for MATLAB.

Step I: C. G., weight and offset distance of C. G. of Set up -1 fixture from axis of rotation are determined as shown in fig 6. The important results from the above output are as follows: weight of fixture with component, without balancing mass = 233.12 kg. C.G. is offset from axis of rotation in x – axis by -130.56 mm, in y – axis by -1.11 mm and in z – axis by 2.38 mm.

Step II: Now set up -1 fixture is cut in 4 quadrants about 2 axis, perpendicular to each other and perpendicular to axis of rotation as shown in fig. 7.

Step III: Weight and C. G. of set up-1 fixture in each quadrant are determined. [Fig. 8-11].

Step IV: The outputs of weight and C. G. of set up-1 fixture in each quadrant are summarized [Table 1].

Step V: According to principles of mechanics, \( \Sigma F = 0 \) and \( \Sigma M = 0 \) for mass balancing. The sum of unbalanced mass in horizontal direction \( \Sigma F_H \) and in vertical direction \( \Sigma F_V \) are calculated [Table 2].
Step VI: Resultant unbalanced mass (R) and its line of action in terms of angle (α) with x-axis are calculated using parallelogram law of forces [Table 3].

<table>
<thead>
<tr>
<th>Quadrant (i)</th>
<th>Co-ordinates of C. G. (mm)</th>
<th>( \tan \theta_i ) (Degree)</th>
<th>( \theta_i ) (Degree)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>83.09</td>
<td>0.10</td>
<td>47.92</td>
</tr>
<tr>
<td>2</td>
<td>-103</td>
<td>-0.78</td>
<td>38.11</td>
</tr>
<tr>
<td>3</td>
<td>-101.14</td>
<td>0.76</td>
<td>37.41</td>
</tr>
<tr>
<td>4</td>
<td>82.35</td>
<td>-1.04</td>
<td>46.14</td>
</tr>
</tbody>
</table>

**Table 1: Summary of C. G. of set up-1 fixture in all quadrants**

Step VII: Sum of moment of inertia about x – axis (\( \Sigma m_i x_i^2 \)) and that about y – axis (\( \Sigma m_i y_i^2 \)) are calculated [Table 4].

<table>
<thead>
<tr>
<th>Quadrant (i)</th>
<th>( m_i ) (kg)</th>
<th>( m_i x_i^2 ) (kg mm(^2))</th>
<th>( m_i y_i^2 ) (kg mm(^2))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>38.5</td>
<td>265802.0019</td>
<td>326147.421</td>
</tr>
<tr>
<td>2</td>
<td>48.09</td>
<td>510186.81</td>
<td>313806.89</td>
</tr>
<tr>
<td>3</td>
<td>53.36</td>
<td>545835.4267</td>
<td>319254.080</td>
</tr>
<tr>
<td>4</td>
<td>43.82</td>
<td>297166.316</td>
<td>321910.663</td>
</tr>
<tr>
<td>( \Sigma )</td>
<td></td>
<td>1618990.554</td>
<td>1281119.056</td>
</tr>
</tbody>
</table>

**Table 4: Calculation of sum of moment of Inertia about X – direction (\( \Sigma m_i x_i^2 \)) and that of about Y – direction (\( \Sigma m_i y_i^2 \))**

Step VIII: Resultant moment of inertia is calculated using principle of perpendicular axis theorem of moment of inertia [Table 5].

| \( I_{xx} \) = \( \Sigma m_i x_i^2 \) | 1618990.554 kg mm\(^2\) |
| \( I_{yy} \) = \( \Sigma m_i y_i^2 \) | 1281119.056 kg mm\(^2\) |
| \( I_{zz} \) = \( I_{xx} + I_{yy} \) | 2900109.61 kg mm\(^2\) |

**Table 5: Calculation of Resultant Moment of Inertia, M**

Step IX: Having M, R and \( \alpha \), the location of C. G. (\( r_{cm} \)) of R is determined.

\[
M = R \cdot r_{cm}
\]

\[
r_{cm} = \frac{M}{R}
\]

\( r_{cm} = 342.33 \) mm

Thus the unbalanced mass is found to be 24.75 kg and its C. G. is situated at an angle of 13.45° with x-axis at a distance of 342.33 mm in III quadrant.
Hence the fixture can be balanced by placing the counterweight equal in magnitude and opposite in direction as that of unbalanced mass.

