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**PROCEEDINGS  
OF  
IJMS-ARC 2022  
XVI INTERNATIONAL CONFERENCE ON APPLIED  
RESEARCH IN ENGINEERING AND MANAGEMENT  
SCIENCES**

**In Association with  
IRANIAN JOURNAL OF MANAGEMENT STUDIES  
12<sup>th</sup> August, – 2022**

**EVENT ORGANISERS**



**Edited By**

**Dr. K. Ravichandran  
Professor  
Acharya Bangalore Business School**



**ACADEMIC RESEARCH CONFERENCES**

PROCEEDINGS OF

*IJMS-ARC 2022*

*XVI INTERNATIONAL CONFERENCE ON APPLIED RESEARCH IN ENGINEERING AND  
MANAGEMENT SCIENCES*

**Edited By**

**Dr. K. Ravichandran**  
**Professor**  
**Acharya Bangalore Business School**

**Organized by:**



**Academic Research Conferences. India.**

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**Dr. Ravichandran Krishnamoorthy,**  
**Professor**  
Acharya Bangalore Business School  
Bangalore



## **Inaugural Address**

**An astute and result oriented professional with over 22 years of extensive experience in operations, business development, academics and institution building. Received the Award for “Outstanding Contribution towards Education 2016 & 17” from World Sustainability Council at DUBAI. Also due to his contribution to the field of finance, he was appointed as a consultant for Abu Dhabi Stock exchange and also he is on a research project in developing an Education application for Arpuda app private limited. He Received championship Award From WSIS ( UN forum) for his two sustainable development projects. Currently he launched the portal for Women Entrepreneurship development in Chennai. Currently employed as Professor and Director of Experiential Learning, New York Institute of Technology, Abu Dhabi Campus, UAE.**

**He holds the Post-doctoral fellowship from University Kebangsaan Malaysia and Ph.D. in Finance from the University of Madras, India. His area of expertise is primarily with corporate finance and conducts focused research in the Behavioral finance and company analysis. He has co- authored several text books in Finance which are mainly focused on Indian markets. He made intellectual contributions that impact on the academic community in the area of corporate and Behavioural finance through papers published in competitive journals in this domain space (Finance India, Journal of investment, Money and Banking, International Journal of Economics and Finance...). He has also made contributions through service to the academic community, as recognition of his scholarship, through her inclusion as a reviewer and/or discussant for several academic conferences and also acting as an Editor of an International Journal. His research in the field of finance also resulted in contribution to teaching and learning by way of the receipt of a NYIT ISRC grant award. His Intellectual contributions have furthered higher education initiatives through his continued collaborative experiential education work with students into the annual Corporate Challenge Competition. His Intellectual contributions, by way of faculty-mentored student research projects were presented by students at International conferences and also got published International journals. So far he has published 25 international journal publications, 12 Books of which 4 are text books and participated in 25 international conferences worldwide.**

**Dr. Hamid Reza Irani**

*Assistant Professor of Entrepreneurship and  
Marketing, Faculty of Management and  
Accounting,  
College of Farabi, University of Tehran  
&  
Director In charge **Iranian Journal of  
Management Studies***



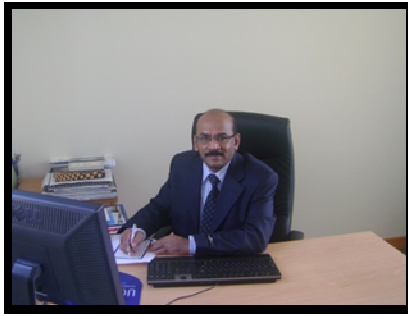
## **Key Note Address**

Dr. Hamid Reza Irani, in most of his teaching position at University of Tehran, he developed highly effective lesson plans, motivational exercises, and performance assessments. The accomplishment he is most proud of in his teaching career is exploiting gamification, as the first teacher in Iran, to enhance the quality of engagement and learning. He also use real case studies related to the subject of courses taught, from his experience of collaboration with industry. Not to mention, he has taught various courses utilizing e-learning tools at University of Tehran.

In terms of researching, He has been always absorbed in mainly three questions. Firstly, “What is the most effective way to employ various research methods and related tools in academic studies?”. Secondly, “how can new marketing concepts, like gamification, be applied to achieve better results in different industries such as tourism, healthcare, and education?” Thirdly, “what are the ethical challenges of organizations in this digital age?”

His professional activities primarily go into three categories. In 2010, he was appointed as the assistant editor of Iranian Journal of Management Studies (IJMS). From then, his dedication to this job brought more quality and reputation to the journal. As the result, this journal is now indexed in Web of Science, ABI Infrom, Gale, and other important indices. It also has more than 7000 members. Furthermore, he is also the member of editorial board of some journals such as International Journal of Organizational Leadership, and reviewer for several journals. Then, as the supervisor, He has five Ph.D students and more than 40 MA students. The third category is cooperation with industry. He has been a consultant to some companies in various industries like health care, IT, food etc. He has also been in the position of manager and boarding member in some of them.





## **FOREWORD**

**Dr. K. PrakashVel,  
Professor,  
University of Wollongong in Dubai.**

It gives me immense pleasure in writing a foreword to the 'IJMS-ARC 2022 XVI INTERNATIONAL CONFERENCE ON APPLIED RESEARCH IN ENGINEERING AND MANAGEMENT SCIENCES in Association with IRANIAN JOURNAL OF MANAGEMENT STUDIES.

ARC is a forerunner in creating and exchanging knowledge in the field of Business Management featuring major developments in the global economy and markets. They have been successful in organizing conferences to exchange skills and acumen on theory and practice on current and emerging management principles, ideas, concepts and research methods facilitating analysis among academicians, scholars and students, both at the post graduate and doctoral levels. I strongly believe that the conference would not only inspire the delegates participating from different parts of the World, but also further add to the existing literature in different research domains in business management.

I am positive that the one day International Conference would be beneficial to the participants. I extend my sincere wishes for a successful conference.

**Dr. K. PrakashVel**



## **FOREWORD**

**Gantasala V. Prabhakar, Ph.D**

**Professor & Assistant Dean,  
School of Management  
New York Institute of Technology,  
UAE**

Knowledge stems from extensive research undertaken by the multitude of experts in academia and the corporate. It then becomes quintessential that research-based findings that contribute to extant knowledge must be shared. One of the integral elements of Nonaka and Takeuchi's SECI model is Knowledge Sharing. I have believed that bringing researchers from across the globe working in their domains of expertise on a common platform is in the direction of creating strong Communities of Practice. Academic Research Publishers has set a benchmark in organizing these congregations of knowledge and research pools and presenting opportunities for knowledge sharing and in turn fuelling possibilities of knowledge creation. ARC has successfully over the years provided the base to present, discuss and enhance research developments in each of the management functions.

ARC has also garnered increasing patronage of participants who represent all the major continents and that in itself has been very inspiring and satisfying for me to be a part of their success. The conferences organized have seen an overwhelming response from global experts and is a testimony of the credentials that ARC embodies and has stood for.

It is my privilege to applaud their vision, their efforts and to be part of **IJMS-ARC 2022 XVI INTERNATIONAL CONFERENCE ON APPLIED RESEARCH IN ENGINEERING AND MANAGEMENT SCIENCES in Association with IRANIAN JOURNAL OF MANAGEMENT STUDIES**. Given the calibre of the participants and the values that are enshrined by conferences organized by ARC, I am very assured that the two day conference will be a resounding success and will draw appreciation and support from all associated with this noble endeavour.

**Gantasala V. Prabhakar, Ph.D**



## **FOREWORD**

**Dr. R. Krishna**  
**Group Director,**  
**Don Bosco Group of Institutions**  
**Bangalore.**

It is with immense pleasure that I write this Foreword for the the Proceedings of the **IJMS-ARC 2022 XVI INTERNATIONAL CONFERENCE ON APPLIED RESEARCH IN ENGINEERING AND MANAGEMENT SCIENCES in Association with IRANIAN JOURNAL OF MANAGEMENT STUDIES.**, organised by the Academic Research Conferences/Publishers, Abu Dhabi, UAE.

I am informed that the responses are overwhelming from all corners in the form of quality research papers submitted for review/approval for presentation during the conference. I am sure, the Proceedings of the conference will serve as an excellent reference book to the Management teachers the world over. I trust also that this conference will be an impetus to stimulate further study and research in all the areas.

Wishing Godspeed in all the endeavours.

**Dr. R. Krishna.**

**IJMS-ARC 2022**  
**XVI INTERNATIONAL CONFERENCE ON APPLIED RESEARCH IN ENGINEERING AND  
MANAGEMENT SCIENCES**

**ADVISORY BOARD MEMBERS**

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**IJMS-ARC 2022**  
**XVI INTERNATIONAL CONFERENCE ON APPLIED RESEARCH IN**  
**ENGINEERING AND MANAGEMENT SCIENCES**

DATE: 12<sup>th</sup> August, 2022

TIME	AGENDA	VENUE
09:15-09:30 AM	<b>REGISTRATION</b>	
09:30-10:00 AM	<p style="text-align: center;"><b><u>Conference Inauguration</u></b></p> <p style="text-align: center;"><b>Topic: “Redefining Pedagogy”</b>  <b>Dr. K. Ravichandran</b>  Professor, Acharya Bangalore B School &amp; <i>Founder ARC Conferences</i></p> <p style="text-align: center;"><b><u>Keynote Address</u></b></p> <p style="text-align: center;"><b>Dr. Hamid Reza Irani</b></p> <p style="text-align: center;"><b>Topic: “A multiple Criteria Decision Making Approach to Rank the Management Faculties of the top Universities of Iran”</b>  <i>Assistant Professor of Entrepreneurship and Marketing, Faculty of Management and Accounting,  College of Farabi, University of Tehran  &amp;  Director In charge Iranian Journal of Management Studies</i></p>	Jade Hall
10:00-01:00 PM	<p style="text-align: center;"><b>Technical Session 1 (Engineering &amp; Management)</b>  <b>Special Panel Discussion</b>  <b>Topic: “Design in Today's World”</b>  <b>Chaired by</b>  <b>Dr. Ritwij Bhowmik</b>  Associate Professor, IIT Kanpur, India.</p>	Jade Hall
02:00-05:30 PM	<b>Technical Session 2 (Engineering &amp; Management)</b>	Jade Hall Online
05:30-06:00 PM	<p style="text-align: center;"><b>Valedictory</b>  <b>by</b>  <b>Dr. S. S. Appadoo</b>  <i>Professor &amp; HOD, Department of Supply Chain Management,  University of Manitoba, Winnipeg, Manitoba. Canada</i></p>	Jade Hall Online

*IJMS-ARC 2022*  
Conference Schedule  
**Engineering & Management**  
SESSION CHAIRS

**Dr. B. Murali Manohar**  
*Professor & Dean – SCM  
D Y Patil Agriculture &  
Technical University,  
Kolhapur. India*

**Dr. S. S. Appadoo,**  
*HOD, Department of  
Supply Chain  
Management, University  
of Manitoba, Winnipeg,  
Manitoba. Canada*

**Dr. Christy Selvarani ,**  
*Former Principal &  
Director (SFC) UDC  
College, Trichy. India*

**12-08-2022, Friday**  
**Session 10:00 AM to 01:00 PM**

REF. No.	Paper Title & Presenter
1	<p><b>A Multiple Criteria Decision-Making Approach to Rank the Management and Accounting Scientific Units of the Top Universities of Iran</b></p> <p><b>Authors:</b> Dr. Hamid Reza Irani, Mohammad Reza Fathi, Maryam Abdoli Masinan, Mohamad Erfan Sobhani</p>
2	<p><b>A Covid-19 Vaccines Selection Model In The Presence of Arbitrariness, Imprecision, and Randomness In the Model Parameters</b></p> <p><b>Authors:</b> Dr. S. S. Appadoo, Dr. Yuvaraj Gajpal and Dr. M. Makhan</p>
3	<p><b>Optimization for Tactical Level Scheduling for Elective Surgery in Operating Theatre</b></p> <p><b>Authors:</b> Dr. Xiankai Yang, Dr. S. S. Appadoo and Dr. Yuvaraj Gajpal</p>
4	<p><b>Issues and Challenges faced by Adani Power Limited in the Global Era</b></p> <p><b>Authors:</b> Shri. S. Rajaraman and Dr. D. Christy Selvarani</p>
5	<p><b>Impact of Visual Merchandising and Store Image on Women's Purchase Decision of Apparel From Organized Retail Outlets in Bahrain</b></p> <p><b>Authors:</b> Dr. Shabana Faizal and Dr. Nidhi S Menon</p>
6	<p><b>Corrosion the Rival Obstacle of Hydrocarbon Industry and Its Deterrence</b></p> <p><b>Author:</b> Er. Sathish Rajkumar</p>
7	<p><b>Feminepsyche And Trauma In The Twenty First Century Expatriates Fiction</b></p> <p><b>Author:</b> Dr. S. Bernath Carmel</p>
8	<p><b>Sustainable Potable Water Supply and Liquid Waste Disposal System on 240 Unit Housing Estates and Ancillary at Kasunya in the Greater ACCRA Region</b></p> <p><b>Author:</b> Mr. Joseph Atuahene Omani</p>

9	<p><b>Factors Affecting the Quality of E-learning- Perspective of Higher Education Students</b></p> <p><b>Author: Dr. Nidhi S Menon</b></p>
10	<p><b><i>Sangeet aatmanubhav</i> – Designing Individualistic Music Streaming Experiences – An Indian Purview</b></p> <p><b>Authors: Mr. Kedar Dicholkar and Dr. Ritwij Bhowmik</b></p>
11	<p><b><i>Baha Sari</i>, from Television to Wardrobe: Tracing the Journey of a Visual Design</b></p> <p><b>Author: Ms. Gargi Ghosh</b></p>
12	<p><b>3D Printer as an Artistic Tool: Researching on Technology Innovation, Applicability, and Future Potential of Printing Technology in Visual Arts</b></p> <p><b>Authors: Mr. Partha Dutta and Dr. Ritwij Bhowmik</b></p>
13	<p><b>In Between Threads &amp; Knots: Understanding Unconventional Art Practice in Indian Contemporary Art</b></p> <p><b>Author: Mr. Aranya Bhowmik</b></p>
14	<p><b>An Improved Otsu Method for Enhanced Image Segmentation with Reduced Thresholding for Target Identification</b></p> <p><b>Authors: Mr. Pushkar Pandey, Dr. Ritwij Bhowmik and Dr. Kalpana Pandey</b></p>
15	<p><b>A Designers Guide to creating a humanoid 3D character for the <i>Metaverse</i></b></p> <p><b>Authors: Mr. Archit Gupta and Dr. Ritwij Bhowmik</b></p>
.	<b>LUNCH BREAK</b>

***IJMS-ARC 2022***  
**Conference Schedule**  
**Engineering & Management (Online)**

Join Zoom Meeting

<https://zoom.us/j/5457092288?pwd=WjFDUXp6VlBGVDVEZlc2NTRORDJEdzo9>

Meeting ID: 545 709 2288

Passcode: 55555

**SESSION CHAIRS**

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*Professor & Dean – SCM  
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of Manitoba, Winnipeg,  
Manitoba. Canada.*

**Dr. Christy Selvarani,**  
*Former Principal &  
Director (SFC) UDC  
College, Trichy. India*

**12-08-2022, Friday**  
**Session 02:00 PM to 05:30 PM**

REF. No.	Paper Title & Presenter
1	<b>Internationalization of Higher Education in India: Strategy Implications</b>  Authors: Ms. Sameera Fernandes and Dr. A. Anuradha.
2	<b>Spur Gears- Gear Geometry, Applied Theory and Practice</b>  Author: Mr. Soumitra Bhattacharya
3	<b>Herd Behaviour and its Impact on Indian Stock Market Returns: An Empirical Analysis Pre and During COVID</b>  Author: Dr. Pradipta Kumar Sayal
4	<b>Disconfirmation Model</b>  Authors: Dr E. Anandharaja Dr. K. Hariharan and Dr. Ashish Kumar Biswas
5	<b>Impact Of Social Media Advertising Among Young Adult Consumers</b>  Authors: Dr. Ajitha Savarimuthu, Dr. Geevarathna and Dr. A. Deivasree Anbu
6	<b>Petro Politics In India – Myth And Truth</b>  Author: Dr. CMA M V Alagesan
7	<b>A Novel Codification Technique for Tacit Knowledge in Software Industry using Opinion Mining</b>  Authors: Mr. Jeffrey Bakthakumar and Dr. B. Murali Manohar



8	<b>Systematic Knowledge Management Of Lessons Learnt In Mitigating Project Overruns</b>  <b>Authors: Mr. Jeffrey Bakthakumar, Dr. B. Murali Manohar and Dr.R.J.Anandhi</b>
9	<b>Changing Role Of Artificial Intelligence In The Growth Of Entrepreneurship Development</b>  <b>Authors: Dr. Shanmugam Sundararajan and Mr. Aliyu Mohammed</b>
10	<b>Factors Influencing The Policyholders Satisfaction Towards Mediclaim Policy</b>  <b>Authors: S. Eswaran and Dr. S. Sudhagar</b>
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## A Multiple Criteria Decision-Making Approach to Rank the Management and Accounting Scientific Units of the Top Universities of Iran

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### Abstract

University ranking, based on the true and accurate data, with clear manner will have many benefits for higher education institutions. The ranking makes logical competition between universities to achieve better position. Since the Ranking systems are mostly at the university level and internationality, the ranking systems cannot be used at the academic level. The aim of this research is ranking the Academic Management and Accounting of the best Iranian universities. This study is practical, and in terms of Method is descriptive – survey. The study population was Iran's top universities (According to the international ranking systems such as Shanghai and the Ministry of Science). The study used 27 indicators that have been classified into five dimensions (education, research, industry cooperation and international prestige). Also have been used from Shannon entropy method for weighting indices and Similarities and Weighted Simple SAW to ranking of scientific management and accounting units. The similarity methods showed that the faculties of management and accounting of Tehran University, Tarbiat Modarres and shahid Beheshti were in the best condition. The results of the SAW methods showed, Faculty of Management and Accounting Tehran University, Tarbiat Modarres and Allameh Tabatabai were in the best position. One of the main recommendations of the study due to the weight of the index of industrial contract, adoption strategies to enhance the interaction and cooperation between universities and industry sectors.

**Key words:** University ranking, Higher education, research, industry, cooperation

### INTRODUCTION

Universities face enormous challenges in the third millennium. Globalization, widespread demand for postgraduate education, modern education systems, the internationalization of the higher education industry, as well as the information technology revolution have forced universities to participate in competitive higher education markets. Universities will have to adapt quickly to the changing environment in order to maintain and improve the special position they have gained over time (kavosi et al., 2014). In order for universities to continue to operate in this competitive market, they must identify the scientific gaps in their organization and address these gaps. Ranking universities is an activity that

helps institutions to know their position in comparison with other universities and according to this position to carry out the necessary strategies to improve their activities. Ranking has many uses if it can accurately clarify and introduce the values and capabilities of each university. Different people benefit from the results of this ranking, for example, it helps university administrators to compare their strengths and weaknesses with other universities that rank higher, identify gaps, and thus plan for improvement and develop their organization. On the other hand, it helps students and their parents assess the quality of institutions and decide which institution to continue their education at. This information helps researchers determine the right environment for their scientific research, and the government

uses this information to invest in growing institutions (Almgren, 2009). University rankings around the world have caused a great deal of controversy and concern among higher education institutions, as we see that the word university ranking has been searched more than 178 million times in the Google search engine. In recent years, we have witnessed a significant increase in the number of university ranking systems that publish a list of the world's top universities each year (Ioannidis et al., 2007). Most of these systems consider universities as a whole and pay little attention to academic units. In recent years, Iran has conducted many studies on the ranking of universities and higher education institutions. However, no comprehensive study has been conducted to compare and rank Iranian universities in scientific units. In the present study, according to the purpose of the research, which is to rank the scientific units of management and accounting, has compared Iranian universities in scientific units (management and accounting) and has tried to adopt indicators appropriate to this field. Another major shortcoming of studies conducted in Iran is the lack of attention to weight determination of indicators used in evaluation. In many ranking systems, the weight of a particular index in various domains increases or decreases unnecessarily, or for unreasonable weighting (for example, in the QS ranking system). 40% is allocated to the university reputation index, which causes small universities to suddenly lose 40% of the score and not gain a place in the rankings) (Ghaderi sheykhi abadi et al., 2013). This study tried to have as good weight as possible by using Shannon entropy weighting method. Therefore, according to the stated issues, the main purpose and motivation of the present study is to rank the scientific units of management and accounting of the top universities in Iran. For this purpose, after

reviewing and analyzing the existing literature, four categories of educational, research, industry and international factors were determined.

### **The main research question:**

What is the ranking of universities in the field of management and accounting?

### **Research sub-questions:**

What are the best criteria for ranking management science and accounting units?

What is the weight of each of these criteria in the ranking?

## **RESEARCH BACKGROUND**

Although the starting point for ranking universities and institutions of higher learning dates back to the early 1980s, when the American Institute, U.S. News, and World Report ranked American universities, the ranking of educational institutions was much earlier. Examples include the ranking of universities and institutions of higher learning announced by the Chicago Tribune in 1957 and the ranking of American educational institutions by the US Bureau of Education in 1870; However, reports from the American Institute, US News, and the Global Report were considerable. This breadth is actually due to the development of the need for this information, which has made this ranking the first ranking of universities and institutions of higher learning, this ranking has been the beginning of the modern era in global rankings (Almgren;2009).

Following the US News Ranking System and the Global Report, the original idea for ranking the world's universities and higher education institutions was established by Shanghai Jiatang University in 2003. The idea came in response to the concerns of the then Chinese president,



who stressed that a number of Chinese universities should be active internationally and be among the top universities in the world; Therefore, in order to achieve the above goal, Chinese policymakers decided to first design a model for ranking the world's universities and then using its results; First, determine the position of Chinese universities in comparison with other universities in the world, Second, the strengths and weaknesses of Chinese universities should be identified based on the results, and finally, necessary measures should be taken to improve the status and promotion of Chinese universities in the world rankings. Therefore, in a project, Shanghai Jiatang University was commissioned to rank the world's universities and determine the position of Chinese universities in the world. In fact, the purpose of this ranking was to measure the distance and gap between Chinese universities and the world's top universities, as well as planning to reduce the distance and improve the quality of Chinese universities and improve their position internationally (Rauhvargers; 2013).

Finally, the results of the World University Rankings were first published internationally in 2003 by the Shanghai University Ranking System, known as the World University Rankings, and have been updated annually since then (Liu and Liu, 2005). The publication of the academic rankings of universities in that year quickly attracted the attention of universities, governments and the media, and changed the view of universities, and it was addressed by numerous researchers and institutions, and with a different title and purpose, a list of Published ranking.