7. MATLAB CODE FOR IV QUADRANT COMPUTER AIDED MASS BALANCING OF SET UP - I FIXTURE

Following is the code for IV quadrant computer aided mass balancing of set up – I fixture. Result generated using Pro/Mechanism are used as an input data to MATLAB code.

```
function quad4
a = 0;
b = 0;
c = 0;
d = 0;
mm = 0;
for i = 1:4
    disp(['Enter details of Quadrant ', num2str(i)]);
m(i) = input('Enter m:');
disp('Enter details of mm:');
x(i) = input('Enter x:');
y(i) = input('Enter y:');
tanthetaa(i) = abs(y(i)/x(i));
disp(['The values of tan-theta is: ', num2str(tanthetaa(i))]);
    thetaa(i) = atand(tanthetaa(i));
disp(['The values of theta is: ', num2str(thetaa(i))]);
costhetaa(i) = abs(cosd(thetaa(i)));
disp(['The values of cos-theta is: ', num2str(costhetaa(i))]);
    mcosthetaa(i) = m(i) * costhetaa(i);
    if (i == 2 || i == 3)
        mcosthetaa(i) = -mcosthetaa(i);
    end
    disp(['The values of mi * cos-theta is: ', num2str(mcosthetaa(i))]);
sinthetaa(i) = abs(sind(thetaa(i)));
disp(['The values of sin-theta is: ', num2str(sinthetaa(i))]);
    msinthetaa(i) = m(i) * sinthetaa(i);
    if (i == 3 || i == 4)
        msinthetaa(i) = -msinthetaa(i);
    end
    disp(['The values of mi * sin-theta is: ', num2str(msinthetaa(i))]);
    a = a + mcosthetaa(i);
b = b + msinthetaa(i);
mm = mm + m(i);
xn(i) = m(i) * x(i);
disp(['The values of m * x is: ', num2str(xn(i))]);
c = c + xn(i);
my(i) = m(i) * y(i);
disp(['The values of m * y is: ', num2str(my(i))]);
d = d + my(i);
end

temp1 = (a*a);
disp(['The values of sum(FH*FH) is: ', num2str(temp1)]);
temp2 = (b*b);
disp(['The values of sum(FV*FV) is: ', num2str(temp2)]);
temp = temp1 + temp2;
R = sqrt(temp);
disp(['The values of R is: ', num2str(R)]);
tanalphaa = b/a;
disp(['The values of tanalpha is: ', num2str(tanalphaa)]);
alphaa = atand(b/a);
disp(['The values of alpha is: ', num2str(alphaa)]);
f1 = c/mm;
if (i == 3 || i == 4)
    f1 = -f1;
end
f2 = d/mm;
disp(['The values of r-cm(x) is: ', num2str(f1)]);
disp(['The values of r-cm(y) is: ', num2str(f2)]);
temp3 = (f1*f1) + (f2 * f2);
disp(['The values of r-cm*r-cm is: ', num2str(temp3)]);
f = sqrt(temp3);
disp(['The values of r-cm is: ', num2str(f)]);
disp('Done');
```

I. DESIGN FOR MANUFACTURING

Photograph of manufactured fixture is shown in fig. 12.

![Fig. 12: Photograph of manufactured fixture](image-url)
8. CONCLUSIONS AND RECOMMENDATIONS

A simplified, analytical method of use of Creo Elements/Pro 5.0 and MATLAB is proposed to solve the balancing problem. This approach is very useful as it opens the door to a more general class of problem and difficult tasks such as asymmetrical fixture as is the case in this work. It would tell the designer during the design stage “Fixture is balanced. Everything is OK. Everything will be OK. Go ahead.” or it would tell, “Stop! You are about to risk an unbalanced fixture. Take necessary measures and calculate unbalanced mass with its location.” Thus it minimizes the material cost and increases productivity. However, it is expected to have more flexibility in its application, since it is not sensitive to dynamic conditions.