In response to the Shanghai University Rankings, the UK-based Higher Education Magazine published the first edition of the World University Rankings in 2004. In its inception, the journal, in

collaboration with the Quacquarelli Symonds Institute, collected and processed the required data from 2004 to 2009 and published a list of the world's top 200 universities each year. One of the drawbacks of the institute's ranking was that, unlike the Shanghai University ranking, which places more emphasis on academic topics, the Times's ranking was more important to the university's reputation. Terminating its partnership with the Quacquarelli Symonds Institute in 2009, the institute presented its new ranking in collaboration with the Thomson Reuters Database (Schwekendiek, 2015).

### **US News and World Reporting Institute**

As mentioned, US News is one of the most reputable ranking systems in the world and has ranked American colleges since 1983. This site has been ranking universities globally since 2015. For ranking out of 12 indicators, the global validity of the research is 12.5%, the regional validity of the research is 12.5%, the publications are 10%, the effect of normalized citation is 10%, the book is 2.5%, the total citation is 7.5, the number of highly cited articles (top 10%) 12.5%, the percentage of highly cited articles (top 10%) 10%, international collaborations 10%, the number of articles in the top 1% 5%, conference 2.5% and the percentage of articles in the top 1 percent 5%.

### **Shanghai Ranking**

The Shanghai Rankings has been published by Shanghai Jiatang University since 2003, ranking the world's top 500 universities based on clear criteria and reliable data. Shanghai distinguishes top universities from other universities based on the four main indicators of 10% education quality, 40% faculty quality, 40% research output, and 10% per capita performance (Billaut et al., 2010).

## **Times Higher Education Institute**

The Times Higher Education Magazine has published its annual report on the ranking of universities and higher education institutions in the world for 2017. This report is based on a survey of 800 universities in 70 countries. Universities and institutions of higher education are ranked in terms of educational quality and global reputation. The report also provides a kind of zoning that includes the ranking of universities in Asian countries and universities in developing countries. Thirteen variables are considered in the ranking of educational quality. Also, each university has scores in terms of teaching quality (30% of total scores), international attitude (7.5%), earning money through industry relations (4.5%), quality and scope of research (30%) and citation Used as a source and reference (30%). Statistics including the number of students, the ratio of students to professors, the percentage of foreign students and researchers, and the ratio of female to male students in the universities in question are also included in this report.

## **Quacquarelli Symonds (QS)**

As mentioned earlier, in 2009 the Quacquarelli Symonds Institute (QS) terminated its partnership with the Times in the field of university rankings and has been publishing the rankings alone ever since. The institute is ranked as the "Best Universities in the World" by the United States News and World Report. The institute pursues its rankings by focusing on the information of more than 33,774 researchers and eminent professors of various universities and according to their international level around the world. In addition to ranking the world's universities in general, the QS Institute also examines and ranks universities thematically, as well as a list of the top 200 universities in Asia each year in collaboration with the South

Korean newspaper Chosunilbo. Also publishes (Rauhvargers, 2011). QS has designed its global ranking based on a wide range of university activities and from 6 main indicators, university reputation review (40%), employment rate (10%), faculty to student ratio (20%), citations per Uses faculty members (20%), international students (5%), and international faculty (5%) (Dobrota et al., 2016).

## **University Ranking by Academic Performance ranking**

Most university ranking systems list only the top 500 universities in the world, which are practically the names of universities in developed and developing countries. This left other developing or underdeveloped countries unaware of their position in the global rankings. To evaluate. To this end, the Informatics Institute of the Middle East Technical University of Engineering in Turkey designed a ranking system based on university performance called URAP in 2009. Since 2009, the institute has ranked more than 2000 top universities around the world based on quantitative and qualitative criteria in six different scientific fields, namely engineering, agriculture, environment, medical sciences, life sciences, natural sciences and social sciences. In 2013, the URAP system ranked universities around the world based on six indicators. These indicators are: number of articles weighing 21%, citations 21%, total number of documents 10%, total impact of journals (AIT) 18%, total citation impact of journals (CIT) 15%, international cooperation is 15% (Rauhvargers; 2013).

## **Leiden rating system**

Science and Technology Studies Leiden University (one of the oldest universities in the Netherlands) has been working since 2007 to evaluate the scientific performance of the world's universities. The institute annually ranks

the world's top 750 universities based on the scientometric index. Leiden ranking system data is based on research works (articles and review articles other than scientific conference papers, books and journals) indexed in the Thomson Reuters citation database. The threshold level for calculating the position of each university in Leiden ranking is to have at least 1000 articles with the name of the university in the above database (Tijssen; 2009). The indicators of this system are classified into two general categories: Impact indicators and Collaboration indicators.

### **Performance Rankings of Scientific Papers for World Universities**

Compared to quantitative studies conducted in the United States, the United Kingdom, China, and other countries, Taiwan also initiated studies on higher education evaluation by the Higher Education Evaluation and Accreditation Council of Taiwan (HEEACT); The council began ranking in 2007 and classified 500 universities based on the performance of research products. In general, it can be said that this ranking system evaluates and ranks universities based on their performance in publishing scientific articles. In the HEEACT ranking system, the required data is collected from the Science Citation Index (SCI), the Social Science Citation Index (ESI), the Web of Science, (SSCI) and the JCR. In this ranking system, the performance of universities is examined in three dimensions of research productivity of 25%, impact of research 35%, top research 40% (Huang; 2011).

### **The Islamic World Science Citation Center (ISC)**

Ranking Secretariat of Islamic World Universities as a Permanent Secretariat in the Institute of Higher Education Research and Planning affiliated to the Ministry of Science,

Research and Technology of the Islamic Republic of Iran in order to implement the ranking of universities and policies The Islamic Conference was established in 2010 to effectively promote educational programs in higher education institutions of member countries. In this ranking, universities are classified based on five general indicators: scientific impact 45%, scientific diplomacy 15%, scientific production 35% and economic impact 5%.

### **Webometrics ranking system**

Ranking the world's universities based on their websites is one of the most important applications of webometrics. The World University Web Ranking is a project carried out since 2004 by the Cybermetric Lab, a research group affiliated with the Spanish National Research Council. The group will introduce the world's top universities and institutions based on webometric criteria. The institute surveyed universities based on an analysis of four indicators: Size, Visibility, Rich files, number of articles, and academic rankings in Google Scholar. In July 2011, the database introduced new indicators, a Presence index with a coefficient of 20%, an impact rate index with a significance coefficient of 50%, a free information supply index of 15%, and scientific excellence of 15%.

### **SC Imago ranking system**

The ranking system of the SCImago Institute is another international ranking system that has been prepared since 2008 at the University of Granada in Spain for the evaluation and ranking of the world's universities and research centers, according to which the list of top research institutes is published. The criteria and indicators of this ranking seek to evaluate the research activities of institutions that have valuable scientific outputs. The focus of this system is on universities and higher education centers as well as organizations

active in the field of research; In other words, the institutions that are examined in this system are universities and higher education centers, government agencies, health system, private companies and other centers (Rauhvargers; 2011). This system is based on three research criteria: 50%, social impact 20 % And innovation ranks 30% of universities.

### RESEARCH METHODOLOGY

The present study is descriptive and survey in terms of applied purpose and data collection method. This study seeks to rank the scientific units of management and accounting of the top universities in Iran. For this purpose, two steps have been done. In the first stage, effective indicators for ranking universities were identified and collected using library studies, articles and researches, and then from the indicators obtained from the research literature in consultation with the supervisor. Were selected as indicators used in this study and finally confirmed by several experts in this field.

In the next step, the data related to these indicators were collected, the indicators were weighted using Shannon entropy method and finally the scientific units of management and accounting of universities using two similarity methods and Simple Additive Weighting (SAW) They were arrested. Statistical population of the study: The statistical population of this study is the top universities in Iran that are ranked in the list of international ranking systems of universities and higher education centers and the ranking of the Ministry of Science and also have units. The sciences of management and accounting are:

- ✓ Faculty of Management, University of Tehran
- ✓ Amirkabir University of Technology
- ✓ Shahid Beheshti University

- ✓ Tarbiat Modares University
- ✓ Sharif University of Technology
- ✓ Allameh Tabataba'i University
- ✓ Farabi College, University of Tehran
- Urmia University

### DATA COLLECTION TOOLS

In this research, indicators such as the number of graduates, faculty members, etc. have been obtained by referring to universities and the Ministry of Science and using their documents.

Indicators such as the number of articles, citations, collaborations have been obtained by searching databases such as Scopus, Web of Science, Google Scholar, Magiran, Noormags, etc.

Evaluation and ranking indicators of scientific management and accounting units of universities:

From the study of the subject literature and various studies, 26 indicators were extracted from various indicators, these indicators were classified into five dimensions:

#### Data analysis process:

#### Weighting method:

#### Shannon entropy method:

In cases where there is a need to identify the weight of the indicators, different methods can be used, one of the most important methods being Shannon entropy. This method was first introduced by Shannon in 1948. Entropy indicates the uncertainty in the content of a message. Entropy in information theory is a measure of the uncertainty expressed by a discrete distribution, so that this uncertainty is greater in cases where the distribution is wide than in cases where the distribution is pointy. Shannon entropy is a useful tool for gaining the weight of criteria

Entropy in information theory is a measure of uncertainty that is expressed by the specific probability distribution  $P_i$  (Akhoni Pourhosseini F. and Ghorbani M. A, 2016). The measurement of this uncertainty by Shannon is as follows:

Steps:

$$E_i \approx S(P_1, P_2, \dots, P_n) \\ = -k \sum_{i=1}^m (P_i \ln P_i) \quad i \\ = 1, 2, 3, \dots, n$$

In this relation  $K$  is a positive constant value. Since the above relation is used in statistical calculations, it is called the entropy of the probability distribution  $P_i$ . The terms entropy and uncertainty are used in the same sense. When  $P_i$  are equal to each other (for all values  $i$  and  $j$ ) in this case.  $P_i = 1/n$

In a decision matrix,  $P_{ij}$  can be used to evaluate different options. There are  $n$  options and  $k$  indicators in the decision matrix. The results of this matrix for the  $j$  index are as follows:

$$P_{ij} = \frac{f_j(a_i)}{\sum_{i=1}^m f_j(a_i)} \quad i \\ = 1, 2, \dots, m \quad ; \quad j \\ = 1, 2, \dots, n$$

The entropy  $E_j$  is calculated as follows:

$$E_j = -k \sum_{i=1}^m P_{ij} \ln P_{ij} \quad j \\ = 1, 2, \dots, n \quad \forall j$$

And  $k$  is calculated as a fixed value as follows:

$$k = 1/\ln(m)$$

Which holds the value of  $E_j$  between zero and one.  $0 < E_j < 1$

The value of the degree of deviation ( $d_j$ ) is then calculated, which states that the  $J$  index provides the decision maker with all the information useful for decision-making.

The closer the measured values of the index are to each other, it indicates that the competing options are not much different from each other in terms of that index. Therefore, the role of that indicator in decision making should be reduced equally. so:

$$d_j = 1 - E_j \quad \forall j$$

Then the weight value ( $W_j$ ) is calculated:

$$d_j / \sum_{j=1}^n d_j \quad \forall j$$

Ranking method:

### 1- Similarity method:

This method, which is an improvement of the TOPSIS method, was proposed by a person named Deng.

The TOPSIS method has one slight improvement, and that is that it does not take into account the position of the points with the options as well as the angle of their deviation from each other as the dimensions' increase to this end, a person named Deng tried to eliminate this point of improvement.

According to Deng, each option that was previously represented as a point must become a vector, so the positive ideal and the negative ideal must be a vector. He then coined the terms degree of similarity or degree of similarity. By definition, the degree of similarity is equivalent to the ratio of the image of option  $i$  on the ideal vector to the ideal vector.

Steps:

**Step 1:** Form a decision matrix: Similar to other decision-making methods.

**Step 2:** Scaling the Decision Matrix: Similar to the TOPSIS method, the Euclidean method is used.

$$n_{ij} = \frac{r_{ij}}{\sqrt{\sum_{i=1}^m r_{ij}^2}}$$

**Step 3:** Calculating the weighted scale decision matrix: Multiplying the scale by the weight vector of the indices is obtained:  
 $V = N * W$

**Step 4:** Identify the positive and negative ideal options

$$A^+ = \left\{ V_{ij} \mid \left( \max_i v_{ij}, j \in J \right), \left( \min_i v_{ij}, j \in J \right) \right\}$$

$$A^- = \left\{ V_{ij} \mid \left( \min_i v_{ij}, j \in J \right), \left( \max_i v_{ij}, j \in J \right) \right\}$$

**Step 5:** Transfer the problem space: At this stage it is necessary to transfer the origin of the coordinates from (0 and 0) to the negative ideal point, so it is necessary that the data of all options and the positive and negative ideal of the ideal values. If the negative is subtracted, this will turn the negative ideal into zero.

**Step 6:** Calculate the degree of similarity with the positive ideal

Length of origin =

$$\sqrt{\sum x_i^2} \quad S^+_i = \frac{x}{|I^+|} =$$

$$\frac{\cos \theta |A_i^+|}{|I^+|} \quad \cos \theta = \frac{\sum \sum x_i y_i}{\sqrt{\sum x_i^2 \sum y_i^2}}$$

$$\cos \theta = \frac{x}{|A_i^+|} \quad x = \cos \theta |A_i^+|$$

**Step 7:** Determine the best option: The option with the largest  $S^+_i$  will be the best and the other options will be sorted by  $S^+_i$ .

## 2- Simple weighted sum method:

One of the most widely used methods in multi-criteria decision making is the simple weighted sum method, first introduced in 1954. A multi-criteria decision problem with  $m$  options and  $n$  indicators. In this method, a score such as  $F_i$  is calculated for each option and the options are ranked according to this score. In fact, the ideal option is defined as follows.  
 $A^* = \{F_i^* \mid F_i^* = \max(F_i)\} \quad i = 1, 2, \dots, m$

In the simplest form of this method, the score of each option is defined as the

weighted average score of the option in the decision-making indicators.

$$F_i = \sum_{j=1}^n w_j r_{ij}$$

Assuming  $\sum_{j=1}^n w_j = 1, w_j \geq 0, j = 1, 2, \dots, n$ . Due to the heterogeneity of the measurement scale, it is often necessary to use non-scaled values in calculating the score to meet the assumption of summability. In this method, the linear method of deciding the decision matrix is used. By converting the scores of the options in the decision indicators into unbalanced values, the scores of each option are calculated as follows.

## RESEARCH FINDINGS

In this study, in order to rank the management and accounting units of Iran's top universities, similar decision-making methods and simple weight total have been used. To do this, before using these methods, it was necessary to calculate the weight of the indicators as the input of these two methods, so in this study, Shannon entropy method was used to calculate the weights, which are shown in Table 1 of these weights. Have been. By calculating the weight of the indicators, these weights were considered in the decision matrix of the indicators and were ranked using the two similarity methods and simple weight totals of the management and accounting scientific units of the top universities. Are presented in Tables 2 and 3, respectively.

## CONCLUSION

The ranking of higher education centers and universities is very important today and its results are used by various people, including students, students' parents, the government, etc., since students spend a lot of time and money to study. So they want to spend this money and time in a university that is scientifically and qualitatively superior to or equal to other top universities. For this reason,

several institutions began to rank universities, but most of these institutions ranked universities as a whole, and few studies have been conducted on the ranking of academic units of universities. The study intends to rank the management and accounting scientific units of Iran's top universities with national indicators. First, according to the study of the subject literature, the indicators used in ranking institutions were collected and according to the opinion of the supervisor, 26 indicators were classified into five groups of education, research, industry, cooperation and international aspect as effective indicators in ranking. They were selected and finally approved by several experts in this field. Then, Shannon entropy method was used to obtain the weight of the indicators in this study. The results show that the four indicators of the number of faculty members, Scopus articles, web of science articles, Google Scholar articles, national colleague in Scopus articles, web of science articles have the most weight (0.043) and the most influence in the ranking. Table (2) shows the weight of the indicators. Finally, in this research, two multi-criteria decision making methods, similarity and simple weight total have been used for ranking. According to the calculations of the fourth chapter, the rankings of universities in the two mentioned methods are as follows:

### **1 .Similarity method:**

According to the calculations of the fourth chapter, it can be seen that at the top of this table is Tehran University of Management, then Tarbiat Modares University and next is Shahid Beheshti University; Which is listed in Table (3) of each university.

### **2 .Simple Additive Weighting (SAW) method:**

According to the calculations made with this method, the University of Tehran

is in the first rank, Tarbiat Modares University and Allameh Tabataba'i University are in the second and third ranks, respectively. In Table (4).

### **Comparison and matching:**

According to the collected documentary and scientific data, the main indicators as well as the opinions of the people who were helped during the data collection, it can be said that the set of results obtained from the simple weighted sum method is much closer to reality and for ranking. Management and Accounting Scientific Units of Iran's Top Universities This method achieves more favorable results than other ranking methods.

### **Executive suggestions:**

As can be seen in the ranking of indicators in Table (1), the Industrial Contracts Index is ranked eighth. In Iran, unfortunately, the relationship between industry and universities has been very weak. Although industry liaison offices have been set up in universities, they are not well known enough for students to be aware of. Universities should introduce this organization to students and give credit to PhD and postgraduate students who have chosen the topic of their dissertation in accordance with the needs of the industry. It will also provide an opportunity for faculty members to conduct research in collaboration with industry, and to include this opportunity in promoting faculty members. Holding joint meetings and meetings with organizations, institutions, industries, etc. In order to create more connection between the university and industry and pave the way for concluding a memorandum. International Cooperation: Today, no country can consider itself without the expertise of other countries in various scientific fields. Therefore, the establishment of international research centers in universities is necessary to

communicate with other countries and gain their experience.

### **Suggestions for future researchers:**

Conducting comparative studies: ranking other scientific units from other branches of science and considering more universities.

Conducting transnational studies, ranking the scientific units of Iranian universities and universities of other countries and comparing them with each other.

In this research, the real data of educational and research units are used for weighting and ranking. In future research, it is suggested to use the opinions of experts in the field of ranking, policy makers of the Ministry of Science for weighting and ranking of universities.

Considering qualitative indicators: For future research, do not pay attention only to quantitative indicators and include qualitative indicators such as ethics in scientific production of universities in the ranking model.

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Row	Author	Publication Date	Title	Discoveries
1	Olcay et al.	2016	<i>Is it possible to measure knowledge creation from universities? Review of university rankings.</i>	<i>In this article, the Times World Higher Education Rankings are considered as the basic rankings, a significant comparison is made between the top universities of this institute with the rankings of the same universities in the rankings of Shanghai, QS and Leiden. .</i>
2	Tee, K. F.	2016	<i>Appropriateness of performance indicators and benchmarking methods in UK universities</i>	<i>In this study, the types of performance indicators that are commonly used in the English and world league rankings have been identified and discussed. The results showed that indicators, top research, entry standards and job prospects were selected among the good indicators.</i>
3	Anowar et al.	2015	<i>A Critical Review of World University Rankings in Four Ranking Systems</i>	<i>Based on their research, it was found that none of these ranking systems can provide a satisfactory evaluation in terms of the validity of their structure and other compatibility parameters. The unavailability of the data and publications through which the ranking is performed is a major obstacle to determining the accuracy of the ranking system. An overview of these four ranking systems reflects the fact that general challenges include adjusting for organizational size, the difference between moderate and severe, defining institutions, measuring time, allocating credits, superior factors, and adjusting for disciplines. Misinterpretation of data measurement is also responsible for some ranking differences.</i>
4	Kehm, B. M.	2014	<i>Global University Rankings - Unwanted Side Effects</i>	<i>Review of ranking systems and analysis of some problems of these systems such as: ambiguous methods, lack of customer information, focus on English-language publications, combined evaluation, evaluation of reputation or performance, disregard for the scientific background of an institution and measurement problems</i>
5	Luca, M., & Smith, J.	2013	<i>Importance of Quality Disclosure: Evidence from US College of News Rankings</i>	<i>The two main findings of this paper are, first, that the effect of rating is determined by practical decisions when the rating is published in the U.S. News. Improvements in ranking lead to a one percent increase in the number of university applications. Second, the response to rankings depends on the way information is presented. Rankings have no effect on practical decisions when colleges are arranged alphabetically.</i>
6	Pooya et al.	2016	<i>Assessing the Factors Affecting the Differentiation of Top Iranian and</i>	<i>The obtained results of each of the indicators of number of articles, total number of citations, total number of citations by field and year, number of citations 1%, share of domestic joint</i>

			<i>World Universities in Leiden Ranking System Using Diagnostic Analysis</i>	<i>publications, share of long distance joint publications, average citations by field and year have made top universities Iran should be ranked lower than the top universities in the world.</i>
7	Khosrowjerdi, M.	2013	<i>Asia's top universities in six world university ranking systems</i>	<i>There are similarities between international rankings. The highest correlation rate belongs to QS-Web Metric</i>
8	Niazi & Abonoori	2010	<i>Ranking of universities based on knowledge management and web metrics criteria</i>	<i>The results obtained in this study indicate that there was no comparison between the two webometric scales and knowledge management indicators</i>

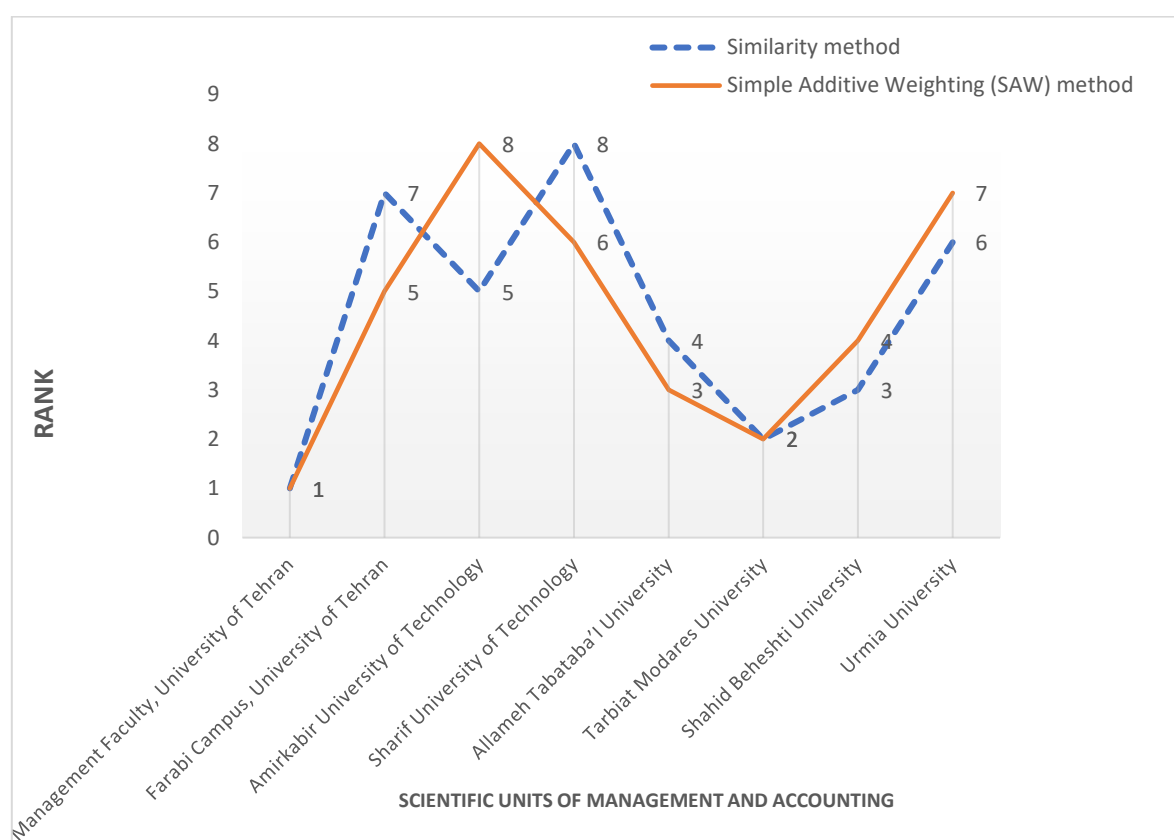
	<i>The number of bachelor's degree graduates</i>	<i>Number of master's degree graduates</i>	<i>The number of PhD graduates</i>	<i>The number of national elite students</i>	<i>The number of faculty members</i>	<i>The number of hall of fame</i>	<i>Number of google scholar articles</i>	<i>Number of Scopus, web of science articles</i>	<i>The number of Persian articles</i>
<i>E</i>	<i>-0.98</i>	<i>-1.29</i>	<i>-0.99</i>	<i>-0.82</i>	<i>-1.35</i>	<i>-0.51</i>	<i>-1.37</i>	<i>-1.39</i>	<i>-1.24</i>
<i>D</i>	<i>1.98</i>	<i>2.29</i>	<i>1.99</i>	<i>1.82</i>	<i>2.35</i>	<i>1.51</i>	<i>2.37</i>	<i>2.39</i>	<i>2.24</i>
<i>W</i>	<i>0.036</i>	<i>0.041</i>	<i>0.036</i>	<i>0.033</i>	<i>0.043</i>	<i>0.027</i>	<i>0.043</i>	<i>0.043</i>	<i>0.041</i>

Table3 : $\cos \theta A_i$ ,  $S_i^+$  and rank

Rank	$S_i^+$	$A_i$	cos	
1	1	s	1	Management Faculty, University of Tehran
7	0.057	329.153	0.999999718	College of Farabi, University of Tehran
5	0.077	447.374	0.999999984	Amirkabir University of Technology
8	0	0.383	0.0002099996	Sharif University of Technology
4	0.143	830.5	0.999999498	Allameh Tabataba'i University
2	0.853	4961.79	0.999999989	Tarbiat Modares University
3	0.3	1746.366	0.999999919	Shahid Beheshti University
6	0.068	395.113	0.999999436	Urmia University

**Table 4:  $F_i$  table and ranking of options by simple weighted sum method**

Rank	$F_i$	Universities
1	0.227	Management Faculty, University of Tehran
5	0.13	Farabi college, University of Tehran
8	0.017	Amirkabir University of Technology
6	0.083	Sharif University of Technology
3	0.18	Allameh Tabataba'i University
2	0.181	Tarbiat Modares University
4	0.159	Shahid Beheshti University
7	0.025	Urmia University

**Figure 1: Comparison of methods**

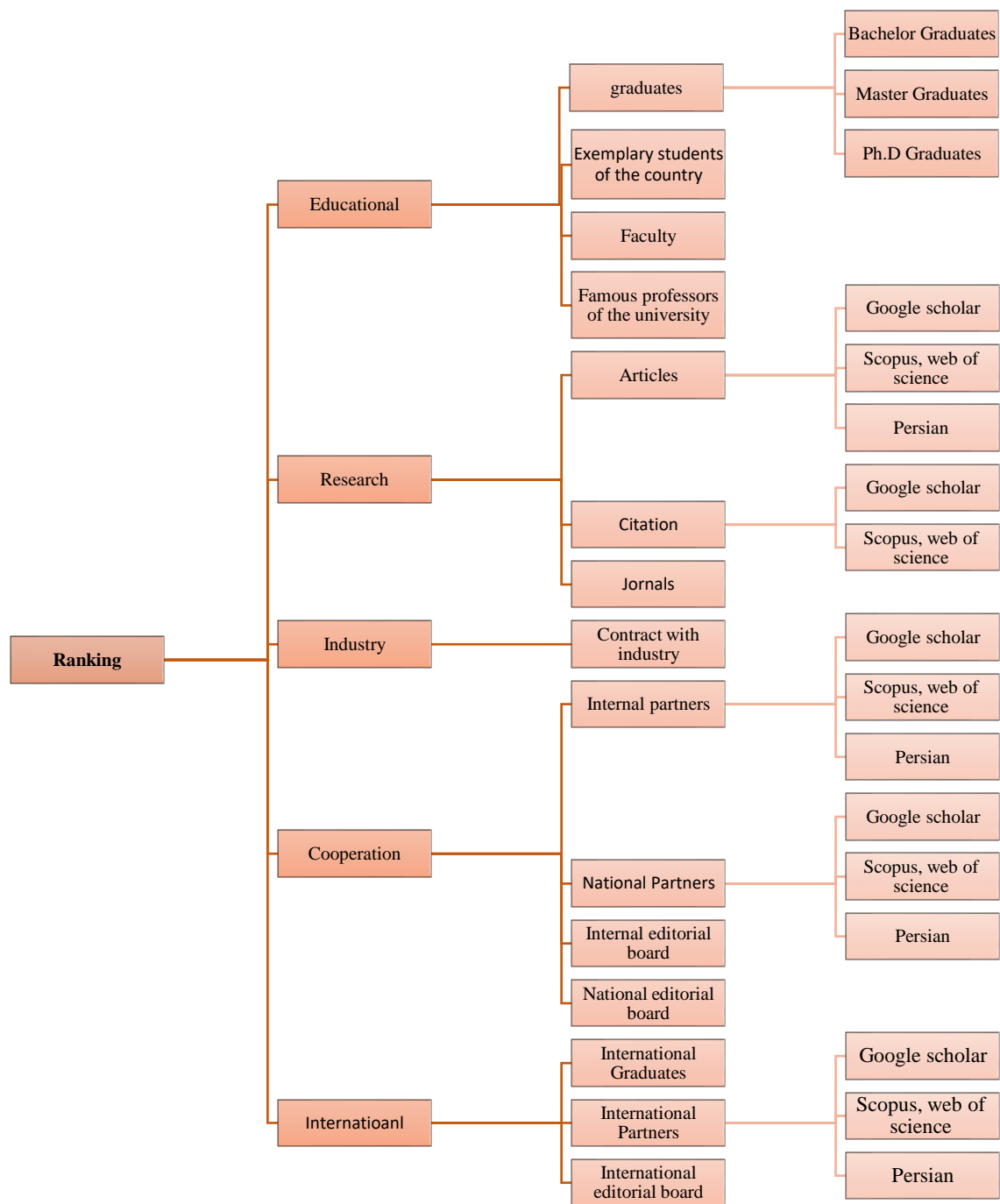


Figure 2 : Dimensions and ranking indicators

# **A Covid-19 Vaccines Selection Model in the Presence of Arbitrariness, Imprecision, and Randomness in the Model Parameters**

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## **Abstract**

The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is one of those decision making tools instrumental in making a sound and objective decision whenever faced with conflicting objectives in a decision-making problem. In this paper, we extend the fuzzy TOPSIS model of Ye and Li(2014) to include the square deviations between the possibilistic mean in the computation of the possibilistic variance formula. Not having possibilistic mean in the possibilistic variance formula may lead to an incorrect feasible selection process detrimental to the intent of the decision process. We also provide an alternative approach based on possibility theory to the decision-making model where the weights of the criteria may not be accurately available. Towards the end of the paper, we apply the new proposed TOPSIS methodology to select the best Covid Vaccine within a pool of various other competitive, equally efficient vaccines.

**Keywords:** Topsis Model, Possibilistic Mean, Possibilistic Variance, Decision matrix, Separation Measure, Relative Closeness Coefficient.

## Optimization for Tactical Level Scheduling for Elective Surgery in Operating Theatre

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### **Abstract**

Operating scheduling is a crucial part of a hospital. It is related to both patient satisfaction and hospital performance. This paper considers elective surgery scheduling problems at tactical level. The tactical level schedule determines the number of time slots for different elective surgeries. There are multiple objectives, including minimizing the number of overdue patients, number of patients on the waiting list, number of days patients waiting after expected days and maximizing the hospital revenue and performance. All the objectives are fulfilled under the resource limitation, such as the number of wards, the number of beds, the number of ICU rooms, the number of surgeons, and the number of operating theatres are considered in the model as well. Variable neighborhood search (VNS) algorithm is used in this research to solve the operating scheduling problem. A numerical experiment is performed in the randomly generated data set to evaluate the effectiveness of the proposed algorithm. By using the VNS algorithm in elective surgery operating room scheduling, we hope to increase patients' satisfaction and reduce the cost of hospitals at the same time.

**Keywords:** Operating Theatre Scheduling, Variable Neighborhood Search, Tactical level scheduling

## Issues and Challenges faced by Adani Power Limited in the Global Era

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### Abstract

The Adani Group of Companies have companies such as, Adani Power Ltd, Adani Green Energy Ltd, Adani Transmission Ltd which has been established by the Founder & Chairman of Shri. Gautam Adani. The Adani Group extended its footprint into power generation through Adani Power Limited in the year, 2006. Adani Power is an arm of Adani Enterprises Limited having a turnover of 70,433 Crores. The Company has achieved the power generation capacity of 12450MW within a short span of 15 years. This includes 9,280 MW of own and acquisition of 1,200 MW Lanco's power plant in Udipi for an amount of Rs. 6000 Crores. The Company set and achieved the ambitious targets of 20,000MW in the year 2020 and looking for acquiring power plants in India. Adani Power Limited is having mines in Queensland, Australia and Indonesia. In spite of all its achievements, the Company is facing a lot of challenges in the Global era. In this paper an attempt has been made to find out the challenges faced by Adani Power Ltd and the solutions to face the weakness threats & challenges face by the company so that they can face the future with good progress & achievements.

**Key words:** power generation, thermal power, threats, challenges, achievements.

### INTRODUCTION

#### Adani Power Limited:

Adani Power Ltd is an Indian Power and energy Company, a subsidiary of Indian Conglomerate Adani Group with Head Office at Khodiyar in Ahmedabad, Gujarat. It is a private Thermal power producer, with a capacity of 12,450 MW. It also operates a mega Solar plant of 40MW at Naliya, Bitta, Kutch and Gujarat. The subsidiary companies of Adani power Ltd are, Raipur Energen Ltd, Raigarh Energy generation Ltd, Adani Power (Mundra) Ltd, Pench Thermal Energy MP Ltd and Adani Power Dehej Ltd. It is one of the World's largest private power plant company with coal based at a single location in India. It is functioning under the great visionary and under the committed leadership of Shri Gautam Adani. He has intruded super critical technology in India. It has established Mundra power plant which is a coal based power plant in India. It is one of the largest sea water based

Flue Gas De-sulfurization plant in India. It has the World's largest solar power plant in Ramanathapuram District in Tamilnadu with the production capacity of 648MW spread within 2,500 acres located in a single place. It has an excellent logistics arrangement for evacuation of coal from the Mines to it's Thermal power stations. It is one of the coal importers in India and is able to complete all the projects before the scheduled time and is able to complete 660MW plant in Mundra within a record break of 3 years. Adani Power Ltd is committed to ensuring the Nation's energy security with thermal and solar power plants across India. Though the world may have come to a standstill but Adani Power will continue to illuminate millions of home in India.

#### Challenges faced by Adani Power Ltd in India:

The Global company is recovering steadily from the COVID -19 pandemic, in the year 2020, the global economic



activity was affected by the pandemic, resulting in contraction of (-)3.4% after a slow growth of 2.4% in 2019. G20 countries experienced an aggregate slowdown of (-)3.2% and China was the only major economy to record a growth of 2.3% in 2020. The Indian economy is beset by a gradual growth slowdown in the last few years experienced a challenge in the financial year 2020-2021 in the form of COVID-19 which led to a lock down enforced by the Government. For India, emerging victory against this invisible enemy and returning to the path of prosperity require concerted efforts by Central and State Government, the health care sector, and the people. With this general back ground of Global and Indian Economy, discussion can be had about how power sector is affected and the challenges faced by them during this pandemic period.

India's power generation capacity is based on conventional thermal sources like coal and gas in addition to hydro power with a rapidly growing proportion of renewable energy. Thermal power represents most of the power generated in India. Coal fired power plants act as base load power generators to India's large coal reserves, in addition to competitive generation cost. The growth in coal was responsible for making affordable and reliable electricity available across the Nation.

India's electricity demand is growing rapidly and due to increase in use of power consumption, the overall demand for power is growing significantly. The demand for electricity is on the rise as India's economy continues to grow due to various factors, such as, improvement of electrification across all villages, GDP growth and general economic activity, increasing consumption of online services, streaming video is emerging growth driver for the power sector, content delivery

networks and cellular as well as terrestrial network infrastructure.

Access to cost-effective and reliable power supply is the biggest catalyst for inclusive growth. They are critical for industrial growth which leads to high human development index. Demand for electricity is expected to grow at a sustained pace given the Government's massive push towards make in India, increasing industrialization, improving income and living standards. Over the years, the overall consumption of coal is increasing continuously. In the Year 2020-21, there was huge decline in domestic and coal consumption due to the impact of COVID-19 lock down. However, coal imports in the year 2020-21 were lower. International coal price were declined during the COVID-19 pandemic in the year 2020. However the prices recovered in the year 2021. It is due to coal shortage due to high demand of coal in China and sea borne coal supply disruptions. However in 2022 the prices are expected to grow more gradually towards the cost support level, with supply improving and imports demand from China easing. However, APL is able to withstand and able to sustain in the mining sector though it is a private company.

The company has the capacity to undertake large power projects based on modern technology with adherence to time and cost limits. The company is capable of turning around stressed power projects after acquisition. The company has a committed team with expertise in O&M, power sector regulation, project management and business development. The company is an independent power producer in India. A mix of coastal, pit-head and winter land projects are in major demand centers and are close to fuel source. The fuel cost pass-through in majority of imported coal based PPA's which provide stability to cash flows and

profitability support. There is fuel security because of the long term arrangement of fuel supply agreements with major coal providers in India. The company is able to sustain regulatory approvals for carrying cost along with late payment surcharge mechanism which protects against delay in claims and payment from power procurers.

#### **Weaknesses of Adani Power Ltd, India:**

The company depends more on monopolistic stage owned coal suppliers for domestic coal requirements. As a result, the company faces disruptions in fuel availability which will affect the production capacity. The data relating to escalation of tariff is not available for coal and these will affect the calculation of cost of coal. If tariff rose for impact of coal is not known to the company, this will have a great impact is fixing the price and the company will face loss to that extent. The increase in tariff is only for private companies while there will be partial increase of tariff in other cases. The company has to depend more on complex and time consuming regulatory processes for claiming compensation for events of change in law thus exposing the company to cash flow mismatches. If the interim 26% of capacity is untied, the company is subject to short term market risk without stable domestic fuel supply. The company is not in a position to get support from Government with regard to rising of debt financing and there is no continuous availability of credit from sector focused financing entities. Moreover, the commercial banks prefer to lend loans to public sector entities rather than to provide sector projects to extend credit especially during crisis period. The company faces difficulty in securing grants for financing equity investments unlike public sector entities during crisis period.

There are various threats for Adani Power Ltd because there is an

increasing preference for renewable power, especially solar power in India and globally. This will constrain the prospects for the thermal power generation in the long run. There is undue reluctance of state DISCOMS to tie up power demand through long term PPA'S (Power Purchase Agreement) in view of subdued rates in merchant and short term markets. There is volatility in International coal prices which may affect the merit order position of PPA'S with coal price pass through and this will lead to lower capacity utilization of the company. There is an inability of domestic coal miners to raise production in line with demand growth which will impact capacity utilization and there is an increased dependence on improved coal.

#### **Solutions applied by APL to face the Challenges:**

The Company has applied several solutions to fight challenges that they faced. Some of the best solutions that they have implemented are to track work order progress, by adopting contractors self-service portal for managing workers, centralized data management solutions for branches across multiple locations and real time notifications in case of exceptional situations.

To face all the challenges faced by Adani Power Ltd, the Government must stimulate the demand of power by offering fiscal stimulus package and by avoiding preferential treatment to PSU's. It is suggested that there should be only tariff based bidding for short term and long term PPA's to get cheaper cost of power to DISCOMS & Public. By this, the cash trapped DISCOMS can reduce their debt to an extent and Private Power producers like Adani can sell them total generated power at competitive rate and reduce their debt. The states should be encouraged to join in UDAY Scheme. In this scheme, the respective state Government takes up to

75% debt of DISCOMS over the years and their scheme is mainly intended to clear the financial mess of DISCOMS.

#### **APL's Future- the Road ahead:**

There is stressed power with locational advantage are available at attractive valuations which provides an opportunity to expand capacity while avoiding execution risk. There is an anticipated demand growth spurred by economic growth as well as government reforms such as, Ujwal DISCOM Assurance Yojana (UDAY), Pradhan Mantri Sahaj Bijli Har Ghar Yojana (SAVBHAGYA) AND Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY). There is a high level of industrial tariff borne by large industrial consumers dependent on State DISCOMS which will affect their competition and profitability. There is a limited amount of new thermal power capacity to be installed over the coming years, while base load demand is expected to increase with the growing economy. This will create opportunities for merchant power and long term tie-ups. Moreover, there is an improved fuel availability which will help plants with competitive tariff and long term fuel supply arrangement to achieve higher PLFS (Periodic Labour Force Survey) as there is growth in demand.

The company is well positioned in the market and one of the greater power producers. As the power trading is done through power exchangers and the company is having its own network of transmission it may offer an advantage due to lower operating cost of its power plants. The acquisition has to gain momentum in the future and the pricing of power has to be competitive to sustain. Adani Power Ltd is also considering acquiring some PSU'S also either strategically or by buying a major stake and by this the company may set to

achieve 30,000 MW target in the near future.

Adani Power Ltd is facing challenges at the Global level because most of Adani Power's plants are developed as port based projects and their coal requirement is met through import from Indonesia and Australia. All the players have negotiated the price for longer periods at a flat rate of \$ 25- 30 / tonne of coal and quoted the price bids accordingly.

When Indonesian government has changed the law and benchmarked their prices to International prices, the coal price rose up to \$ 80 per tonne of coal due to which the developers could not supply the electricity at the tariff already quoted. All the plants which operate based on import of coal are remaining under losses due to change in law.

#### **CONCLUSION**

Adani Power Ltd is expanding and completed acquisitions of 100% of equities in SPPL (Support Properties Private Limited) and EREPL (Eternus Read Estate Pvt. Ltd) for about 609 cores. On June 7, 2022 Adani Power Ltd had signed a share purchase agreement to acquire 100 percent equity shares of two companies. The company is expanding diagonally and vertically and is all set to grow and the days are not far off that the company will grow to greater heights by broadening the domain as domestic private player.

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# Impact of Visual Merchandising and Store Image on Women's Purchase Decision of Apparel from Organized Retail Outlets in Bahrain

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## Abstract

The research looked at the literature on aspects of market behavior, especially the buying habits of Bahraini women when buying clothing. The current study examines "how the modern shopping centers use visual merchandising and store image impact the purchasing decisions of Bahraini women when purchasing from the retail outlets". The study aims to explore the overall implications of shop design, ambient components, and an arbitrary selection of workers among female customers who frequently visit clothing stores. Results were collected from 750 female respondents from the best clothing retailers in Bahrain, using a separate mall capture questionnaire survey and a designed questionnaire. Several descriptive analyzes were used to examine the answers. This research will help merchants to understand the elements of the visual trade and to select them when designing store interiors to impact customer purchasing decisions when visiting branded clothing stores. A pleasant perspective can be established based on the unique visual trading strategies of the business; Also, merchants will use it as a distinct technique to support the creation of a unique retail store image in the eyes of women customers.

## INTRODUCTION

Lee et al.,(2021) explored that women are said to be a part of civilization and although their appearance is increasing in various aspects of life, it is necessary to focus on them when developing commercialization techniques because they play an important role in the life of the society and make such decisions at different stages. However, from a marketing standpoint, past research has shown that women are not only part of civilization, but, above all, make up or influence 85 percent of decision-making. As a result, awareness of women's issues has become a major focus of human social concern. And looking at the significant impact of women on purchasing decisions, marketing scholars and practitioners need to design new trading techniques and approaches to suit their needs, aspirations, lifestyle, and buying motivations.

## Research Background

Most of the ideas already involved in exploring and structuring purchasing decision-making methods are based on recognizing that purchasing is a method of problem-solving. To achieve a goal, solve a problem or understand an opening, a woman must "choose one of the many options available" (Usman and Victor, 2021). Purchasing decision-making in female branding can be categorized as actions or phases such as a woman experimenting with the products they want to buy in Bahrain (Arshad and Victor (2020).

## Research Questions

Therefore, the following are the questions that the researcher wants to probe and find answers to through this research study:

1. To what extent does the demographic profile of women customers impact their perception of visual merchandising and store image of organized apparel retail outlets in Bahrain?
2. Do demographic variables have an impact on the purchase decision behavior of women customers at organized apparel retail outlets in Bahrain?
3. To what extent do visual merchandising and store image have an impact on various attributes of purchase decision behavior such as personal, product, store, and social attributes among women customers?
4. Which are the key factors that impact the purchase decision behavior of the women customers who purchase their apparel from organized retail outlets in Bahrain?
5. How to draft a model by incorporating the factors of women's purchase decisions and represent its association with visual merchandising and store image?

### **Scope of the Study**

According to several previous studies, women are more active consumers than men. This study aims to place more emphasis on the influence of visual merchandising and store image within the built-in retail sector in the event of purchase by female consumers for apparel in Bahrain. The survey was conducted in five reputed shopping malls across Bahrain, including the Bahrain City Center, Seef Mall, Dragon Mall, Bahrain Mall, and The Avenues, shopping malls built over 500,000 square feet.