It is already recognized that computerized fixture design can result in high efficiency, stable accuracy, short set-up time, and low cost. But the real performance of a computerized fixture design system is rooted in a powerful ability of the system to “replace” or exceed that which is done manually by a fixture designer. For instance, an increasing research interest is using various methods to obtain optimal fixture layout solutions for mass balancing, which often requires much precise calculations in geometry and mechanics. The present research work precisely answers to this question, solves the problem and proposes the use of Pro/Mechanism and MATLAB which ease fixture designer from tedious and time consuming work of solving mass balancing problem. Fixture is not only designed and mass balanced, but manufactured also; this paper sets the classical example of design for manufacturing. Design and development of set up – 2 and set up – 3 fixture is future scope of this paper.

9. ACKNOWLEDGEMENT

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AN STUDY OF METAL REMOVAL RATE FOR MICROMACHINING USING MICROORGANISMS

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Abstract: Several studies showed application of microorganisms in metal removal for producing microstructure on a metal work-piece. This process is called as Biological machining or biomachining, also known as machining via bacteria, is emerging too. The biomachining more environmental friendly than other methods of metal removal, and also has advantages like lower power consumption, major energy efficiency, low cost and elimination of thermal damage in the workpiece. Various studies on laboratory scale have been conducted to date on this issue. In this work biomachining is implemented on Bronze alloy to increase its scope. During the work effect of the presence of bacteria on material loss has been studied and also effect of surface quality, temperature and pH of the solution has been investigated.

Keywords: Biomachining, Metal removal rate, Surface roughness.

1. INTRODUCTION:
The term used to designate corrosion resulting from the presence and activities of microorganisms is microbiologically influenced corrosion (MIC). Some of the endless and detrimental effects of MIC are Corrosion of materials by microbes, fouling of industrial components and degradation of historical monuments. Microbe–metal interaction can be considered as a negative factor in this sense. If this corrosion behavior of microorganisms can be applied to a machining process of metal surface as a positive factor then the process would be environmentally friendly, free of residual strain and offer energy conservation. Generally Micromachining is done through physical or chemical processes, such as micromilling, micro-EDM, and chemical etching. These methods form damaged layers on the surface of work-piece and are expensive as well. Therefore alternative micromachining processes is in search of many researchers. Such an alternative micromachining process was first utilized by Uno et al. [21].

They have used Thiobacillus ferroxidans mediated MIC process for micromachining of carbon steel. They showed that use of microorganism as the tool to remove metal from a work-piece, have potential applications in the construction of micro-scale features.

Several studies reported an application of autotrophic bacteria like Thiobacili spp., Staphylococcus sp., Acidithiobacillus ferrooxidans, Acidithiobacillus thiooxidans for biomachining experiments. They revealed the possibility of using bacteria to drill metallic surfaces. Bacteria are acting as tool in biomachining. These bacteria are also called as iron eating bacteria because it requires iron for respiration.

1.1 Mechanism of machining:
The basic theory of biomachining based on the indirect bioleaching mechanism is illustrated in Figure 2. At. ferrooxidans has a cytoplasm and a biomembrane, which consists of an outer membrane, peptidoglycan, periplasmic space, and inner membrane. The attachment of bacteria on a copper surface is mediated by the extracellular polymeric substances (EPS) surrounding the bacteria. Iron-oxidize are generated in the periplasmic space and inner
membrane. An Fe\(^{2+}\) (ferrous) radical, which is transported to the periplasmic space from the culture fluid across the biomembrane, loses an electron by the catalysis of the iron-oxidize and becomes Fe\(^{3+}\) (ferric). This lost electron is then transported by oxygen with an electron transport chain (ETC), which couples a chemical reaction between an electron donor and an electron acceptor, to transfer H\(^+\) ions across a membrane through a set of mediating biochemical reactions. The overall reaction is as follows:

\[
2\text{Fe}^{2+} + \frac{1}{2}\text{O}_2 + 2\text{H}^+ \rightarrow 2\text{Fe}^{3+} + \text{H}_2\text{O}
\]

This chemical reaction generates energy. The ferric expelled from the cell is a strong oxidant, able to oxidize copper (Cu\(^0\)) to produce Cu\(^{2+}\). Therefore, a metal-based workpiece can be machined by the ferric that is produced by At. ferrooxidans.

\[
\text{Cu}^0 + 2\text{Fe}^{3+} \rightarrow \text{Cu}^{2+} + 2\text{Fe}^{2+}
\]

The ferric is reduced to ferrous by this biomachining process, which then can be re-oxidized to ferric ion by the oxygen in At. ferrooxidans. Thus, a circulatory system is formed Figure 2.