### **Research Gap**

Following a detailed evaluation of the academic papers obtained, the author

has chosen to examine the overall impact of visual merchandising on the purchasing decisions of women buyers. According to the findings, there has been very little research in this field of study, which includes branded retail clothing stores. Second, several studies have found that a few factors have been identified for investigation, and many factors have not been studied. Each year, a greater number of researchers are hired to collaborate on the aforementioned efforts, paving the way for further research and a more comprehensive and specific solution to change the core function of the display business, influencing the women customers for positive store behavior.

### **LITERATURE REVIEW**

All of the exhibits were thoroughly researched, including sales, and the appearance of the store, as well as whether they affect customer buying behavior. Finding the features that influences the women when they shop in the store or how to display the products to change their purchase decisions and be motivated by customer satisfaction is studied. This study explores various researches to better understand the concept, including shop display decorations, client entry choices, display business, and store designs, and also the use of new technology to market products to buyers. Each of the studies shows a relationship between the impact of the display trade and the impact on female customer behavior.

### **Purchase Intention**

Mandol et al.,(2021) described that the purchasing intention was developed by the promoted product features and its use to the customer. Customers' purchasing intentions at a retail store may vary depending on the location, travel timing, and products offered.

### **Store image**

Abbas et al.,(2020) explained that the "personality" features of a retail store are its environmental and aesthetic characteristics. In many situations, the image of a retail store is expressed through multiple characteristic architectures. By focusing on the literature, many product offerings have found a variety of store qualities in the search to define "store image".

### **Service Quality**

Usman and Victor (2021) stated that in a highly competitive corporate environment, service quality is a key difference in measuring service that effectively meets customer expectations. Businesses can affect customer happiness, trust, and retention by improving service quality.

### **Influence of visual merchandising on a woman's purchasing decisions**

Kapoor and Munjal (2019) described every company seeks to create and force itself in the female market by creating a woman-liking brand that is different from the competition. From a customer perspective, every product is not just what the company's executives think it can do; It also aims to persuade customers to explore the products they buy, based on their perception of the value of the item they want to purchase.

### **The store image has an impact on a woman's purchase decision**

Hanaysha et al.,(2021) detailed that Store image refers to the women spending more money on the branded models and avoiding purchasing failed models. The price of pink and related decisions are the most difficult choices advertisers face because they have to take women into account on the one hand, and the goals of the company on another hand. It is

activated by all the factors that affect the price of another.

### **Hypothesis of the study**

Visual merchandising strategies have little impact on a women customer's buying choice.

- i. The aforementioned hypothesis was extended to each aspect of visual merchandising to examine its statistical power.
- ii. Women buying decisions are unaffected by store displays.
- iii. The women customer's buying choice is unchanged by the window display.
- iv. The atmosphere surrounding a shop has no bearing upon that woman customer's buying choice.
- v. Branded store image has no impact on a women customer's buying choice.
- vi. The shopping experience has no impact on the customer's buying choice.

### **SEM (Structure Equation Modeling)**

SEM (Structure Equation Modeling) is a multidisciplinary approach for simultaneously estimating the sequence of interconnected dependent connections. Structural equation modeling refers to the fact that the causal processes of research are characterized by a sequence of specific equations.

### **METHODOLOGY**

The ultimate goal of this study is to determine the impact of display item sales (VM) on branded clothing by the purchasing decisions of female customers in Bahrain. The multilevel selection approach was used to select the model. The survey technique was used to obtain the primary data. The answers are compiled using a formally generated

questionnaire, which is a closed-type questionnaire and is offered to buyers at selected branded fashion retailers.

### Research Design

This research is designed using a quantitative analysis method to analyze the impact of visual aids and store images on a woman buying clothing from a retail outlet in Bahrain. This study used a descriptive research approach to collect sample data from 750 female participants. This study looks at the most important properties of display products that can affect customer purchasing decisions. The goal of the research was to bring about important control variables that lead to the effectiveness of consumer behavior. Research is descriptive and uses descriptive design.

### Duration of the Research Study

The current study is divided into four sections. The first phase involves obtaining literature and the second phase involves creating a questionnaire and testing it. The third step involves data collection, data processing, and data analysis. The study, which covers all of these stages, took place between 2021 to 2022.

### Methods and Type of Data Collection

The perspectives of the research problem were revealed using primary and secondary data in this study. The primary data of the research study were obtained using a structured questionnaire, while the secondary data were collected using the literature study approach.

### Primary data

The researcher created a standardized questionnaire and distributed it to female shoppers in five shopping malls. Similarly, data was obtained from 750 female consumers who visited retail outlets in various malls.

### Secondary data

The researcher collected data from already written and readily available articles, magazines, websites periodicals, journals, and books from 2021 to 2022. These were used to mark the research hole.

### Target Population and Universe

A target model is known as a whole set of elements with a unique feature determined by the model standards of the scientist, while the target respondents are the whole group of individuals who want to generalize the research result.

Most of the women's clothing at the Bahrain Shopping Mall occupies shop space. Brands rely heavily on malls to compete with fashionable products, especially luxury stores, power structures, discounts, and key features. Female consumers buying clothing at five specific shopping malls in Bahrain are the target group for this data analysis.

### Sampling Design

This is a specific strategy for obtaining a sample from a given population. Consequently, it refers to the approach or process agreed upon by the researchers when selecting materials for the model. As a result, a survey method (non-probability model) was used to select the model from the target population, and the actual number of women shopping in Bahrain's regulated retail stores is uncertain.

### Determination of Sampling Size

Several equations have been proposed to determine the sample size based on the accessible data. To calculate the response rate to the actual population, the researchers used the technique below.

$$\text{Sample size } n = (ZS / E)^2$$

Where, Z score at a 5% significance level = 1.96



$S$  = Sample S.D from the pilot study of 50 samples = 0.6987 (Largest SD among all the items given in the questionnaire)

$E$  = Sampling error 5 % = 0.05

Therefore,

Sample size  $n = (1.96 * 0.6987 / 0.05)^2 = 750.159 \sim 750$ , where  $n = 750$

### Questionnaire Design

The survey's structured questionnaire has five sections: Personal Details (10 items), Clothing Purchase (15 items), Display Items (20 items), Store Image (25 items), and Purchase Decision Behavior (30 items).

#### Personal details

The first section of the questionnaire includes specimens of the sample population and fabric purchases. This investigation aims to identify the demographic characteristics of female customers and to identify purchasing information. Personal data factors include age group, parental status, educational qualification, financial status, employment, annual income, socio-economic status, and types of clothing purchased.

#### Visual Merchandising Factors Evaluation

In the second section of the survey, there are twenty items used to evaluate the features of visual merchandising components that affect women's consumer choice in organized retail outlets. One factor is color (3 things), storefront display (2 items), synchronization (3 items), signage/images (4 items), lighting (4 items), and perceptual and aromatic notes as the following subdivisions of the visual business concept. (4 items). The magnitude of the perceived impact on aspects of the visual trade among female consumers was measured using a five-point Likert-type scale rating (1 - strongly

disagree, 2 - disagree, 4 - agree, 5 - strongly agree).

#### Opinions on the things that affect the store's image

The opinion on the store image and Visual merchandising by the survey questionnaire contains twenty-five factors. The goal was to determine whether female consumers generally buy clothing through structured retail stores. A five-point Likert scale (1-strongly disagree, 2-disagree, 4-agree, 5-strongly agree) was used to assess female consumer attitudes toward shop image elements.

#### Evaluation of Personal, Product, Store, and Social Attributes

The fourth component of the questionnaire consists of thirty items, which are used to measure the extent of the respondents' judgment on the various possibilities associated with the factors influencing the purchasing decision-making behavior of women in organized retail outlets. Store environment (5 items), method knowledge (4 items), shop layout (5 items), marshal plan (4 items), product selection (5 items), and attractive display are the six sub-structures of store image design (2 items). The total amount for the purchase option is estimated using a five-point liqueur type scale (1 - never 2 - rarely 3 - sometimes 4- often 5- always).

#### Administration of the Questionnaire

The questionnaire was presented online to the female participants by the analyst. Furthermore, the personal information of the respondents was kept confidential, giving them a sense of security. Nearly 1500 questionnaires were distributed to female consumers selected by the researcher and the survey forms were used for analysis. The average time taken to complete each poll is fifteen minutes. The survey aimed to determine the impact of display items and store image

on women's clothing purchasing decisions in Bahrain's retail sector.

### **Pilot Study**

To test the consistency of the questionnaire rather than such data, a pilot research was conducted with 50 samples comprising fifty female consumers selected from five different malls. Following the pre-test, necessary changes were made to the survey to ensure that it was on track for current research. The validity and reliability of the questionnaire were confirmed using relevant methods such as expert round table discussion for content verification and latent variable verification using biased analysis. Finally, a total of 50 samples from a pilot test study were used to measure the validity of this test tool using internal logic.

### **Development of SEM**

The overall performance of the connections across the elements can be explored using the structural equation model. Within a specific study, they perform validating factor analysis (CFA) to assess the architectural accuracy and effectiveness of all measuring materials used. Second, they infer and test the key components that affect each structure and variable reference.

### **DATA ANALYSIS**

The data for this study were analyzed using descriptive statistical approaches, which are described in detail in the sections below.

#### **Descriptive Analysis**

It is a descriptive-analytical approach that enables the analyst to explain, integrate, or understand statistics. An example of one-size-fits-all data that emerges from a model. The limitation of the analysis is that it does not allow even drawing assumptions beyond the collection of data under investigation. Descriptive figures are capable of defining what is

revealed. Quality data cannot be used to obtain accurate conclusions on every basis. Descriptive statistical research methods include statistical measures, variability and constant deviation, and measurements of curvature and kurtosis.

### **SEM Analysis**

The following diagram shows that performance with a beta value of 0.895 has the greatest impact on customer purchase results. For example, window display. This result emphasizes the importance of the window display. It is an efficient approach of a store that expresses the basic idea of the business, as well as telling the customer about the products that the merchant supplies in the store and pulling women customers into the stores.

### **FINDINGS**

The findings of the study are presented in the first section, The scope for further research is mentioned in the second section, And the consequences of the study and recommendations are discussed in the third section, which precedes the conclusion.

#### **Analysis by Percentage**

The proportion of participants (81.5%) tends to buy clothing from organized retail outlets, with 34.5 percent saying they usually buy "casual clothing". About 36.1 percent of respondents said they were going to buy clothes with their families, while only a few said they went alone. Among the participants (81.5%) who chose to buy clothing and accessories from organized retail stores, 22.1 percent prefer regulated retail stores due to the "supply of designer products" and 15.6 percent prefer regulated retail outlets because of "discounts and offers".

## Statistical analysis

According to the detailed statistical analysis, the most essential feature of organized retail outlets attracting female customers by store image is the essential part which increases the customer average value by 4.00 and the second indicator is the improved business growth. It has an average score of 3.99, with the result that the notable element is 'every stop shop for all shoppers' with an average score of 3.87. As a result of the detailed research design, the visual attractiveness of the garments stimulates the interest or desire of the female customers and also acts as an appeal point for them, which has become the mainstay of well-organized retail companies.

## Independent samples t-test results.

The t-test results revealed that there is a significant difference between the economic status of women and their attitude towards Visual merchandising (i.e. color, visual appeal, integration, and signboard as a component), the store environment, and consumer buying activities. Economically insecure women have a more positive attitude toward all of the above characteristics affecting women purchase. The investigation also revealed that the purchase of store products, revealed a significant difference in the socio-economic status of female consumers and their attitude towards the purchase of clothing.

## Result of SEM

The results of this study show that there is a correlation between buying behavior and strategies used to sell display items. The model fits in with the best standard coefficients of 0.895, 0.777, 0.712, 0.678, and 0.461 for store image features such as storefront, signage, store layout, product quality, product display, lighting, and mannequin. 0.307, and 0.305,

based on the purchasing intent of the female customers.

## CONCLUSION

The findings of the study also show that the merchandise display items and the shop image have an impact on the amount of money spent on buying clothing. As a result, well-organized clothing retailers should focus on improving interiors with cheerful colors and themes, lighting, signboards, good music, pleasant atmosphere, enjoyable temperature, store planograms, layouts, or imaginative and unique designs in visual cases. The outdoor atmosphere of the store also plays a role in the outlet selection, forcing the organized retail outlet to provide easy access and loving hospitality within the store's physical conditions.

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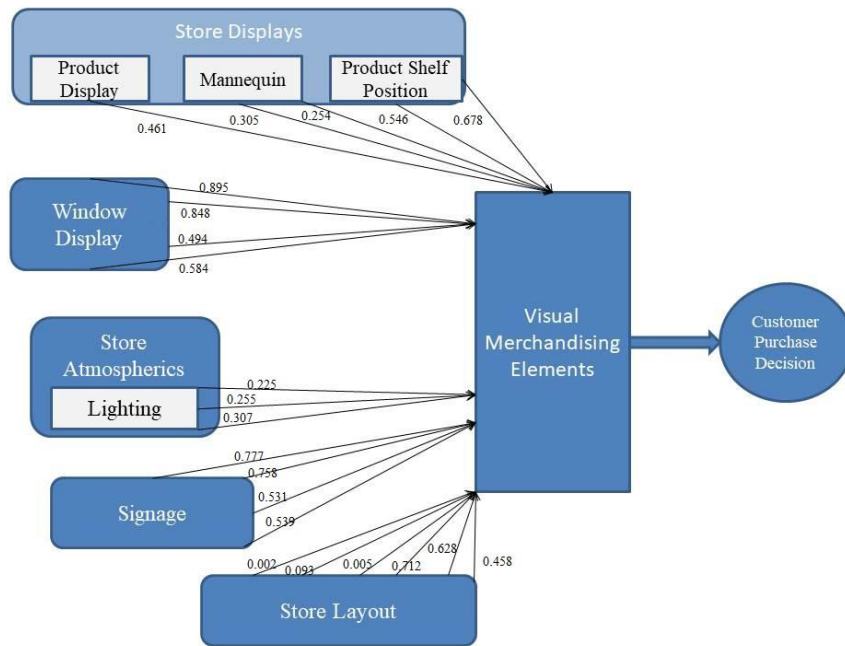
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# Corrosion the Rival Obstacle of Hydrocarbon Industry and Its Deterrence

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## **Abstract**

The unhasty deterioration of metals triggered by the catalytic consequence of air, moisture, or a chemical reaction is labeled as corrosion, which cannot be taken lightly; Corrosion is very costly and has a major impact on the economies of industrial nations. The annual cost of corrosion consists of direct costs and indirect costs. The consequence of corrosion is the failure of a machine, a pressure vessel, a pressure piping, gas transporting line pipes, a storage tank, a steel structure, or any system to function complying to the specifications or the proposed standards. This research paper strives to identify the triggers of corrosion and its destructive impacts on hydrocarbon industry, and the techniques to efficiently lessen corrosion which in turn will reduce the cost of corrosion to the company. The aim of this research is to identify the key internal and external sources and the technology that may be required to cut down the cost of corrosion. The objective is to explore the factors that may prompt corrosion and to determine the suitable and cost-effective method, To generate a set of recommendations based on the findings of this study on how to lessen the detrimental effects and to counteract corrosion losses. This can be accomplished by conducting a detailed study on the mechanism of corrosion that may be, but not limited to the certain factors like The nature of the corrosion and the mechanism of the corrosion. Detailed research on the at present existing practices to control the deterioration of materials will be performed, some of the methods that may reduce the effects of corrosion may begin right from the design to the selection of materials for various applications. This study will analyze the several foremost and historical failures of industries and their lessons learnt , also various mitigation plans suggested by international experts will be clearly elucidated , correct use of corrosion effective methods like coatings, cathodic protection and the use of inhibitors and the technologies currently available across the globe will be explicated, even to the use of software's and various microprocessor controlled programs used in corrosion monitoring cells will be considered. Based on the findings of this research a conclusion will be provided that may be suitable for the industry in relation to the material and the types of process involved to reduce the cost of corrosion and to reduce the corrosion loss to an industry.

**Keywords:** Cathodic protection, Inhibitors, Anti corrosive Design, Corrosion monitoring cell, Corrosion control Devices, Material selection for corrosion protection. Protective coating.

## **Feminepsyche and Trauma in the Twenty First Century Expatriates Fiction**

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### **Abstract**

Trauma emphasises in relation to the condition of remembering and as an event sheltered in the unconscious mind that result in ego or dissociation. Trauma is perceived as anexasperating experience that emphasise and individuals' emotional organisation and perception of the external world. This research paper strives to explore the traumatic experiences in immigrant fiction by women writers. Trauma is part of everyday life. One of the reasons of trauma in immigrants fiction can be traced due to migration or displacement of characters and the process of healing is assimilation. The separation from home, family, country is both physical and mental can be the cause of the expatriates to feel isolation, striking for an identity and pricking of nostalgic about their motherland. This paper sheds light on the psychological trauma of immigrant female protagonist in the select novels. The writers and their novels selected for the study are Shaila Abdulla's *Saffron Dreams*, Faqir Fadia's *The Cry of the Dove*, also known as *My Name is Salma*, Bharati Mukherjee's *Desirable Daughters*, and Francine Prose' *My New American Life*. All the novels focuses its attention on the trauma faced by women expats who lived without their parents and loved ones for the fulfilment of various purpose in life. This paper also highlights the various factors causing traumatic experience and suggestions are given to get rid of their trauma and lead a good life with good mental health.

**Keywords:** Trauma, Immigrants, Isolation, Identity crisis, Nostalgic, Alienation.

# **Sustainable Potable Water Supply and Liquid Waste Disposal System on 240 Unit Housing Estates and Ancillary at Kasunya in the Greater Accra Region**

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## **Abstract**

The design of potable water supply and distribution and sewage treatment systems for the initially scoped 300 housing units and social infrastructural component under the Banana Accelerated Measures (BAM) project is comprised of the following; treatment of raw water from a canal constructed purposely for the banana plantation and a portable sewage treatment system per apartment with the outflow of each system connected into a stabilization pond. The project which was funded by the European Union through the Ministry of Finance and Ministry of Trade and Industry (MoTI) has the Golden Exotics Limited as the beneficiary. The EU agreed to offer the grant to an amount of €5,900,000 under the Banana Accelerated Measures (BAM) for the development of 300 housing units at the farm of the GEL; located at Kasunya in the Greater Accra Region in Ghana. This was due to the success of the BAM's production of bananas and the performance on the European markets over the years. The housing project was purposely to accommodate the workers for an improvement in productivity. This was because they initially had to be transported to work from the main cities in Accra and Tema; where majority of the workers reside. With this arrangement the beneficiary stood to gain from savings in transportation and improved timeliness to their duties. The main idea for the accommodation for the workers which was tentatively to enhance their performance by proximity made economic sense to include sustainability as a major factor in the provision of utilities. Utilities such as electricity, potable water and sewerage systems could not be said to be effective if sustainability is not factored especially in this part of the world. Workers would be left to go in search of water when the supply is not continuous. It would then defeat the main purpose for its provision on the project.

## **INTRODUCTION**

The design of potable water supply and distribution and sewage treatment systems for the initially scoped 300 housing units and social infrastructural component under the Banana Accelerated Measures (BAM) project is comprised of the following; treatment of raw water from a canal constructed purposely for the banana plantation and a portable sewage treatment system per apartment with the outflow of each system connected into a stabilization pond. The project which was funded by the European Union through the

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### **DESIGN CONSIDERATIONS**

The design considerations applied on the potable water extraction and the liquid waste disposal systems on the 240 housing units and social infrastructure component were based on many factors namely; availability and type of water, topography, soil nature, population and rate of discharge of foul water and the land size allocated for 240 housing units at area under consideration. It was established that there were no natural water bodies in the area apart from a dredged canal specially created for the banana plantation. This was monitored for some time to ascertain the availability especially in the drought seasons coupled with information available from the Golden Exotics Limited (GEL) and was found to be applicable for harvesting as raw water for treatment purposes. In the design considerations adopted, sustainability was the main factor used to ascertain a complete and functioning system in the search for potable water and sewage treatment systems. In this regard the factors as mentioned were tackled in detail. The topography of the

area did not help much as the area was found to be virtually flat. Initial consideration was to have a multiplicity of treatment systems but that would have worsened the sewage systems as the second factor of the nature of soil did not help matters. The ground was clayey making any meaningful usage of the traditional soak-away systems unfeasible. Water remained in the pit when percolation tests were carried out. The third hitch was the span of area for the housing units under consideration. Having a virtually flat area, in a clayey environment and a large span of area made the design of liquid wastewater treatment system an arduous task when sustainability is factored in.

The EU-BAM intended to construct a 240 housing estates with a social center and police and fire station with a market square at the Kasunya Nankana District in the Greater Accra Region in Ghana in the year 2014. The contract was awarded to a joint venture company; comprising of Evans Anfom Associates and K-Line Design Limited. The area allotted for the project spanned to 119Hectares in total. The design and supervision contract was managed by a project manager with considerable years of experience in contract administration, a degree in civil/structural engineering and post graduate diploma in LLB. The project manager steered the affairs of the supervision of the project and also acted as the interface between the contractor and the client.

In the joint venture was a team of consultants comprising of Architects, Civil and Structural engineers, Mechanical and Electrical engineers, Quantity Surveyors and Interior designers.

The designs were completed with inputs from the team of expertise; however, there was no initial provision of potable cold water in the area because it was a

virgin land with only canals and pumping stations available for dredging and continuous supply of raw water for plantation and agricultural purposes. Geophysical investigations revealed that borehole water was not suitable for the 240 housing estates as the yield could not be relied on due to its unwholesomeness similar to the raw water from the canal. The canal which was artificially dredged purposely for the banana plantation was not suitable for domestic usage and needed to undergo various treatment processes in order to be used for domestic purposes.

In view of the above considerations, the source of raw water from the existing canal which was situated over one thousand and five hundred kilometers away from the site for the construction was to be relied on extensively for the necessary treatment for potable water for the housing estates. The other worrying factor was the disposal of liquid waste because the ground was clayey which could not permit the conventional simple septic tank and soak away systems

### **COLD WATER INSTALLATION**

#### **Supply of Potable Water, Storage and Distribution**

Among the scope of works as determined by the client, there was the need to include an nearby village which was a few kilometers away from the facility. This was because they were considered as stake holders on the project who might be affected either positively or negatively. The approximate population was 2000 indigenes. The estimated population of the 240 estates facility was calculated on an assumption of 5 persons per family; a decision which was arrived at from data taken by the MEP consultants in the community and also with considerations for possible future expansion purposes.

The total consumption of water for the entire facility was calculated based on the Ghana Water standards of 90 liters per person;  $240 \times 5 + 1000 = 2200$ . This means for a day's consumption, the total water would be approximately 198,000 liters. As a rule, based on availability of water a three-day storage was considered for the township to curtail possible malfunctioning of the treatment facility by which repair works would have been undertaken. This worked out to 600,000 litre total plant capacity.

The design comprised of a raw water intake pump installed in a carefully selected position in the canal. The canal which was constructed solely for plantation purposes had been facilitated with pumping stations and piping to various areas of the plantation. The selection of the intake pump installation was taken into effect with the performance of the existing systems. This enabled the MEP consultants to arrive at a most suitable location which was found out as a position where water was never dried out.

Tests performed on the raw water quality gave the water treatment specialists the types of treatments to be performed in order to acquire a satisfactory results of water quality acceptable by the international authorities.

It was firstly designed to pump raw water to the site from a one and a half thousand kilometers away to be stored. From the raw water stored in excess, the treatment is effected through a series of processes then pumped into a treated water storage facility on the ground. A smaller transfer pump would then lift the water into an elevated water tank to serve the houses by gravity. In the initial design there was no consideration for the supply to the village a few kilometers away from the facility. It was decided that the bulk tank should be installed on the ground for safety

and cost reasons so that elevation would be done by the transfer pump as frequent as may be desired with automatic level float switches. In this regard a day's storage of 108,000 litres was mounted on a steel structure to serve the new community by gravity whereas the 2 days' storage mounted on the ground in a cordoned tank farm. In as much as the overall capacity of 600,000 litres was not to be ready for a while, consideration for 108,000 litres was to be elevated with 225,000 litres to be mounted on the ground for the first phase of the project. The remaining 250,000 litres was to be considered for installations during the construction of the second phase which comprise of the supply of potable water to the village nearby.

### **Design Considerations for Cold Water Installation**

Cold water availability for the workers' accommodation is as mentioned in the introduction was treated as very essential and as such supply was designed to be continuous to enhance the main purpose of the project, predominantly to enhance productivity. The available source of raw water in the Kasunya district is a canal purposely constructed for irrigation systems as the place is into crop production. In this regard the community fed the consultants with information on the flows especially during the draught season. The distance between the canal and the water station proposed for the facility was 1000m. Water intake pump was designed to be submerged in the canal. This was to be done with the assistance of the GEL farm management which have been operating in that domain over the years for irrigation purposes. Raw water was stored to a capacity of 90,000 litres. The treatment of the raw water was based on the Aclaira system as produced in Europe

It was stated that an Aclaira-C8 will run for 15 hours to produce 180,000 litres

of treated water and 17 hours to produce 200,000 litres. This implied that the 20,000 litres of treated water requirement of GEL for the Nyapienya Community was being taken care of as stated. The daily treated water produced is only 180,000 litres. The "estimated annual consumption of chemicals for membrane cleaning" has been indicated for 180,000 litres per day of water production of 66,000 metre cube per year.

The number of houses is 240 during the construction but the design comprises the picture stipulated for 300 housing units.

There were two proposals. The Aclaira treatment system and the Bioland water treatment systems from Denmark. They all based their proposals on the following considerations;

1. The average number of persons per house is 5
2. The daily volume of drinking water consumed per person is 70 litres (Ghana standard)
3. The above figures lead to a treatment capacity of 78400 litres per day
4. GEL Fair Trade Premium wishes to design the water treatment so as to also supply the inhabitants of Nyapienya village. The estimated extra volume of treated water to consider for this duty is 20,000 litres per day.
5. The raw water will be taken from the reservoir of the banana farm.
6. First estimations of the raw water pipe length between the reservoir and the location of the housing units is 3000 m
7. Raw water requires rejection of particulate contaminants only:

turbidity, suspended solids, colloids and micro-organisms.

8. The technology proposed is Ultrafiltration, therefore it will not eliminate any dissolved contaminants.
9. Treated water meets or exceeds the most stringent World Health Organization (WHO) guidelines about parameters influenced by a mechanical filtration i.e.:
  - a. Turbidity < 0.2 NTU (norm - DIN EN ISO 7027)
  - b. Bacteria, Cryptosporidium, Giardia cysts > 6 log removal efficiency
  - c. Virus 4 log removal efficiency
10. The unit was placed in the immediate proximity of the housing units at a location selected to minimize the raw water pipe length
11. The location of the 4 x 25 m<sup>3</sup> elevated (12m) treated water reservoirs was at the immediate proximity of the water treatment unit.

### **Bioland Water Treatment System**

Water analysis report shows elevated levels of total dissolved solids, chloride, Iron, total hardness as well as being bacteriologically unsafe for potable water use.

Treatment systems are pre-designed to cater for the above mentioned parameters.

Pre-design is modulated according to the maximum discharge rate

### **Need for Ground Water Protection**

Domestic wastewater is a major source of water pollution which as per

Wang et al, (2013) is as a result of poor urban planning with illegal settlement due to rising population. In this regard there is the need to focus on the right system of waste disposal right from the planning stages. This when shunned would create a problem in the future as the right areas for the right sewage treatment facilities could not be compromised with.

The Table 1 below shows the BIS desirable standards as against the WHO standards. In determining the extraction of potable water in an area, it would be necessary to explore the water bodies in the area to facilitate the extraction processes. In the Kasunya area as discussed above, their main source of water is from boreholes where the average water table was 60m. The borehole in this area uses submersible electric pump sets. In discussing sustainable water supply system therefore, this would not serve the purpose as electrical power in itself cannot attain sustainability as supply is incessant in this part of sub-Saharan Africa. The Kasunya suburb is lowly populated with less than 5000 indigenes. With such population it could be of lesser problem to specify the effective systems for potable water to satisfy the water requirements.

### **Design Implementation**

After the contract was awarded, the company that installed the treatment facility at the BAM facility was engaged by the contractor to undertake the cold-water extraction and storage system. They expressed the desire to pump the raw water directly into the treatment facility without necessarily storing the raw water before effecting the treatment, they explained that the water which was untreated would be prone to staling should there be unforeseen delay in the treatment processes. This was considered as an excellent input especially considering the fact that there would be cost saving as well.

The pumping from the canal was originally designed and as such there was cost reduction with the proposal for the elimination of the raw water tanks at the pumping station. There were 9No 25,000liter capacity water reservoirs on the ground and 4No 25,000 elevated on a support steel structure. In all the total capacity of the potable water came to 325,000liters.

This capacity could satisfy the indigenes for two days when the whole facility is operating on full occupancy, however, the facility was capable of receiving expansion when necessary.

### **Elevation of Potable Water Tanks**

The height of elevation of the water tanks for gravity feed to the sanitary appliances depended on the following;

- Topography of the area
- Length of the furthest distance away from the treatment plant
- Types of sanitary appliances installed
- Pipe sizing and types of pipes and fittings.

The various equivalent friction losses of each fitting were measured against the pump discharge rate calculated as explained earlier. These were considered in the design implementation as it would ensure that once the water was capable of reaching the house with the longest distance it was presumed that all the friction losses in the pipe had been overcome making it possible for water to be tapped from every household.

The elevation of the tanks would then be dependent of the equivalent friction losses plus the potential energy;

Head of elevation of the tanks =  $f + z + tp$

Where;

$f$  is the head due to total friction loss

$z$  is the potential head

$tp$  is the terminal pressure

The terminal pressure in this case is the shower outlet terminal pressure; as explained a satisfactory shower performance would require a pressure of 1bar at the shower outlet. This means that a head of 10m which is approximately 1 bar should be considered.

The sanitary appliances expected in the housing estates were the water closet suite, wash hand basins and shower fixtures. The shower fitting was the main item to consider due to the height at which it is normally fixed which is normally above the rest of the sanitary appliances; in this regard a height of 1.5m which is the assumed standard height for the shower head was added to the potential height difference.

The buildings were of several types however they were all of the single storey types. Since there was no other structure expected to be built on the facility (according to the initial scope) and considering the fact that the project was called for by the EU-BAM, there was no need to base the determination on other factors other than the scope received from the client. In that regard the height of the elevation was pegged to serve single storey buildings. This gave the height of 20m to curtail all losses in the pipe to reach all the buildings satisfactorily.

### **Pumps and Pump Size Determination**

The project comprised of a multiplicity of pumps, namely; raw water pumps, cold water transfer pumps and low lift pumps. All the pumps were the dual purpose types to allow for one duty, one assist/standby purposes,



### Raw water transfer pump set

This was the main pump supplying raw water to the treatment center. The location was determined with the assistance of the BAM experts on the ground as the operation of the BAM banana plantation was dependent of pumping of water to various locations in the farm yard. The location allowed for the availability of raw water at all times even during drought seasons. The dual purpose pump set was selected to allow for duty and standby purposes as stated earlier. The calculation of the pump capacity was based on sanitary appliances in the buildings. The fixture demand unit of each sanitary appliance was used in the determination of the raw water pump set capacity. It was also realized that there was the need to factor into the design, all future expectations in order not to incur the possibility of under performance of the system put in place. An extensive discussion was held with the stakeholders to conclude on the determination of the pump sizes.

In the case of the raw water performance, the decision to base the capacity of the pumps was not too much of importance so long as the over flooding of the system was concerned; however the installers' decision to run the raw water directly through the treatment tanks made it a necessity to consider the sanitary appliances it is to serve. This was considered even though the raw water was not to serve the sanitary appliances directly, it had direct impact on the distribution of the treated water to the various areas of the community.

The following were the supposed quantities of sanitary appliances installed in the 240 apartment buildings; it includes police post, fire service post, a supermarket and a social center;

No of water closets for each apartment - 240

Number of wash hand basins - 240,

No of shower heads - 240,

No of kitchen sinks – 240.

Allowance was made for the installation of washing machines and dish washers and washing machines, but for 10% of the total number of houses. This was based on data gathered by the Researcher on other estates houses even in the community of the elite simply because of the fact that it is always better to overestimate especially for water capacity and distribution than to under estimate. Most communities gradually become cosmopolitan and as such could be found wanting in such later times. Another consideration is the urbanization factor; an issue in the sub-Saharan Africa which cannot be determined by data.

Using the demand unit method by Hall 2004, the pump capacity was determined as follows

Having arrived at a capacity at the discharge of the pump, the head developed could be determined. This is because the rate of flow in the pipe is directly proportional to the friction losses in the pipe. The length of the critical path of the 150mm diameter pipe was 1,500m. The fittings installed on the line were determined. The equivalent friction loss per each fitting was determined using the Carrier (1990) friction factors and the graph for the determination of equivalent friction losses to the pump discharge. These were used to arrive at the total friction loss for the pump head required. Again the potential head was determined from the site topography and the difference in height was used to factor in the potential head. Since the raw water was to serve the treatment facility directly, an assumed

terminal pressure loss of 10m was considered.

The total pump head as against the pump discharge was determined as follows;

$$H = f + p + t$$

Where;

H is the Pump head

f is the Friction losses

p is the Potential head and

t is the Terminal Pressure

### **Cold water Transfer Pumps**

The cold-water pumps were two in number. These pumps were the pumps that transfer the treated cold water and stored in the water storage tanks ready for distribution to the various houses. The main pump being the low lift pump transferring cold water from the ground tanks into the elevated tanks. Once the water consumption capacity was determined and sized for the 240 housing estates, there was no need to size the capacity of the pump by the demand unit system. This was because it would only need to transfer water from the ground to the overhead tank as and when the water level dropped substantially. The pump capacity could not necessarily be dependent on the demand unit method as the treatment plant was capable of feeding the overhead tanks together with the ground tanks at the same time as water flowed through the system. The operation of the pumps was designed to operate by level float switches connected to the overhead tank which caused the transfer pump to trigger at designed low water level. There were two sets of level switches to facilitate the start and stop processes of the pumping system. There was the low level cut-in switch and the high water level cut-out switch installed in the tanks and

connected to the pump control panel. The low water level switch which was fixed to the desired level which would enable the pump to automatically start and continue to pump until the water reaches the desired water level and automatically cuts off with the installed high water level.

All the pumps were the dual purpose types to allow for one duty and one; standby, for automatic continuity purposes. However there was the need to install a third pump in series as and when desired. This is with regard to sustainability and continuity purposes as the availability of pump spare parts could not be dependent on with time. Revision of manufacturers' production could affect the supply of spares with time. (This assertion is from survey carried by the Researcher)

The second pump set was mainly to be dependent on in case the main raw water pump set fails to operate and maintenance works are being carried out. During such times the second pump would be in operation to assist in pumping the treated water to the various housing units until repair works on the faulty pump is completed. This was considered for installation mainly for sustainability and maintainability purposes.

### **FIRE FIGHTING SYSTEM**

The project considered a number of fire hydrants at vantage points in the vicinity. This was augmented by the fire station allowed in the vicinity. The raw water pumping system from the canal to the water station was used to serve the fire hydrants for the vicinity. Each hydrant was the ground wet type housed in a fire hydrant chamber. The fire station was equipped with fire hydrant accessories namely; branch pipe and a hose 65mm diameter complete with instantaneous coupling. There would be no need for training as the availability of the personnel

from the Ghana National Fire Service would be directly in charge of the fire-fighting activities.

In all there were 4No fire hydrants installed in the vicinity. 4No hydrant accessories were recommended all to be housed in the fire station. The pressure at each hydrant terminal was designed to 5bar. This was to be provided with the capacity of the raw water pump set installed to the raw water intake in the canal.

### **Testing and Commissioning**

Each pipe line laid was subjected to testing at one and half times the running pressure of 5 bar. The testing pressure in that case was 7,5bar. The pipe line was subjected to 7.5bar for a 3-hour duration with an hour interval regular reading and recording throughout the duration.

Sample of record keeping of testing and test certificate

## **LIQUID WASTE DISPOSAL SYSTEM**

### **Consideration of Types of Suitable Liquid Waste Disposal Systems**

The selection of the suitable types of liquid waste disposal system at the vicinity became a difficult process due to the following conditions on site. The topography of the area was barely flat and as such long runs of sewers were not a factor to consider as the outflow would be too deep making meaningless an effective sewage disposal by gravity. The nature of soil was nothing to write about when it comes to soak-away as it was impervious and clayey. These conditions made the liquid waste disposal quite challenging. Bringing the thoughts of all the consultants together especially the civil and the MEP engineers, it was decided that the portable sewage treatment systems be considered.

There were many portable liquid waste treatment systems being installed in the country but there were not enough literature covering them.

### **Septic Tank and Soak-Away Systems**

From the above preamble *the septic tank and the soak away system* was completely out of the question since the soil nature cannot absorb the effluent dissipation into the ground.

### **The Biogas Technology**

*The biogas technology* could not be considered as it would be quite expensive to install considering the outflow process which could go through a similar process of treatment. The cost alone could not be absorbed under the contract.

### **The DST Treatment Systems**

The Duraplast septic tanks (DST) is produced by Duraplast Ghana Limited; a plastic producing company in Ghana. It consists of a coal loaded reinforced plastic chamber from where effluent is processed preliminary before connecting a dosing chamber. The Ghana Standards Authority have accepted that the treated effluent from the DST is acceptable to be transferred into the public drainage system. The acceptance of the treated effluent was based on tests carried out in 2015 is evidenced with a certificate as per the appendices. Below is a sample of test results in 2013 in Ghana giving way to its application nationwide. Assessing the sustainability of liquid waste disposal systems in West Africa; A case study in Ghana and Nigeria in 2021 as per Table 5. Sample test results of treated waste from Duraplast Septic Tank Outlet Sample Identification.

The DST treatment system produced in the country and had undergone testing by the governing institution which acceptable certificates,

however to install one per apartment would have thrown the budget into unaffordable venture.

### **The Biofil Digester System**

*The Biofil digester system* which also was being installed nationwide over the years was examined vis-à-vis the project parameters. The biofil digester system was found to be efficient when discharged into the ground, either into landscape activities or through agricultural drainage systems. Comparing the costs of both DST, the biogas systems and the biofil systems, it was agreed that the biofil digester systems be considered and piped into a saturation pond at a location of a lower terrain identified quite some distance away from the facility.

Each building was connected into a biofil digester system and piped into various sewer manholes collecting the semi treated liquid waste from the buildings all the way into a saturation pond as explained quite a distant away.

The saturation pond and ancillary comprised of a holding tank to receive the semi-treated liquid waste from the outflow of the biofil digesters. The levels of the inlet of the holding tank and its outflows was not considerate enough and as such a low lift pump was installed to complete the treatment process. The low lift pump was to transfer the semi-treated liquid waste into the saturation pond. The open-to-nature saturation pond was subjected to treatment by nature's influence on the pond. This was successful and was not creating any kind of inconvenience as the treatment was effective with nature's influence; namely evaporation and reeds in the pond all contributing to the success of the treatment process.

### ***Piping of Liquid Waste into The Saturation Pond***

The determination of pipe sizing was based on the loading units of the various sanitary appliances in the buildings. Similar to the cold water piping as per the cold water supply and distribution topic, the loading units for foul water flow was used. The total loading unit was compared with the gradient 1 to 150 which is used to determine the flow for a 150mm diameter piping. A gravitational flow of 2feet per second was assumed as the flow in the pipe. From the parameters given, a gradient of 1:150 was used in a 150mm diameter poly vinyl chloride (PVC) piping. The total flow rate required allowed for the 150mm diameter pipe to a slope of 1:150 with an assumed flow velocity of 2feet/second for gravity flow in a circular pipe.

Testing was effected on the pipe with a test pressure of 3 bar; being one and half times the system pressure. This is due to the assumed system pressure of 2bar in the pipe based on gravitational flow in the pipe.

### **SUITABILITY OF THE DESIGNS ADOPTED**

The facility which was completed in 2017 has been subjected to usage for five years without any defects recorded in the cold water and liquid waste disposal. Sustainability of the designs of the potable water provision and liquid waste disposal system was considered an important feature due to the frequency of breakdowns of such systems in the country in general. This was based on data available from earlier research activities e.g. CED KNUST (2017) and primary research carried out by the researcher, Omani (2021). In this regard the necessary steps were factored in to arrive at a sustainable system as described. The treatment of the water

facility coupled with the storage systems factored into the designs made it possible to attain quite a suitable facility for the 240 housing estates facility and ancillaries.

Apart from privately owned properties where failure of liquid waste treatment plants could result in penalties slapped by the metropolitan authorities, the rest managed by public works department and governmental agencies were all broken down. The worst of all was the fact that they were still subjected to usage with the untreated or semi-treated waste water flowing into water bodies or affecting the ground with saturation. This contravenes the WHO regularities as it causes unhealthy environment.

### CONCLUSION

Many considerations were made in the selection of suitable designs adopted for the project. These were based on the client's scope and budget made available for the project. With the estimated number of houses requested by the client and the budget of nearly 6million Euros, the consultants made many proposals with costs and concluded on the designs that were implemented. During the costing of the various designs, it was realized that the 240 buildings could not be targeted and with the consent of the client, it was agreed that the project could start with 220 housing units instead of the 240 units. The social center and the market square were seen as priority so were included in the first phase of the project however the police and the fire stations were omitted in the first phase. The client however expressed their willingness to consider the omitted ones in a near to be implemented second phase of the project.

The road network was completed as designed with the landscape as well. With the electricity network and street lighting completed, the facility which initially comprised of 240 housing estates was completed with a 220 unit estates. It had

been implemented successfully as the stakeholders were involved in the supervision and in attendance of the periodic monthly meetings. The stakeholders were planned to include representatives of the financiers, the Ministry of Trade and Industries and Ministry of Finance. Also included in the stakeholders were the end users of the Banana Acceleration Measures (BAM) in the Kasunya Nankana district who helped in the provision of information on the existing canal; the only water body available for the treatment of potable water for the facility.

In all the project was successful. This was the conclusive remark by all the stakeholders as enlisted above.

### ACKNOWLEDGEMENTS

The head of the project management team in the consortium, Ing. Seth Attipoe contributed immensely towards the successful implementation of the pre-consultancy and post-consultancy aspects of the project. He was a structural engineer by profession and has a legal background. The consultancy contract was awarded to K-Line Design Limited who entered into a joint venture agreement with Evans Anfom and Associates. They formed a consortium comprising of mechanical and electrical engineers, civil and structural engineers, a quantity surveyor and an interior designer. All these professionals played their roles in the compilation of this article which could contribute to the body of knowledge in the housing industry in Ghana and largely West Africa.

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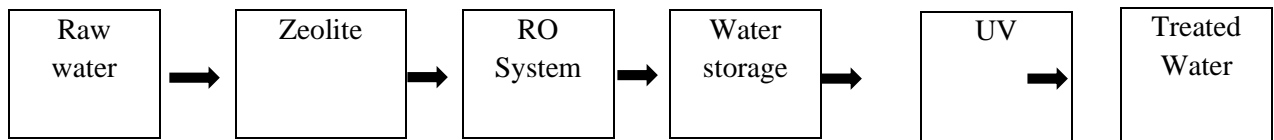
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Flowrate	70	lpm
75,600		litres after 1080 minutes (18 HOURS) OF PUMPING
	4.2	m <sup>3</sup> /hr
	75.6m <sup>3</sup> /day	NB:where a day in the pumping is 18 hours
	19971.41us gpd	Expected volume after 18 hours of pumping
18.49		us gpm
Surface loading	1 m/hr	Typical design value



When related to the above 74,800 litres per day this is similar to be applied to the Aclaira system.