Table: 1 Composition of workpiece

<table>
<thead>
<tr>
<th>Element</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cu</td>
<td>78</td>
</tr>
<tr>
<td>Zn</td>
<td>&lt;0.0050</td>
</tr>
<tr>
<td>Pb</td>
<td>0.0302</td>
</tr>
<tr>
<td>Sn</td>
<td>&gt;18.0</td>
</tr>
<tr>
<td>P</td>
<td>0.004</td>
</tr>
<tr>
<td>Mn</td>
<td>&lt;0.002</td>
</tr>
</tbody>
</table>

General properties of Bronze are: It is highly corrosion resistant, poor conductor of heat and electricity, Strong and ductile, high wear resistant.

2 OBJECTIVES:
The objective of this work is to analyze micromachining of Bronze alloy using microorganisms and see the effect of various parameters like surface quality, temperature, pH of medium and bacteria concentration. To fulfill the objective of the work following study have carried out:

- Effect of the presence of bacteria on micromachining of bronze,
- Effects of temperature on material removal,
- Effect of Surface quality on material removal and
- Effect of pH of medium on material removal.

3 LITERATURE SURVEY:
A careful study on work that has been done by researchers revealed that biomaching is successfully implemented for following applications:

- Metal removal of pure copper, aluminum, nickel and tin.
- Metal recovery from printed circuit board.
- Micro feature fabrication.
- Biroleaching of metal from printed wire board.

Since biomaching is still an emerging machining technique of metal removal and it needs more improvement for successful industrial implementation, it is necessary that biomaching should also be applied on alloys. Still work has not found on implementation of biomaching on alloys.
As bronze is one of the most widely used alloy and requires micromachining also, so biomachining should be used for its machining and results should be studied to increase the scope for biomachining in industries.

4 METHODOLOGY:
To conduct our own experiments with *A. ferrooxidans*, the bacteria first had to be obtained and cultured successfully. Bacteria were obtained from National Collection of Industrial Microorganisms (NCIM) Pune. Once bacteria were received from NCIM Pune, several variations on the basic liquid media for this species were tried until one that was both effective and easy to make was found. After several trials in NCIM no. 18 medium, 9K medium and basal 510 medium it was found that NCIM medium was easy to prepare and was also giving satisfactory growth of bacteria in 3 days during continuous sub-culturing. Once we had inoculated NCIM medium we need to be confident about growth of the bacteria. For surety we need to determine presence of microorganism in the solution and if a bacterium has grown, its concentration should be known.

Figure 3. Experimental Procedure

All of the experiments show that, without some significant changes to the basic biomachining process, with proper adjustment of parameters affecting material removal, metal removal rate (MRR) can be improved slightly. Even though some material removal can be seen, the less Metal removal rate (MRR) makes direct applications in manufacturing seem doubtful for bronze.

A second experiment was conducted to obtain a crude estimate of the effect of the presence of bacteria concentration on mass loss. In that experiment, very thin Bronze pieces were exposed to solutions of *A. ferrooxidans*, as well as sterile media, for the same time periods. The difference in mass was recorded and converted into a material removal rate using formula of MRR given below.

The experimental procedures used to observe the effects of *A. ferrooxidans* and other parameters on material removal rates of the Bronze samples involved many steps and many different pieces of laboratory equipment. The combination of experimental steps and the continuous culture protocol employed to maintain a healthy population of the bacteria is summarized in the flow chart below (Figure 3). Bacteria Concentration was estimated using 3-Tube MPN technique.

Equipment required for this study are Laminar Hood, Incubator, Autoclave, Centrifuging, Microscope, Digital pH meter and weighing machine.

Liquid Media
The most basic recipe found for NCIMB medium no.18 bacterial media. This recipe employs two separate solutions that are mixed after sterilization. Each component is added in the order listed.