**Table 1 – Drinking water quality standards as recommended by BIS and WHO**

Parameter*	BIS Standards		WHO standards
	<i>Desirable</i>	<i>Max. Permissible</i>	
Color	5	25	-
Odor	Unobjectionable	Unobjectionable	-
Taste	Agreeable	Agreeable	-
pH	6.5-8.5	6.5-8.5	6.5-9.2
TH	300	600	300
TA	200	600	
TDS	300	1500	500
Cl <sup>-</sup>	250	1000	250
SO <sub>4</sub> <sup>2-</sup>	250	400	200
NO <sub>3</sub> <sup>-</sup>	45	45	50
F <sup>-</sup>	1.0	1.5	0.5
Ca <sup>2+</sup>	75	200	100
Mg <sup>2+</sup>	30	100	150
K <sup>+</sup>	-	-	200
Na <sup>+</sup>	-	-	200
NH <sub>4</sub> <sup>+</sup>	-		1.5
Phenol	-		0.0
B	-		0.3
Fe	-		0.3

\*Except pH and color (hazen unit) all unit are in mg l<sup>-1</sup>

**Table 2.** Loading units for cold water consumption of various sanitary appliances.

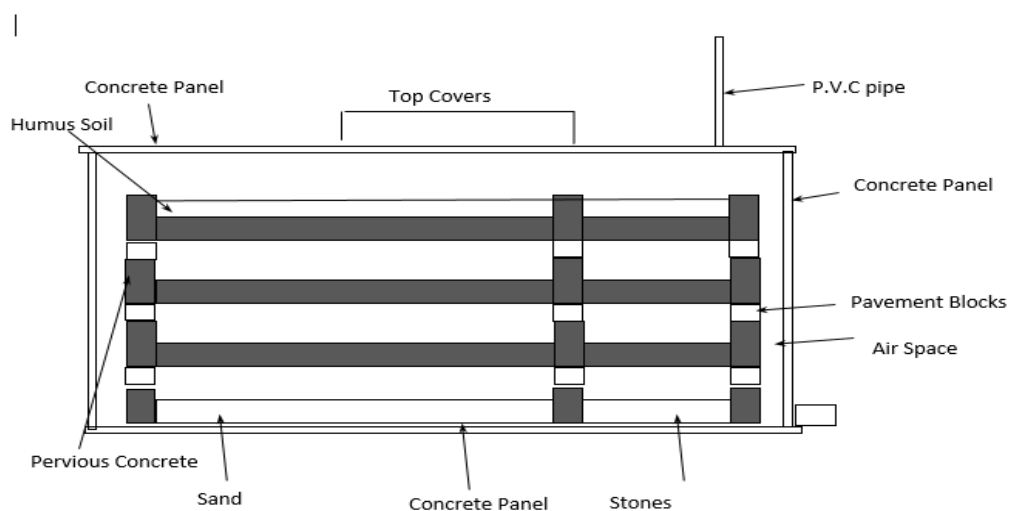
Building purpose	Storage/person/24 hours
WC cistern	2
Hand basins	1.5 to 3 (depending on application)
Washing machine	3
Bath (20mm diameter tap)	10
Bath (25mm diameter tap)	22
Shower	3
Sink (12mm diameter tap)	3
Sink (20mm diameter tap)	5
Dish washer	3

Source: (Hall & Greeno 2004)

**Table 3.** Sample test results of treated waste from Duraplast Septic Tank outlet

Sample Identification Effluent	Total Coliform (TC) cfu/100ml Method: APHA 9222A	E coli (cfu/100ml) Method: APHA 9260F
Inlet	1488	930
Outlet	0	0
EPA Ghana – Maximum permissible levels	400	10
Recommended Limits for irrigation	<1000	<10

Source: Duraplast Ghana Limited (2015)

**Fig 3** Cross-section of Biofil Digester System. (Extracted from Amoah et al, (2016))**Table 4** Analysis Results of the outflow of biofil digester by Dav-Tech Company

Simple ID:		Company Name: DAVSAR	
BIOTECHNOLOGY&CONST, LTD			
Lab Code		Site Name	
Analysis state date: 01/08/16		Analysis stop date: 12/08/16	
Parameter	RAW TOILET	TREATED TOILET	EPA Guideline Values
PH. PH units	7.50	7.10	6.00 – 9.00



Conductivity, $\mu\text{S cm}^{-1}$	8,450	2,730	1,500
Turbidity, NTU	235	2.00	75.0
Apparent Colour, Hz	380	5.00	200
Total Suspended Solids (mg/l)	170	3.00	50.0
Total Dissolved Solids (mg/l)	5,070	1,638	1,000
Ammoniac Nitrogen ( $\text{NH}_4\text{-N}$ ) (mg/l)	15.0	0.262	1.00
Nitrogen ( $\text{NO}_3$ ) (mg/l)	26.8	24.0	50.0
Total Phosphorous (mg/l)	1.89	0.041	2.00
Chloride (mg/l)	1,171	467	250
BOD (mg/l)	90.0	0.483	50.0
COD (mg/l)	595	1.42	250
Total Coliform (cfu/100ml)	$465 \times 10^4$	$36 \times 10^4$	400
E-Coli (cfu/100ml)	$186 \times 10^4$	0	10

Source: Water Research Institute, Environmental Chemistry Division. CSIR Premises, Airport Res. Area



Usage of Biofil Digesters for sewage system on the 240 No housing units

Source: Evans Anfon Associates, Consultants for the project (November 2019)

**Table 5.** Flow rates of wastewater for various sanitary appliances.

Building purpose	Storage/person/24 hours
WC cistern	0.11
Hand basins	0.15
Hand basins (spray type)	0.03
Bath (20mm diameter tap)	0.30
Bath (25mm diameter tap)	0.60
Shower	0.11
Sink (12mm diameter tap)	0.19
Sink (20mm diameter tap)	0.30
Sink (25mm diameter tap)	0.40

Source: (Hall & Greeno 2004)

## **Factors Affecting the Quality of E-Learning-Perspective of Higher Education Students**

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### **Abstract**

The objective of the research was to study the relationship of seven independent factors: administrative support, course content, course design, instructor characteristics, learner characteristics, social support, and technical support on quality of e-learning in higher education. Further, the study analyzes the moderating variable by the relationship between gender, level of the course, and quality of e-learning in higher education. COVID-19 has changed the complete phase of the education sectors. The COVID-19 pandemic situation has impacted the entire education system, especially universities, and brought a new phase in education. The study aimed to bring the factors affecting the quality of e-learning like administrative support, course content, course design, instructor characteristics, learner characteristics, social support, and technological support.

## **Sangeet Aatmanubhav – Designing Individualistic Music Streaming Experiences – An Indian Purview**

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### **Abstract**

In today's world of a celestially infinite (Goldstein, 1994) yet precisely curated music streaming, individuals try to find a musical identity and simulate a culturally indicative space wherein their emotional needs are sufficed. To cater to these needs of users, music streaming platforms collect and analyze data like playlist curation, streaming statistics and search histories to optimize their services. The results of which are an analytically intuitive and accurate recommendation system that facilitates the above-stated simulation of emotionally driven music space, but the interface continues to remain generic, lacking to imbibe the persona of the user despite the rich individual-based information. This paper looks to work on the same correlation and present user experiences unique to different personas created by the meticulously collected data by such platforms. We first dwell on the correlation of musical tastes and habits to personality traits which leads to the creation of information-based personas. Based on this groundwork, we will observe the correlation of personality to user experiences and attempt to create the same using UX tools from an Indian point of view, which itself is a case of multicultural origins and exchange.

**Keywords:** Music streaming platforms, individuality, user experience design, Communication Design, persona, user Interface, Design.

## Baha Sari, from Television to Wardrobe: Tracing the Journey of a Visual Design

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### Abstract

The paper traces the path of the Baha Sari—a sari exclusively designed for the character named Baha in the Bengali serial *Ishti Kutum* (Dir. Saibal Banerjee, Sujit Pyne, 2011-2015), becoming one of the most popular fashion trends in Kolkata in the second decade of the twenty-first century. Bengali television serials enjoy a constant and regular viewership within the domestic space. Daily broadcasting of the same sari-clad characters thus also acts as continuous advertising of their fashion. Even amidst the vast westernization of women's portrayal on Indian television, Bengali serials have continuously shown their female leads in Sari. This paper broadly discusses a design that was meant to personify a young tribal woman's character in television yet found acceptance and immense popularity among the urban clientele in a metro city like Kolkata. Through interviews with the original sari's designer and sellers and customers of the product available on the market, the researcher follows the extensive journey of a design, from the designer's sketch pad to the buyers' shopping bag. The paper is divided into three parts. The first part focuses on the history and evolution of Sari fashion in the context of Bengal. The second part elaborates on the methodology. Finally, the article concludes with the evidence to understand television's contribution to the process of cultural hegemony in a limited area, being manifested through media channels of a particular language.

**Key words:** Sari, Bengali television, Bengali women fashion, fashion influence, visual design, visual culture, cultural identity, Bengali middle class

### INTRODUCTION

My interest towards television was not something new. But I vividly remember the precise moment when I had felt the sheer strength of this mass culture medium. It was a sultry evening of July and I was walking towards home with a couple of hot eggplant fritters wrapped in a piece of newspaper in my hand- following my father's request to have an evening snack. Right at the moment when I stepped my foot inside our paara, the theme of "Ishti Kutum" (the Bengali TV serial) reached my ears, coming from the house on my right. As I progressed towards my house walking past one house after the other, so did the theme song. It never faded, as literally every house had its TV on at precisely the same channel to watch the same serial. It almost felt like the clichéd Bollywood scene of constantly shifting Dutch angles

showing the desperate hero walking towards the deity in a temple with hundreds of bells ringing madly over his head within a dust storm. In the same manner, like ringing bells, the theme song accompanied me coming in bits from surrounding houses, at times overlapping, at times coming split second after the other, till I entered our house's drawing room to discover my parents fondly watching at the TV screen as it glows the words "Ishti Kutum" with the main actors staring out to me. This experience fascinated me as I had never seen such unspoken unification in my paara except during the Anjali in our paara's Kalipuja and prasad distribution. Without even anybody's knowledge my whole paara (and so many other people throughout West Bengal) was actually watching together the same serial and experiencing the same emotions expressed through the

actors at precisely the same moment. It was also at that precise moment when my old interest towards TV got a boost and thereafter I started observing TV related elements in our immediate visual culture as closely as possible.

Incidentally the topic of the research paper also has an inseparable tie with this serial, "Ishti Kutum." Baha sari is the sari that grabbed the viewers' attention, originated from this serial and became a trend- in that order. Before tracing on the path of Baha sari, which was an early- mid 2010s trend in Kolkata and other parts of West Bengal, it would be wise to slowly approach it starting from the inception of the first urban style of wearing sari.

Sari or the five yards of unstitched fabric with one inner ending and a more decorative outer ending with two borders running through its horizontal limits has been the attire for Indian women for more than thousands of years. Within this space, endless designs and countless fabrics, ambitious and simple drapes alike- all have been made possible. Throughout India, different lengths and draping styles of sari are present, yet sari is the unifying attire in the whole country. Not only geographical location, the draping is known to change according to the functionality and also the class of the woman wearing it. While many traditional ways of draping exist till today, the urban style draping of sari was introduced post 1870s by Gyanodanandini Tagore (wife of Rabindranath's elder brother Satyanendranath Tagore). Chitra Deb in her book "Thakurbarir Andarmahal" lucidly describes the stories of Gyanodanandini becoming the first non-royal woman to step outside her home and travel, accompanying her husband.

The way women wore sari inside their homes was neither aesthetically pleasing, nor functionally fulfilling for a lady to travel or step outside. A first hand

sufferer of the problem, after going through a few unsuccessful experiments of uncomfortable substitutions for sari, Gyanodanandini picked up the simplistic way of wearing sari from Parsi women in Bombay during her stay in the city. Upon her return to Kolkata after two years, other women from Thakurbari and later from other noble families of Kolkata too slowly started adapting Gyanodanandini's way of sari draping or "Bombai Dostur". This "Bombai Dostur" later became known throughout whole Bengal as "Thakurbarir Sari." Gyanodanandini even put out advertisements in newspapers to teach women how to wear "Bombai Dostur." She introduced and taught ways of wearing sari with petticoat, blouse and jackets to the then Bengali women. Gyanodanandini's story truly proves that necessity is the mother of invention. "Bombai Dostur" was born out of the desperate need of an acceptable, accessible, aesthetic yet functional sari look. The world has since then progressed till the second decade of the twenty first century yet Gyanodanandini's "Bombai Dostur" is still the base of Bengali women's sari draping- be it for office wear, puja or a wedding ceremony.

Today's women have ample opportunities to experiment on the fashion of sari. We are living in a digital age with countless images crossing our views daily, waiting to be picked up and appropriated. Baha sari is only one instance of that. Television is a medium that provides daily entertainment within the four walls of a domestic space throughout the whole world. In our country, majority of the TV audience is women and the TV serials too, are specially made keeping its women viewership in mind. In such a scenario, elements of women's fashion having direct influence from TV serials is very natural. This paper will look at this journey where a design intended for a character in a TV

serial establishes itself as a trend for four years in the sari market of a metro city.

What is Baha sari?

Baha saris are saris named after Bahamoni Soren aka Baha, the protagonist of the extremely popular Bengali TV serial *Ishti Kutum*. Having run successfully for more than 4 years (24 October 2011 to 13 December 2015), one can safely grant *Ishti Kutum* the status of a mega serial. One of the main reasons behind the popularity of the show was the freshness of the storyline and the adorableness of Baha, a young village girl of tribal origin. Although, the age old TV serial formula of husband, wife and the other woman was applied there as well, it was the picturesque locations of tribal village, well written strong characters, standpoint of the husband, his questions of morality, complexity of social situations and customs, difference of social values added to various social status etc. gave the serial many perspectives to offer to its viewers. Complexities in the story start when the hero Archishman Mukherjee (Archi), a journalist by profession runs to Palashboni, a tribal village to interview an outlaw and after some unfortunate misunderstandings, is forcefully married to a young tribal girl, Bahamoni Soren (Baha). Nobody pays heed to the fact that Archi is already engaged to his long term girlfriend Kamolika Majumdar (Mun), an Economics professor. Archi and Baha both decided to keep their marriage a secret as it was null to their eyes and beliefs and Baha continued to stay with Archi's joint family with the identity of a domestic help. Among such turmoil, Archi eventually marries Kamolika too without disclosing to her about the forced marriage he had with Baha. Gradually the story progressed to reveal that Archi, the husband to both women has slowly fallen in love with Baha. Kamolika decides to leave her husband's house upon learning the truth and in order

to start afresh, they both opt for divorce. The serial perhaps reached the peak of its popularity when it presented its audiences with the ultimate question of morality- who should the husband accused of bigamy choose as his life partner- the innocent and naïve young village girl he was forced to marry under misunderstandings and social pressure, or the rich, educated and cultured urban woman with whom he had been in a relationship for seven years? The immensely popular show even had several active Facebook groups made by and dedicated for fans of this show. Heated discussions over chat used to take place over which of the heroines is being victimized. Dedicated audiences made themselves part of either "Kamolika camp" or "Archi-Baha camp" based on their own judgements. While a large portion of the audiences showed their favour against Baha, it only increased the popularity of the show many folds as viewers from both camps made sure to tune in to watch the fate of the heroines. This popularity of the show was instrumental in the rise of the product "Baha sari". Also, actress Ranita Das's strong performance as Baha had won over every audience's heart. *Ishti Kutum*'s stupendous popularity in West Bengal caused adaptations of the serial in eight other Indian languages, broadcasted in the regional channels of the same network. While four of them have already run their course, the other four are ongoing. Fig 2. *Ishti Kutum* promotional poster

As simple as the two words express, it is the sari that Baha wears. Throughout the show, Baha was shown wearing a particular kind of sari that had a very simple yet vibrant design. The sari generally had a solid body colour, with thin strips of contrasting colour/colours constituting the paar or border. In some cases, stripes of the same colour family could be seen too. Such colour stripes

would generally be dominantly present in the aachol or pallu of the sari.

The creation of Baha sari:

The look for Baha in the serial “Ishti Kutum” was envisioned by ms. Sabarni Das. She had first tried the look with one of her own sarees bought from the well-known boutique ByLoom situated near Gariahat in south Kolkata. The saris that later gave birth to the phenomenon of Baha saris had actually come from the “Abir” range of saris offered by the boutique. The “Abir” saris have simple yet vibrant look that suited the young, bubbly and energetic character of Baha. The designer of these saris is Bappaditya Biswas, co-owner of Bai Lou and also a partner of the handloom store ByLoom. No sari was designed particularly with any idea of attiring Baha. The “Abir” range of ByLoom saris existed before the show’s conception and was later utilised by the stylist with an unprecedented success. Fig 7: Abir sari

Ms. Sabarni Das’s idea for the look was to drape Baha in simple, cotton saris as the character is a poor santhal girl who can’t afford to wear anything more extravagant than that. The look was completed with simple and cheap oxidised jewellery and a small bindi drawn with thin, black lines, imitating tribal tattoos. The draping of the sari neither completely matched Santiniketan’s Santhal women’s draping (Baha’s village, Palashboni was an imaginary place but the shooting was done in Santiniketan’s tribal villages, situated in West Bengal’s Birbhum) nor Kolkata’s women’s draping (After her marriage, Baha moved to Kolkata and lived there). Rather, it had parts of both. Baha’s sari included the separate kuchi anchol of typical Kolkata women’s sari draping and also had the part of tucking the anchol in the waist as in Santhali draping. The drape was an amalgamation of both the village

and the city that Baha lived in. Since the character was created for a TV serial that is essentially a commercial product and not a documentary, many elements in Baha’s look deviated from that of an actual young Santhal woman. Her sari was very neatly pleated and draped, resembling that of working city women rather than a Santhal girl from humble backgrounds. The thick accent in which Baha spoke was also far from the way real Santhals speak Bengali. Being a character shown in a TV serial meant for commercial entertainment, Baha’s character needed a polished outlook and a distinct personality to stand out and also be presentable.

### METHODOLOGY

For this study, I have interviewed two separate groups- ten sellers and customers. By customers, I am referring to ten women from diverse age groups who are all residents of my colony. There was no common factor among any of them except the fact that they are all women and they wear saris regularly. Although I am mentioning the term “Customers”, it’s not necessary that they have all at some time bought or owned a Baha sari. I am using the term as customers of saris, not necessarily just Baha saris.

To get the sellers’ point of view, I interviewed ten shopkeepers from South Kolkata’s Gariahat market. All these shopkeepers have their sari shops on the pavement right outside Basanti Devi College. I have only talked to shop keepers who have the experience of selling Baha Saris during its heyday. The following questions were asked to every one of them.

Was it the customers themselves that came to you and wanted to buy Baha sari?

How did its popularity increase?

What was the reason behind its popularity? Design, material or trend?

What other trend can you remember coming from serials?

What kind of budget range was there for this sari?

Were customers from all financial standards buyers of this sari?

For understanding the mind-set of the sari customers, these following questions were asked to each of them:

Did you watch the serial "Ishti Kutum?"

How did you like the serial?

Do you own a Baha sari?

Why did you buy a Baha sari? For its design, material, uniqueness?

For those who hadn't bought it-

How did you like the serial "Ishti Kutum"?

Which character/characters did you like there?

Did you like/notice anything unique about the sari Baha wore?

After analysing the answers of both the sellers and customers, it is clear that the reason for popularity of Baha sari was because it offered an amalgamation of comfort with affordability, topped with simple yet eye-catching style, perfectly matching urban casual wear needs. As for the customers' opinions, they were aware of the trend of Baha sari but the fact that it's a popular TV character's attire, didn't influence their shopping choice. But the word of mouth spreading of the sari's praise interested them to give it a try. None of my interviewees had considered buying the sari solely based on the fact that they want to be a part of the trend. It was bought based on its good material quality, comfort factor and multi-purpose functionality. Only one of the interviewees explained she never considered Baha saris worth buying

as the design was too "rural" in her opinion. The rest confirmed the design's simplicity made it a good casual wear and at most a work wear. It was never suitable for wearing in special occasions. Overall, the customers' responses mirrored much of that of the sellers.

Also, the most important point to remember is that this sari featured continuously in a TV serial six days a week for four continuous years. The serial also, was a super hit with the audience- thanks to its fresh storyline and brilliant performances by the actors involved. The character Baha had become a household name due to the sheer brilliance of actor Ranita Das's performance. So much so, that today even after seven years since the show ended, people remember her name just as accurately as her character's name. Several sellers and buyers whom I had interviewed for this paper had mentioned her name to me while discussing about Baha sari. Such instances only proved to what phenomenal height the popularity of the serial had reached. The serial Ishti Kutum enjoyed a gross viewership providing the sari automatic advertisement. Watching the character wear the sari on a regular basis created a fascination and need for the same within a group of viewers. It was really easy for women to envision Fig 9, 10, 1, 12: Baha sari as available in the market themselves in such a sari as the actor portraying Baha on screen looked lively and grabbed attention among other actors even though she was attired in such minimalistic sari, with little makeup and jewellery. Interested customers went to the shopkeepers and asked for saris like that of Baha. Some of them would show images from their smartphones to the sellers as well. Upon realising the rise of the demand, weavers were given orders of that particular kind of sari and supply of Baha sari was generated to meet the demand. The saris being



produced in handloom, in pure cotton (later in mixed fabric) provided comfort to the users as well as being pocket friendly (a standard Baha Sari would cost around INR 600-800) for the average shopper. Later as the popularity of Baha sari had reached its peak, many variations of the sari were being available in the market. While in some cases, the basic Baha style was mixed with a bit more elaborate border or paar, sometimes applique was also being introduced into the body of the sari. At times, Baha style was mixed with other popular styles of sari like Khesh or kalamkari. Sellers owning boutiques introduced many such variations as per their own designs. Even Kurtis made out of the unsold Baha saris were available in the market. Not just that, other sari styles that had slight stylistic or visual similarity with Baha sari had seen a boost in their sale during that time.

As slowly the popularity waned after the serial ended, very low quality and cheap versions of Baha sari were also sold. Due to its degraded quality that could be because of reasons like low quality yarns, improperly dyed sari, made in power looms or weaved in mixed yarns, Baha saris were available for as low as INR 300 apiece. Gradually, like any other trend, Baha sari disappeared. But not before making an everlasting impact on the sale of handloom saris as the sellers from Gariahat have repeatedly mentioned. No other sari trend had brought such overwhelming profit for sellers and weavers. Baha sari single handed broke the monopoly of Taant, Tangail and Jamdani of becoming the primary choice of any sari shopper. Baha sari's popularity cemented the acceptance of handloom saris as a viable and affordable option to the sari-buying clientele. Even after Baha sari's trend was over, the later saris that found favour with customers were also handloom saris. Saris from TV serial

characters that later made its place in the market include Imon sari (Kusum Dola), Rashmoni sari (Korunamoyee Rani Rashmoni), Mithai sari (Mithai) etc. Yet, nothing so far has even come close to the popularity that Baha sari had garnered for itself. This statement remained unchanged for each and every seller while they fondly remembered the good business that Baha sari had given them. To quote seller Barun Chakraborty (32), “দিনে ৫০-৬০ দিস ত ো ধুন োর মন ো উনে তেন ো।” (50-60 pieces of sari will clear away as easily as dust in the wind).

### LIMITATIONS

The serial Ishti Kutum had last aired on 13th December 2015. It has been almost seven years since its last episode and now in June 2022 I am interviewing customers and sellers on the sari that came into being from this serial. Naturally because of this time gap, all the information I am able to gather is mostly dependent on the interviewee's memories. Thankfully the Baha sari trend was strong enough for people to still remember it quite vividly. Since my area of interest and observation was focused on a very pin-pointed small area of local popular culture that has occurred within less than ten years, there was no theoretical reference available for me. Other than personal conversations, most of my references were gathered from the web.

### CONCLUSION

TV serials in India, as well as Bengal have been frequently accused of showing the most illogical, unrealistic and repetitive situations in their storylines. Well accepted and co-existing polygamy (mostly from men's side), extremely multi-talented and docile, excelling at both workplaces and domestic chores housewife, unrealistic ways of plotting and committing crimes successfully yet facing no legal consequence, dead characters

illogically coming back to life often with a new face etc. are just the tip of the iceberg for tried and tested TV serial drama formula. While these shortcomings of one of the biggest sources of daily entertainment is often accepted and discussed at length by both academicians and tea-stall frequenters, my approach towards looking at the Bengali TV serials doesn't share the above mentioned concern. My interest solely lies into its visual appearance and whether and how it transcends the realm of virtual world and establishes its presence in the material, physical world. Baha sari has been a very popular commodity product in the markets of Kolkata during the time period of 2012-15, generating very good business for Bengal's weavers and small sari businesses, independent boutiques etc. It was a trend on its own and had spawned several other trends after its course had ended. But such a popular product would not have existed without the TV serial Ishti Kutum and its most popular character Baha on whom the sari was named.

The results presented in the essay above have solely come from analysing the answers of my interviewees and from my observations. Both the trend of Baha sari and the serial Ishti Kutum have long expired but Baha sari's pioneering presence as an element from a serial being able to make the transforming journey from inside the TV screen of a drawing room to the wardrobe of the same house was interesting to have a look at. The conclusion that I have reached at after my research is that while the argument of having realistic situations in TV serials is valid, yet it is also true that the serials are at the end of the day only commercial products made for daily entertainment and revenues coming from advertisers. Thus, unrealistic yet drama inducing situations are used frequently as that often attracts more viewership. Also, TV is an audio-

visual medium. So, eye-catching, camera friendly and character defining looks are generated to peak the audience's attention. Yet, within around nine-ten serials telecasted daily in an average entertainment channel, seldom a look/costume/sari/jewellery gets as much appreciation from the audience outside the TV screen as Baha sari has got. The design's practicality, simplicity with soberness and affordability mixed altogether has made it stand out among the other styles. The sari had enough simplicity for a homemaker to wear it to the local market and enough comfort yet formal appearance for an office worker or a teacher to wear it in her workplace daylong. Unless and until the design seen on TV will be able to meet the practical necessities of the contemporary women, it won't be popular enough to be a trend as strong as Baha sari. Because the sample size I'm looking at, consists of adult women from mostly middle class economic background. Within this group the intention of buying a product simply as a fan merchandise is pretty far-fetched.

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- Mr. Somnath Mondal (34)
- Mr. Biswanath Saha (65)
- Mr. Dulal Debnath (62)
- Mr. Badal Debnath (64)
- Mr. Babu Mondal (56)

- Mr. Shankar Mahata (53)
- Mr. Dilip Dey (54)
- Mr. Pradip Pal (58)

Customers-

- Ms. Santana Sarkar (60)
- Mrs. Shobhona Bal (70)
- Mrs. Meera Sen (68)
- Mrs. Ruma Das (56)
- Mrs. Swati Sen (35)
- Mrs. Ananya Dutta (34)
- Mrs. Suchitra Sengupta (74)
- Mrs. Shampa Chakraborty (60)
- Ms. Srabani Ganguly (55)
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Fig 1: Gyanodamini Tagore



ongoing.

Fig 2: Ishti Kutum promotional poster



Fig 3: The character Baha



Fig 4: The character Baha



Fig 5: The character Baha



Fig 6: The character Baha



Fig 7: Abir sari



Fig 8: Santhali women in Santalkeeta's Bazar pukur danga village



Fig 9, 10, 1, 12: Baha sari as available in the market



Fig 13- Mithai (Mithai)



Fig 14- Rashmoni (Korunamoyee Rani Rashmoni)



Fig 15- Imon (Kazum Dola)

# 3D Printer as an Artistic Tool: Researching on Technology Innovation, Applicability, and Future Potential of Printing Technology in Visual Arts

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## Abstract

Technologies are ubiquitous in every field of our contemporary society, even the fine arts. New technologies have always motivated artists to reconsider their methods of creation and processes. Rapid advances in computer science and technology have revolutionized professional art practice. International contemporary art has rapidly changed in a neo-liberal, global milieu. In this digital era, technology expands the border of creative space. Apart from the traditional style of works, artists are making digital painting, cybernetic sculpture, video art, and projection to display works. The print medium is essential for the art world. Artists are creating extraordinary artwork through print technology. Besides art practice, print is the communication and information transmission medium. The invention and development of printing technology accelerated print production—initially, the invention and use of different print techniques for commercial purposes. Later, many commercial processes were adopted by artists and incorporated into the canon of artistic practice. However, many artists produced their artwork in print format for sale, becoming a commodity. For instance, renowned artist Raja Ravi Varma's oleographic print made him famous. Now, in the present era, his original oleographic print appreciates as an artistic work. On the other hand, still many companies reproduced his work with new printing technology for commercial purposes. Therefore, the researcher may argue how one commercial technology becomes an artistic medium and how we can judge it as artistic work rather than production. At the end of the twentieth-century invention of the computer revolutionized the printing industry. Printing is no longer restricted to two dimensions; it has evolved into a three-dimensional output known as a 3D print, an additive process. However, 3D printing is not used very much in artistic printmaking. In this study, the researcher intended to review different printing techniques to understand the evolution of 3D printing and its academic methodological procedure.

**Keywords:** Visual arts, Printmaking, Digital technology, 3D printing.

## INTRODUCTION

Technologies are omnipresent everywhere in our modern society, even in the fine arts. The advent of new technology has always spurred artists to reevaluate their work procedures and methodologies. Advances in computer science and technology have had a profound impact on the way artists work professionally. In a neoliberal, global context, international contemporary art is quickly evolving. Creative space grows as a result of new technologies. Digital painting, mechanical sculpture, video art, and projection are just some new ways artists display their work.

The print medium is indispensable in the art world. Artists are creating extraordinary artwork through print technology. Aside from creative practice, print is a communication and information transfer medium. Printmaking can be traced back around 3500 BC, when civilisations in Mesopotamia first began employing carved cylinder seals. These seals rolled on a wet clay tablet and produced an impression that served as a signature. Over centuries, various cultures produced reliefs print on fabrics, ceramics, and paper. After that, the invention of the Gutenberg press shows the path of faster print. Later, many printing presses

developed for better and faster print. The invention and development of printing technology accelerated print production—initially, the invention and use of different print techniques for commercial purposes. Soon, many saleable methods were embraced by artists and incorporated into the canon of artistic exercise. Such as wood relief prints used for fabric prints and different information as a text reproduction for commercial sales. 15th c German artist Albrecht Durer beautifully utilised woodcut medium for his work. 17thc Dutch artist Rembrandt and 18th c Spanish artist Francisco Goya did etching aquatint. Henri de Toulouse-Lautrec, 19th c French artist popular for his lithography poster. In contrast, 20thc American pop artists utilise serigraphy to portray popular culture. In India, renowned artists Krishna Reddy, Laxma Goud, Haran Das, Anupam Sud, Naina Dalal, and many others use traditional mediums such as woodcut, etching, and viscosity.

Today, Computer technology brought us to a new printing era, and many artists adopted digital media. Artists directly take print from digital devices such as inkjet, lesser printers, and offset print to advertise their work to the public. However, several artists work with digital media intervention and the conventional medium. Artist creates their hybrid form of work. Such as computer generate woodcuts, machine engraving plates, photo transfer, microscale print, and many others. Paul Hamilton, a graphic designer and instructor used a combination of linocut, digital printing, and software. Erik Brunvand, a professor of computer science, experimented with Micro-Scale Silicon Printmaking. Computers allow artists to combine traditional printmaking with others as a form of artistic and scientific expression. Sun Xun, one of the emerging artists from China, creates an animation of his sequential woodcut print with the help

of computer software. Maximum manual techniques belong to the subtractive technique. In this 21st century, printing is not limited to the two-dimensional form; it is shifted into a three-dimensional output called 3D print. The thought of printing is not only fixed in 2D vision; it transforms into three dimensions tangible objects. 3D printing is the digital technology-based mechanical process of creating an object with material layer by layer in three-dimension formations. The difference between traditional manufacturing and 3D printing is that the 3D printer involves additive technology, but most traditional processes involve a subtractive approach that includes a combination of grinding, bending, forging, moulding, cutting, gluing, welding and assembling. Charles W. (Chuck)Hull is generally credited with developing the first working robotic 3D printer in 1984, 3D printing has been changing the manufacturing and prototyping industries since the late 1980s, but it was not until 2009 that “desktop” 3D printers were readily available to the public.

### **AIM OF THE STUDY**

- In this paper, the researcher wants to analyse different printing techniques to understand 3D printing inventions and its procedure.
- How 3D printing can use as an artistic medium in the academic studio?
- How does artistic practice differ from commercial manufacturing?

### **METHODOLOGY**

This research followed a systematic review of the literature to learn more about the historical context of 3D printing, artists, and their works. Literature review incorporates a variety of data sources, for example, empirical and research articles, books, and journals. The objective of the systematic review is to provide empirical data that offers an

overview of the artists and their art practice, to identify research gaps, and to answer the research question or hypothesis. By adopting specific and systematic processes for assessing papers and all relevant material, bias may be reduced. As a result, conclusions and judgments can be taken with confidence (Snyder, 2019). In this study, papers are gathered using a systematic review procedure, and their evaluation is done using qualitative methods. This review procedure is often called a systematic qualitative review. The researcher also conducted semi-structured interviews with practicing artists and professors to understand contemporary art practice, possibilities of using 3D technology as an artistic medium, and possibilities to introduce 3D technology in academic practice.

### **NEED AND APPLICATION OF 3D PRINTING**

A new technology or innovation can be evaluated based on its uses and beneficial effects on society and human existence. Professor Andreas Gebhardt and Miranda Fateri have compared 3D printing needs with "Maslow's hierarchy of needs" (Gebhardt, Andreas & Fateri, 2013). According to a hypothesis created by Maslow, our motivation comes from meeting five fundamental needs. These requirements are set down in a hierarchy. Maslow talks about the five basic needs of humans, which are arranged in a hierarchy (Maslow, 2017). The Hierarchy of Needs is as follows:

**Physiological need-** Human's basic physiological needs are food and shelter. In the present scenario, many companies have started to produce 3D-printed food. "Redefine Meat" is a food company that uses 3D printing to generate plant-based meat, and the company claims meat texture and taste like meat (Katsnelson,

2021). Now, a 3D chocolate maker is available on an online merchandise platform. Director of India's National Institute of Food Technology Entrepreneurship and Management C. Anandharamakrishnan and his team created 3D printable chocolate bars which contained different proteins and fibers (Katsnelson, 2021). On the other hand, Architects and city planner engineers have been using 3D printers to create miniature models. Very recently, in India, a startup company Tvasta Manufacturing Solutions has built 3D printed house, which costs 30% less than the conventional construction method (Action, 2021).

**Safety -** The second category of Maslow's pyramid contains safety. Health is the major concern in this section. As 3D printing technology accelerates daily, some recent research and developments have been made on the 3D printer to fix damaged cartilage in knees, noses, and ears through 3D bioprinting. As 3D bioprinting has developed, it now offers a variety of methods for creating tissue, such as inkjet printing, laser-assisted bioprinting, extrusion bioprinting, stereolithography, and many others.

**Self-actualisation -**At the top of Maslow's list of needs is self-actualisation. This section examines education and creativity as two crucial aspects. 3D printer manufacturers have taken up a more direct role in education. Engineering design and architecture students can print out 3D models and prototypes of designs in a short time. Chemistry and biology students can print out 3D models of molecules, cells, organs, or other critical biological organs. Graphic design students can print out a 3D version of their artworks. Using 3D printing as a production method helps students to move from the conceptual idea to producing a physical object which is an advantage for students in learning 3D design. It is easier for pupils to spot design



mistakes to Interrogate a physical object, allowing them to gain valuable problem-solving skills in a creative, hands-on way. Without a design prototype, it would be considerably more difficult for students to identify weaknesses in their designs and improve upon them. Nowadays, many colleges and universities offer 3D printing courses (Gebhardt, Andreas & Fateri, 2013).

Apart from that, many sectors use 3D printing very much. High technology companies related to aerospace and automobile use 3D printing as a prototyping tool. This 3D printing design process has allowed these companies to advance their designs for faster production. Conventional manual processes take a long time to create a prototype from a new design, but now with the help of 3D printing, the design team can have a prototype in their hands for check and testing within hours. Creating a new product involves many iterations of the same design. 3D Printing revolutionised the industry by allowing designers to create, see and touch their designs the next day. Filmmakers depend more on CGI (Computer-Generated Imagery) to create extraordinary images. To generate a realistic approach in a movie, they convert real props objects or 3D software-created models into computer graphics. 3D is the best way to create character models, props, and many more for a lower cost.

### **THE EVOLUTION OF 3D PRINTING IN THE CONTEXT OF THE VISUAL ARTS**

3D printing is still relatively new, with several distinct patterns in its evolution. Very few people in the 3d industry know the apparent relation between visual arts and 3D printing. To develop a visual history of 3D printing, it is necessary to investigate its earliest roots. The early history can be compared to the

development of the coil pot in Neolithic culture (Lesley, n.d.). Coil pot making is an additive process that builds one coil layer by layer until it finishes. This method of making a coil pot by hand is very similar to the fused deposition modeling (FDM) method, in which plastic wire extrudes from a heated nozzle. Now, several different kinds of materials can be used in the FDM process, such as clay, wood, recycled plastic, and many others. Instead of the heated FDM head and plastic, a syringe filled with clay or slip is first replaced by Unfold lab ("Stratigraphic Porcelain," 2012).

In 2001, Joseph Beaman from the University of Texas in Austin traced two methods, topography and photosculpture, which were used from the middle of the nineteenth century to the 1970s. In 1892 Joseph E. Blather patented his method to create a layer-based topographic map. He had created a different layer of topographic maps contour lines on a series of wax plates and arranged them in a manner that allowed them to be assembled into a three-dimensional representation of the landscape. He used wrapping paper, cardboard, or transparent sheet on top of the model to give the landscape an authentic look (Syrkel, 2021). Frenchman Francois Willem designed Photosculpture technology, and he patented it in 1860. There are two different processes he develops to produce Sculpture: mechanical sculpture and photosculpture. Willem came up with the concept of "mechanical sculpture" in 1859. It is a kind of photographically generated sculpture that requires relatively less handwork.

According to the Willem process, a subject or object placed in a circular room took 50 photographs from an equally divided angle. The photographs are developed and traced the contour line on wood with the help of the pantograph tool. At that time, the pantograph was a helpful

tool for tracing one image in a smaller or enlarged form. Each wooden plank is cut vertically, and then cut the contour line with the saw cutter to divide the positive and negative areas. Afterward, the hundred positive half-profile pieces were assembled according to the photographic sequence angle and knotted together. As a result, the 3D form will create. Another way to create a 3D form is by assembling negative wooden pieces, which create a void cylinder form. As a consequence of this, the cylinder might be used as a mould for further casting. The photosculpture process is a little different from Mechanical Sculpture. Firstly, 24 photographs require in this process instead of 50. Secondly, the previously described wooden plank assembly is not necessary. Rather, curving and moulding processes follow. Twenty-four photos were developed as glass-plate negatives instead of positive print. Glass plate negative images project on a translucent screen in an enlarged form. Cut the modeling clay with the help of a pantograph whose second arm has a carving blade or stylus. For that, 24 images were articulated a 360° around the clay. Pantograph must be used multiple times until it creates every minute detail. Finally, carefully smooth the linear junction to make a harmonious form. The finished object is treated as a model. A mould is made from it and cast as many as required with any materials (Sobieszek, 1980). This method took a lot of effort. However, Carlo Baese invented a technique to expose photosensitive gelatin using images and graded light in 1904. As he shot a torso from different angles, he suggested building the relief by stacking gelatin layers. To generate the physical model, the gelatin would expand in proportion to the amount of light it was exposed to (Patent No. 774,549, 1904). Willem's photosculpture process is related to photograph and scan, whereas Carlobaese gelatin is a biopolymer. So,

both processes flow in modern 3D printing in a new way.

The beginnings of modern AM technology can be linked to a stereolithography technique developed by Otto John Munz in 1951. This approach selectively exposes a transparent photo emulsion layer by layer, each layer originating from a different cross-section of the object that will be printed. The three-dimensional representation of the object is contained inside a transparent cylinder. In order to form those layers, a piston is lowered inside a cylinder, adding an appropriate amount of photo emulsion and fixing the solution. Finally, the product etches out or manually cuts from the cylinder (Patent No. 2,775,758, 1956). The process discussed above could be considered a pioneer of modern 3d printing.

1981, a description of a functional photopolymer rapid prototyping system was initially published by Hideo Kodama of the Nagoya Municipal Industrial Research Institute. According to his procedure, a solid model is created by layering a component. Charles Hull patented Stereolithography (SLA) process. He used liquid photopolymer resin as material and UV lasers for solidifying the liquid (Patent No. 4,575,330, 1986). He commercialised this rapid prototyping process, reducing the time to create a 3D model. Because of that, 3D printing has been transforming the manufacturing and prototyping industries. Nevertheless, it was not so widespread until 2009, when the "desktop" 3D printers were readily available to the public.

Founder of Stratasys INC Scott Crump invented Fused Deposition Modelling (FDM) technology and patented it in 1989 (Patent No. 5,121,329, 1989). The selective laser sintering (SLS) technology was invented in 1986 at the University of Texas at Austin and

commercialised in 1992 by DTM Corporation. Various materials such as polymers, ceramics, and metals can be used in this process (Kramschuster & Turng, 2013). Nowadays, 3D printers have developed a lot. Now, it is possible to create one object with multiple materials, enabling components with varied material qualities to be built in different construction sections simultaneously.

### **AN OVERVIEW OF THREE BASIC 3D PRINTING TECHNOLOGIES**

**Stereolithography (SLA):** Charles Hull invented the SLA process in 1986. This process employs a vat of liquid ultraviolet curable photopolymer, called "resin," and an ultraviolet laser to simultaneously build the parts of the layers.

**Fused Deposition Modelling (FDM):** Patented by Stratasys in 1992. FDM technology works as an "additive" principle by applying the material layer by layer. A plastic filament or metal wire supplies material to an extrusion nozzle that can turn the flow on and off. The nozzle heat melts the material and can move in horizontal and vertical directions.

**SLS - Selective laser sintering:** In this technique, high power laser (for example, a carbon dioxide laser) is used to amalgamate tiny particles of ceramic, metal, plastic, or glass dust that form a three-dimensional shape.

### **3D TECHNOLOGY IN FINE ARTS PRACTICE**

"The most interesting and most important technological innovation in the field of design and the field of manufacturing is 3D printing."

Paola Antonelli, curator, Museum of Modern Art (MoMa), MOMA Multimedia.

3D printing has become increasingly widespread in several sectors

in the manufacturing world. Even in fine art, some art practitioners creatively explore computer-aided design technologies. Among them, many are working with a hybrid form of work or interdisciplinary way. German artist Karin Sander has employed 3D scanning and printer in her work. Between 1998 and 2001, he worked on a concept named "people 1: 10". 3D body scanners were used to scan real individuals to create this art piece. The data from the scans was then sent to a fast-prototyping machine, which printed a miniature replica figure. It is a quite automated process where anyone can create a self-portrait (Hoskins, 2018). Artist and researcher Justin Marshall has investigated the significance of using CAD-CAM and rapid prototype technique in craft and design practice. One of his works, "Pouring Bowl," is a research project where he investigates the creative possibilities of 3D CAD and creating rapid prototyping (Walters & Thirkell, 2007). Jeremy Gardiner is a modern British painter who specialises in landscapes and is interested in computer technology. He has resided on the Jurassic coast for several years to investigate ancient history via the medium of his art practice. He employs various media in his work, including sketching, printmaking, painting, and even 3D printing technology ("Virtual Landscapes Made Tangible," 2012). At the same time, American figurative sculptor Rick Becker collaborates with The Centre for Fine Print Research (CFPR) to create a 3D maquette of his work. He received a commission from Vietnam War veterans in San Diego. He traditionally started his work with an initial sketch and clay maquette. However, commission people asked him for an exact replica for their fundraising. He took the help of CFPR to get a small 3D maquette. After, he did little modifications to the print and added plasticine clay where he wanted to build up. Later, he applied faux bronze patina for an accurate

look (Hoskins, 2018). Eminent American sculptor Bruce Beasley is a pioneer artist working with 3D technology since 1987. In 2008, famous software company Autodesk company organised an art show. Along with other artists, Bruce Beasley showcased his work. He used 3ds Max software for the initial structure, and then it was 3D printed. His work series is named Coriolis ("Renowned Sculptor Bruce Beasley Launches Coriolis, a 3D-Printed Art Exhibition at the Autodesk Gallery in San Francisco," 2013). Above mention artist worked with additive 3d technology. However, Sculpture Bridgette Mongeon used CNC mills to build 3d form, a subtractive process. Apart from manual sculpting, he also used Mudbox or Z Brush software for digital drawing and, with the help of a CNC machine, created the real form in foam materials. He adds detailing with clay. Finally, he followed the lost wax process of bronze casting (Mongeon, 2016).

In the present scenario, in India, much research is going on to use 3D printers significantly. In design, architecture, and mechanical engineering fields, 3D printing is one of the important techniques. Although, in fine arts use of 3D printing is very rare. There is no such training in 3D printing in fine arts colleges.

## DISCUSSION

History shows that when new technology is combined with the fine arts, there are several debates or arguments. Firstly, Some Critics argue that computers can be dangerous for human creativity and experience. Heidegger predicts concern that humanity will succumb to technology in ways that endanger humanity's and the planet's future (Heidegger, 1977). Surprisingly, several media debates on 3D printing on the topic of originality and intellectual property. 3D technology is an automatic manufacturing procedure;

software-generated data can create multiple copies of any object. Even when we look into artist Karin Sander's work, she employs automatic scanning and modeling processes. In contrast, the conventional process of creating art requires artistic involvement from beginning to end. So, many can question the artist's integrity and intellectual property because it is easy to produce a digital reproduction by just pressing a button. To counter that argument, the researcher tries to understand different artists' creative working processes and the necessity of 3d technology. As we discussed before, American figurative sculptor Rick Becker process where he used a 3D printed maquette, which helped him to produce a replica of the actual look of his idea. Small replicas helped him understand the required changes before creating the more considerable final work; simultaneously, he saved time. On the contrary, German artist Karin Sander created a miniature form of several human figures in an automatic scanning modeling process. She wants to avoid her influence on human poses. She eschews individual artistic interpretation and the conventional way of creation. However, it might be argued that a large part of the work's impact comes from the enormous quantity of little "people" created in this manner. Whereas American sculptor Bruce Beasley, instead of the stereotype drawing and modeling process, used 3ds Max software for initial structure. In this matter, the researcher can compare it with the modern animation process where animators use software, but it is not hampering the idea and creativity. Only the tool has been changed.