NCIMB medium no. 18
Solution I
\[(\text{NH}_4)_2\text{SO}_4 0.5 \text{ g}, \ K_2\text{HPO}_4 0.5 \text{ g}, \ \text{MgSO}_4 \cdot 7\text{H}_2\text{O} 0.5 \text{ g}, \ 1\text{N H}_2\text{SO}_4 5.0 \text{ ml} \] and Distilled water 1.0 L

Solution II
\[\text{FeSO}_4 \cdot 7\text{H}_2\text{O} 167.0 \text{ g}, \ 1\text{N H}_2\text{SO}_4 50 \text{ ml} \] and Distilled water 100 ml

Autoclave solution I at 121°C for 15 min and sterilize solution II by ultrafiltration.
After sterilization 4 parts of solution I are added to 1 part of solution II. pH of the medium should be 3.0. The cultures should be incubated at 30°C under stationary condition.

BRONZE samples of 10 mm x 10 mm and 0.5 mm of thickness were used for analysis. The sample was kept inside cultural solution in such a way that both sides of the sample be in exposer of solution.

Figure 4 Dimensions of the specimens used in the tests; (b) Placement of the specimen in dissolution.

\[
\text{MRR} = \frac{\text{Weight of the material removed (mg)}}{\text{Area (cm}^2\text{)} \times \text{time (hr)}}
\]

5 RESULTS AND DISCUSSIONS
In this study, the characteristics of Bronze bio-machining were evaluated experimentally.

5.1 Effect of presence of bacteria: Initially an experiment was conducted to identify the effect of presence of bacteria in the solution.

From the MRR study it was found that metal removal rate was increasing and decreasing continuously. The same pattern was observed by Hong Hocheng et al(2012) in his study on copper and he has explained it as Fe$^{3+}$ concentration is reducing when MRR is decreasing and increase in MRR is due to increase in concentration of Fe$^{3+}$. This increase in Fe$^{3+}$ concentration is due to presence of bacteria which oxidizes Fe$_2$SO$_4$ present in the solution. So, in this cycle bacteria are working as tool and gives continuous metal removal. During this experiment an average of 6.0 mg/24hr/cm$^2$ was obtained.

Graph 1 MRR of bronze in presence of bacteria.

5.2 Metal removal with and without bacteria:
An analysis was carried out to identify the effect of the presence of bacteria on metal removal. For that a sample was kept inside bacteria active culture and another similar sample was kept in medium having no bacteria. From the study it can be observed that bacteria has significant role in micromachining of bronze. Without bacteria very less metal was removed and in presence of bacteria metal removal rate was increased very much. An average of 0.7 mg/24hrs/cm$^2$ metal removal rate was obtained in absence of bacteria whereas it was increased to 6 mg/24hrs/cm$^2$ in presence of bacteria. So bacteria are acting as tool in micromachining of bronze alloy.

Graph 2 Comparison of metal removal with bacteria and without bacteria.
5.3 Metal removal with culture supernatant:

From these readings it was observed that metal removal was continuously decreasing for supernatant. This decrease in MRR for supernatant proves significance of bacteria as a tool. In comparison between MRR in presence of bacteria and in absence of bacteria it can be seen that there is continuous increase in MRR in presence of bacteria, while MRR is decreasing in absence of bacteria. Also total MRR obtained in presence of bacteria is more unlike MRR in study by Hong Hocheng et al (2012). In case of copper supernatant give more MRR than that of bacteria culture, but bronze is giving less MRR in presence of bacteria.

This may be due to time required for reproducing $\text{Fe}^{3+}$ ion. In case of copper MRR is very high and in this much small time interval bacteria has no tendency to oxidize $\text{Fe}^{2+}$. This makes decrease in MRR as in case of copper as explained by Hong Hocheng et al (2012). Unlike copper bronze has less MRR and also bacteria can sufficiently produce $\text{Fe}^{3+}$ ion for metal removal as $\text{Fe}^{3+}$ got consumed. So this is the reason for more MRR in case of bacterial culture than supernatant.

5.4 Effect of surface quality on MRR:

For this study four different samples of bronze were taken and ground using different grades of water proof grinding papers to see the effects of surface quality. Four different grades of grinding paper were chosen with grades 320, 220, 180, 150. Surface of the sample was made rough using these papers and pre-weighed bronze samples were allowed to be exposed in 3 days bacteria culture. Again readings were taken after each 24 hrs, and following results were found.

Graph 4 Effect of surface quality on metal removal
By comparing total metal removal for different grades of samples, it was found that as grades of grinding increases metal removal also increases. Metal removal was maximum for grade 320 and then decreasing continuously for grades 220, 180, and 150 respectively. Also during this study average material removal rate of 8.84 mg/24hrs/cm², 4.96 mg/24hrs/cm², 4.7 mg/24hrs/cm² and 2.08 mg/24hrs/cm² were obtained for the roughness grades of 320, 220, 180, and 150 respectively. So, good surface finish gives more metal removal as well as MRR.

5.5 Effect of temperature on MRR:
Temperature has also effect on mass loss during bio-machining as per study by E. Diaz-Tena et al. in their study on oxygen free Copper. So, an experiment was conducted in order to see effect of temperature on mass loss of Bronze. Five samples of Bronze, previously weighed, were introduced in different flasks containing 150ml bacteria solution (2 ml inoculated 3 days culture) and tests were made. All flasks were kept in incubator at five different temperatures viz. 20°C, 28°C, 38°C, 48°C and 58°C. After 24 hours of exposure to bacteria work pieces were taken out dried, cleaned and weighed carefully in order to determine mass loss. Table contains mass loss of Bronze at different temperatures.

From the graph it can be observed that higher temperature gives maximum metal removal. But also metal removal for 28°C was found higher than 20°C, 38°C and 48°C. As 28°C is optimum for bacteria growth, below 58°C optimum growth temperature for bacteria gives higher metal removal. So, it can be conclude that higher temperature is favorable for mass loss of Bronze and in this study highest metal removal of 11.2mg was obtained at 58°C.

5.6 Effect of pH of the solution on MRR:
All industrial metals and alloys have effect of pH of the solution when it allowed to be exposed in it. Metal degradation is always varies with change in pH of the solution. So, to study the effect of pH of the solution an experiment was conducted. Five bacteria solutions were prepared with total incubation time of 3 days for all. Once the bacteria has grown enough pH of the solutions were adjusted to different values. The pH of the solution can be adjusted using dilute 1 Normality (i.e. 1N) H₂SO₄ and 1 Normality (i.e. 1N) NaOH. So, in number of trials pH of the solutions were adjusted to five different values viz. 2,3,4,5 and 6.
After finishing this experiment it can be observed that metal removal is more for pH values of 3 and 2. Further increasing value of pH reduces metal removal. Also bacteria are acidithiobacillus i.e. it can survive in acidic environment only and at higher pH value bacterial activities reduces. It can be conclude that, though pH of the solution has effect on metal degradation, in Bio-machining low pH value gives higher metal removal due to favorable environment of the bacteria. So, for maximum metal removal rate pH of the solution should be 3. In this study maximum metal removal of 7.4 mg/day/cm² was obtained.
6 CONCLUSIONS:
The use of extremophile bacteria for material removal on Bronze samples was studied. Firstly, the effect of process parameters on the material removal rate was established. Based on the experimental results, we conclude that:

- Adding bacteria in the solution gives value of material removal approximately five times higher than the material loss in the absence of bacteria. So, bacteria are working as a tool during bio-machining of Bronze.

- During biomachining of bronze material removal rate is increasing and decreasing continuously, this proves continuous machining can be possible for Bronze.

- Culture supernatant gives equivalent material loss as bacteria culture, but material removal rate is decreasing continuously for culture supernatant. So, presence of tool i.e. bacteria is must for biomachining of Bronze.

- Work must be done on improvement in material loss by bio machining. So, experiments were conducted to see the effect of surface quality on material removal. Surface quality of the work piece also has effect on material loss. Better the surface quality gives higher material removal.

- During study with temperature and pH it was observed that higher temperature gives more material loss and optimum pH of bacteria survival gives improvement in material loss.

A work has been carried out for implementation of Bio-machining on Bronze alloy. Effect of the presence of bacteria and other parameters on loss of material has studied. Though improvement in material loss at some optimum parameters was found, but overall material loss is very less. So, in this regard implementation of biomachining on bronze and its industrial acceptance has fewer chances.

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