Secondly, the artwork produced by artists using 3D technology is fascinating, and in some cases, the artwork is outright astonishing, but many have asked, "is this art?". Suppose we look into the historical context; whenever artists do not follow the

traditional process of art or do not work with the conventional medium, the conversation repeats. In that matter, the researcher must argue with the help of 'Institutional Theory of Art'. Arthur Coleman Danto, an American art critic, philosopher, and professor at Columbia University said:

"To see something as art requires something the eye cannot descry—an atmosphere of artistic theory, a knowledge of the history of art: an artworld" – Arthur Danto (Danto, 1964)

The notion of "an art world" is a community of artists, art critics, art historians, dealers, curators, and collectors who have good perceptions of art. So, whatever the form develops, something is art if that community recognise and appreciates it as art. Another notable philosopher George Dickie gave his viewpoint on institutional theory based on Arthur Danto's research. He had explained that:

"A work of art in the descriptive sense is (i) an artefact (ii) upon which some society or some sub-group of a society has conferred the status of candidate for appreciation" (Dickie, 1969).

According to him, once work is exhibited for others to view, it is an artefact, and if something is an artefact, it qualifies as art. Secondly, art organisations such as museums and galleries, as well as art intellectuals who are related to that organization, have the authority to determine what is and is not art. Consequently, gallerists and art curators know all the processes of creating art with digital technology. Hence, 3D printed, CNC milled, or even two-dimensional work created with software eventually gets acceptance by curators, critics, and collectors, giving value to a work of art. The Museum of Modern Arts and Design featured the interdisciplinary work of 80 international artists in their 2014 show "Out

of Hand" ("Out of Hand: Materializing the Postdigital," 2014). In 2008, MoMA's exhibit "Design and the Elastic Mind" featured various works using 3D technology ("Design and the Elastic Mind | MoMA," 2008).

### **COMPUTER-AIDED ART PRACTICE IN ART COLLEGES OF INDIA**

The researcher has visited some art colleges and conducted semi-structured interviews with professors and art practitioners to understand current art practice and future possibilities. Art colleges have followed the same curriculum and syllabus for several years. Especially in the printmaking sector still holds only manual printmaking techniques such as woodcut, etching, lithography, and many others. Through those techniques, students are producing quality work. Although after a certain time, students gradually lose interest because the conventional process time consuming and laborious. The conventional process of work and computer-aided technology both together can bring a new way of art practice. According to the conversation with the experts, the researcher understood that introducing computer-aided technology to the fine arts curriculum, appropriate space for each process, and safety majors are very necessary. The Hyderabad-based emerging artist said:

"It should introduce in colleges.... Editing, software. Suppose anyone working on a big woodcut and CNG cutter machine may reduce physical work. But, artists need CNG machine knowledge..... there is a computer base technical gap among the students..... how to render the manual drawing in the machine.....this kind of class is required.....added into the syllabus."

As he said, students must gain a basic understanding of computer-based

technology to consider utilising it in their work. Technology can alleviate physical work and time consumption. Similarly, another artist said:

“If computer-based printing technology such as offset, CNG cutter, 3D printing many other introduced in the academic area can motivate present student or pass out student to work with printmaking area. Also, it will give more opportunity to get an industrial job. For that, students need proper training from an expert person.”

Here the artist has discussed the benefits of technology. Including new technology in the academic curriculum will increase the path of artistic expression, and it can motivate students to experiment more. Simultaneously, it will increase the job opportunity as the industry needs technology knowledgeable people.

“Absolutely required, very important. I am sorry to say..... But the problem is that how it will be apply, it should have a good clear idea. How we can utilise digital techniques.” - Said Santiniketan based professor

Though he has agreed on technology's importance, he is concerned about how it will be applied in work. There is a lacking understanding between making digitally and making manually. An artist should be concerned about selecting appropriate materials and techniques for their artwork. Many art practitioners have a misconception regarding the potential value that differs from making it digitally or manually.

## CONCLUSION

Throughout the study, the researcher wants to find the application of 3D printing and its possibilities in India's academic and artistic practice. The opportunity is significantly less to do computer-aided collaborative artwork

because of a lack of equipment and proper knowledge. 3D technology is an industrial manufacturing tool. However, the literature demonstrates that many internationally recognised artists are experimenting with industrial technology to create their art, which has succeeded to some extent. So, it can open up new creative opportunities for art practice that are not traditionally associated with industrial design and manufacturing. Furthermore, this may result in new synergies, leading to innovative interdisciplinary practice in both the process and outcome. In this study, the literature analysis and expert review's inferences suggest that both traditional and contemporary technologies are crucial for studying fine art.

3D technology has been gradually developing and will reach a mature level. In the future, it might be an important tool for visual arts. In summary, 3D technology has immense possibilities for the future of visual arts.

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Yangshao Funerary Jar (~2500 BC),  
Neolithic period

Image source-  
<https://i.pinimg.com/564x/54/ed/43/54ed431f98632120562c8a1a1982a268.jpg>



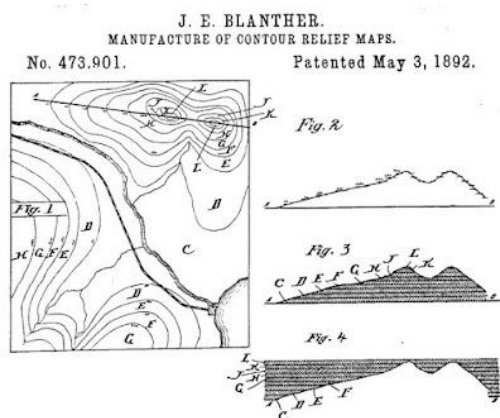
Coil pot creation process

Image source-  
<https://i0.wp.com/ancientpottery.how/wp-content/uploads/2019/06/coil-pot-header.jpg?resize=1024%2C449&ssl=1>



3D printed cup

Image source-  
[https://www.researchgate.net/figure/A-3D-printed-cup-16\\_fig5\\_347087305](https://www.researchgate.net/figure/A-3D-printed-cup-16_fig5_347087305)



Layered method suggested by Blather for  
fabrication of 3D relief maps.  
Image source-  
<https://patentimages.storage.googleapis.com/86/2f/0c/068f23e0fa552c/US473901.pdf>



Photosculpture in Willeme studio Image  
source- [https://4.bp.blogspot.com/-U987if3-8qQ/WuBZ-2TyZ0I/AAAAAAAAAI/\\_NGZ0th0WswH97f0gO2WVf03Jy2-M6LwCK4BGAYYCw/s400/2018-04-25\\_16-05-11.jpg](https://4.bp.blogspot.com/-U987if3-8qQ/WuBZ-2TyZ0I/AAAAAAAAAI/_NGZ0th0WswH97f0gO2WVf03Jy2-M6LwCK4BGAYYCw/s400/2018-04-25_16-05-11.jpg)



Willeme, untitled mechanically  
produced bust, ca. 1859-1861, oak and  
twine. Rochester, George Eastman  
House Museum (GEH)  
Image source-  
<https://scholarworks.iu.edu/journals/index.php/artifact/article/view/3906>



Photosculpture Pantograph tool  
Image source-  
[https://youtu.be/jS\\_rcwG9mxU](https://youtu.be/jS_rcwG9mxU)

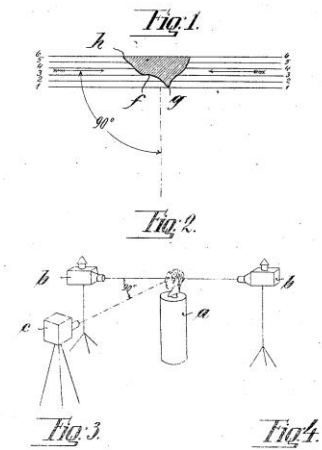
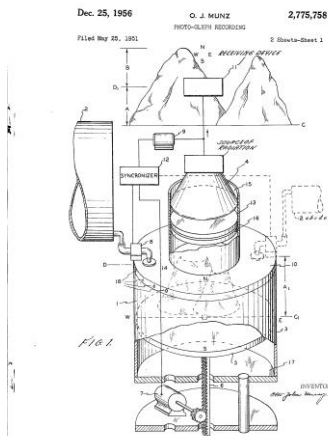
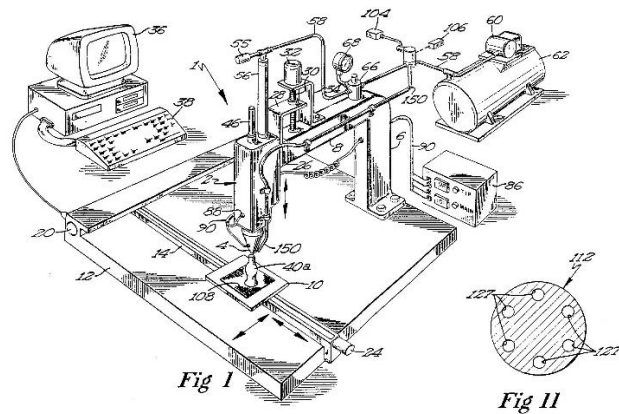


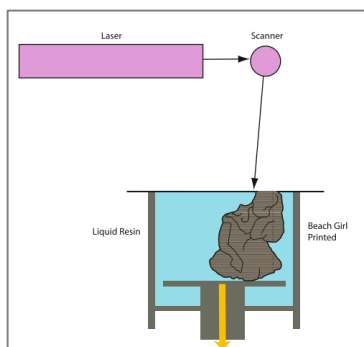
Diagram of Photographic process  
for the reproduction of plastic  
objects by Carlo Baese.  
Image source-  
<https://patents.google.com/patent/US774549A/en>



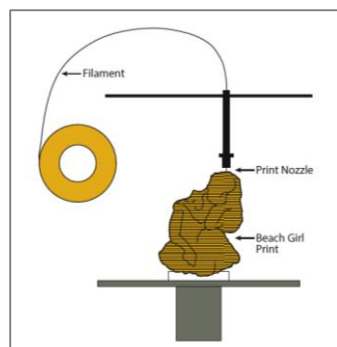
Technique suggested by Munz in  
1951 for photosculpture.  
Image source-  
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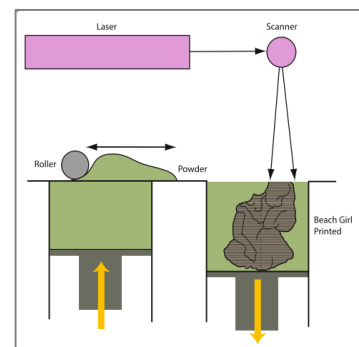
Scott crump proposed diagram, FDM  
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<https://patentimages.storage.googleapis.com/21/01/d3/69165ba25d15e0/US5121329.pdf>



**Stereolithography**



**Fused Deposition Modelling**



**Selective laser sintering**

Image source- 3D technology In Fine Art And Craft' book by Mongeon, Bridgette

# In Between Threads & Knots: Understanding Unconventional Art Practice in Indian Contemporary Art

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## Abstract

In India, various artistic traditions are categorized as folk art and crafts because of their functional characteristics and presence in mundane life. But these traditions are not bereft of any artistic sensibilities. Hence, it is important to understand these traditions in the context of art and their intrinsic connection with society. Traditions that involve embroidery or macramé are very commonly found in Indian households as they often decorate an interior or a person with garments and accessories. However, mainstream art has often neglected these traditions, where they were never seen as a medium or material to be explored in modern and contemporary art practice. This paper intends to look at two artists who have extensively explored the material of naturally dyed hemp and thread-based experimentations. It is with the elaborated discussion of Mrinalini Mukherjee and Sumakshi Singh that the paper will try to understand the implications and applications of embroidery and knotting in the context of modern and contemporary art in India. Sumakshi Singh's almost translucent gossamer thread-based works inhabit space. They are capable of creating layered interactions with audiences where ideas of migration, bio-diversity, space-time continuum and many other concepts are addressed. At the same time, Mrinalini Mukherjee has been able to create a language that challenges the conventional idea of sculptural practice. Her large-scale natural fiber-based works cannot be compartmentalized within any box of textile, sculpture, or installation but rather combine all and create a distinctive identity of their own. The objective of this paper is to navigate through all these elements and create a constructive idea not only about contemporary art practice but also about art and craft from a social and historical perspective.

**Keywords-** Unconventional, thread-based, installation, craft, fiber-based art.

## INTRODUCTION

It is a fact that there are intertwining of multiple traditions, cultural contexts, as well as locales, play an important role in the artistic practice of modern and contemporary art. The understanding of the material and its application is significant for an artistic outcome. Multiple reasons enable an artist to choose a particular medium over others. Often these mediums are used in an individualistic manner and hone a new identity than the usual one. It is this process of adapting a new medium and expressing it through the individual language that the researcher is interested in pondering.

In the academic curriculum, there are certain mediums and materials that are often taught to use to the students but it is those students who later on develop their

individualistic language that explores and adapt different media that becomes an integral part of the artistic expression. In India, modernism and the initial academic curriculum are borrowed from the colonial system as they established art schools to create efficient draughtsmen who will be able to document Indian geography, people, and historical monuments for creating a better understanding of the vast and diverse Indian society and its people.

In the colonial period there was clear agenda behind the establishment of 'Academies of Fine Arts' and 'School of Design'. The concept behind developing art education in India in the colonial period is quite clearly explained by the art historian Tapati Guha Thakurta, "The Government school of Art, Calcutta was caught within the dual, often contrary

priorities of British art-education schemes in India- between its self-avowed mission of inculcating the 'right' taste of art in Indians, and its practical concerns with providing them with some useful and employable skills." (Thakurta,1992,p.57) The motive behind creating a taste suitable enough to cater the art of the west as well as creating artists with skills and aesthetics principles that are clones of the west. Thakurta refers to the 'Arts and Crafts movement' in Britain lead by the likes of William Morris, that had its effect in the education policy of the British ruler in India. As the prioritisation of industrial design and craftsmanship gained a importance the art education steered more towards creating understanding the skills and aesthetical principles required to make industrial designing. " The scheme of art instruction in India showed much of the same priorities, with the attention squarely focused on the industrial and ornamental arts- 'the lesser arts' as opposed to the 'higher arts'. The differentiation between 'fine' and 'industrial arts' acquired however, new colonial overtones in Indian contexts." (Thakurta,1992,p.58).

The beginning of art education in the colonial period had its agendas that focused more on creating skilled draughtsmen who will able to cater to the requirements of the patrons of the colonial period. The establishment of the art school represented the 'useful knowledge' of the Victorian era that wanted to train artists with skills that are technical and functional in nature, where conceptual understanding was triumphed by perceptual observations of the academic education of the Victorian era. English art instruction was very different from the conventional Indian apprenticeship. Additionally, there were pronounced distinctions between European and Indian artistic processes. An art school's approach was more formal than that of a master and his pupil. The

distinction between a conceptual and perceptual one, which continuously amends the initial formula through observation, is how they are best articulated. For instance, the traditional Indian painting begins with an outline sketch or stencil, which is then colored without making any significant changes. Conversely, a western painting or drawing constantly modifies the initial schema in an effort to create a three-dimensional depiction of the subject. (Mitter,1994, p.30).

From the development of colonial art education to the challenges posed by the like of Abanindranath Tagore, E. B. Havell, and Ananda Coomaraswamy. Indian art education has gone through significant changes via different avenues that have changed the course of Indian art distinctively. The understanding of modernism is also different than that of the west as it is not linear but has vital ruptures and junctures that make the discourse critical and contextual in nature. "In the West the history of modernism is primarily conceived as the history of the avant-garde. Such conflation of the modern and avant-garde, however, will not help us to understand the historical logic or dynamics of non-western modernisms such as India's." write R.Siva Kumar (Kumar,1999,p.14). The articulation of R. Siva Kumar has helped to create a new understanding of the modern art practice in India which has multiple avenues dissecting and bifurcating each other. It gave Indian artists means of asserting their modernist identity while also inspiring them to take another look at their traditional ancestry. Initially, colonialism and subsequently the continued existence of traditional arts and their support systems alongside industrialization in the postcolonial period provided these artists with an intellectual and experiential grounding for extending the principles and

languages of traditional and modern arts into one another as part of their modernist aim. Indian artists did not feel pressured to dedicate themselves to a linear model of progress and fight their way to the forefront of history since the traditional/modernist division was not as stark as in the west. As a result, their approach to modernism evolved to be eclectic rather than aggressively distinctive. (Kumar, 1999,p.14)

The point at which this discussion has arrived is a crucial juncture, the art education and the discourse of modernity play an important role in the forthcoming discussion where the paper will look into the works of Mrinalini Mukherjee and Sumakshi Singh, who belong to two different eras and generation and has a distinctive practice of their own yet their practice contributes in a great extent to the understanding of modern and contemporary art in India as well as the position of women artists in the context of working in unconventional material since the 1960s to contemporary times.

#### Unfurling the Knots: Understanding the Works of Mrinalini Mukherjee

“That in Mrinalini’s hand sculpted object (in hemp-fiber, clay/ceramic and bronze) was crafted not only with formal integrity but with integral intelligence. To reiterate: she had internalised the various histories of the concept ‘form’ and with it a morphological principle suitable to her purpose; she had understood the modernist canon and, with it, the way an art object cathect.” (Kapur, 2015,p.26-27)

What Geeta Kapur points out about the formal integrity combined with the conceptual embodiment in the works of Mrinalini Mukherjee is crucial to understand not only how modernism was embodied in the art practices in India but also how art education has contributed to it. The monumental hemp-fiber sculptures

of Mrinalini have a dominating presence of their own, which not only in their physical form but also through their spatial dynamics represents a language that is innovative and individual in its own right.

The pupil of K.G. Subramnayan another significant personality in the postcolonial era, studied under the tutelage of Benode Behari Mukherjee, another important figure in modern art and art education in India, who was also Mrinalini’s father. The education that M.S. University of Baroda offered through the teachings of Subramanyan played an important role where she was able to adapt craft (a term that often creates a hierarchy between art and other artisan traditions) in her work where the blurring of the hierarchic notion of material and process started to emerge as an important praxis that can be located in her work in a great extent. In her postgraduation years, she started to explore macramé and other natural fiber as a medium that is often used for decorative purposes. Mrinalini Mukherjee started to explore the material for making murals (which was her postgraduation specialization) distinct from conventional mural and textile art. Macramé was popular material used for decorative purposes but it was manipulated and structured peculiarly by Mukherjee, who was able to give it an architectural dimension through intricate knotting that created complex folds shaping a monumental body that has its dominating presence in a space.

Her training in the mural department in Baroda was channelized differently through her engagement with fiber-based sculpture that were malleable and fragile in nature but flexible and offered an opportunity to go beyond the boundaries of conventional materials practiced by other artists of that period. “Despite affinities with fiber art, Mukherjee as Kapur points out, devised her own

“indigenous” approach to material process and form, which in certain respect deviates from the main tenets of the movement-including her use of intense and varied colour. She favoured synthetic dyes, whereas in the fiber art mainstream there is a tendency towards monochrome, the natural colour of the materials themselves; Shiela Hicks, for whom colour is major component, is one of the exceptions.” (Watson,2019,p.118)

Nonchalantly Mukherjee pursued her practice that had playfulness of both forms and decorativeness that often was downplayed by many contemporary fiber artists of her time. She was able to bridge the gap between the functional nature and process of a medium and its creative outcome. The intricacies of the process played a major role in the out of her work. She was often photographed with her works hanging from the ceiling creating a monumentality and spatial character that brought the intention of the artist where it defies the conventions and spatial dynamics of a fiber work/sculpture.

She refuted any compartmentalization of her work as well as attributing any iconographic character to the sculptures, yet the sculpture often had titles that has vernacular references related to mythology and other poetic resources. Yakshi, Van-raja, and Nag-Devta are some of the well-known works that have references related to Indian mythology. The transformation of the fiber sculptures from being wall based to ceiling-hanging in the round sculptures have not only physical transformation but also conceptual and spatial transformation. Santo Dutta has commented on this transformation as, “what could have ended as wall-hangings, tame and hugging the wall surface, has now assumed sculptural forms in the round opening up like gigantic flowers.” (Dutta, 1985). Her works started to become morphologically protean with

their complex structures of knotted and pleaded hemp fibers that have a sense of endlessness just like nature itself. Her art is the result of her brilliant sense of spontaneity and intuitiveness; without any preliminary sketches, the forms in her work express a spiritual, “deconventionalized,” and “personal” story and imagery that transcends any traditional artistic trajectory and also adds to the work’s intrigue and cerebral quality. She never attempted to imitate the anthropomorphic or conventional iconographic shapes seen in mythical literature. Yet her sources were often the ancient texts as well as a large collection of photographs that she and her husband had documented while traveling to various historical sites in India. There is no direct transaction of such documentation of readings but it is her cerebral and intuitive embodiment of these imageries and texts that reflects in her work.

A shared experience that allows for communication is historical memory. Mukherjee’s work avoids narrativity in favour of a poetic abstraction that emerges via a rich language of both art and design, drawing inspiration from the fundamental principles that have guided the creation of art in India and around the world. (Ahuja,2019, p.113) A work like Vriksh Nata/Arboreal Enactment (1991-92) is a significant work, that carries Mukherjee’s core spirit and ideas that made her work distinctive from any other fiber-based practice. The way she inhabits a ‘hybrid modernist’ (Anant,2019, p.237) form combined with a sense of theatricality in the arrangement and figuration ( the word here is used to connote the human-like quality embodied in this work of art) of the forms talks about a language that is protean with metaphorical meanings as well as replete with procedural complexities. Here, to understand the complexities of the process and the idea of

this work, Estelle Barrett's understanding of 'aesthetic image' is helpful to articulate the practice more deeply. "...what I call the "aesthetic image", a structural aspect of the artwork that emerges as an outcome of the grafting of affect to the symbolic through artistic practice. Unlike images that operate via established symbolic codes and that serve to communicate information, the aesthetic image is "performative"; it emerges through sensory processes and gives rise to multiplicity, ambiguity and indeterminacy. Out of this meanings that fall beyond the codes of a given sign system (visual or verbal) may be accessed." (Berrett,2016, p.63)

In Vriksh Nata, there is a gesture that is reminiscent of any humanized posture a kind of frozen moment is created through the spatial dynamics of the sculptural group. The 'performance' of the aesthetic image as explained by Barrett can be found here in this work. Where the viewer encounters the work with not only visual senses but physical interaction is also at play that enhances the sensorial communication between the beholder and the work. There is a subtle play of ambiguity in the forms as they are reminiscent of trees and plants forms at the same time a playfulness can also be located in the way they stand and create an invisible communication with each other. It is not only in the group sculptures but also in sculptures like Purush (1980) and Rudra (1982) has a presence that inhabits a space with a certain sense of emotions may that be pathos or anger. In the first work, Purush lies on the ground almost like a human figure though no distinctive human figural features can be traced. The knotted folds move inward and outward creating a structure that may seem like a reclining figure. A vegetal growth with a humanized posture that is reminiscent of the ancient Greek Sculpture of the Dying Gaul.

In the work monumental work of Rudra, a different feeling is generated, a sense of intimidation and monumental presence that pervades even the space around the sculpture. The way Mukherjee creates the intricate, intertwined structure of her works as well as the color that she chooses to use has the 'aesthetic image' that evokes a certain sensibility in the viewer. Her work would be seen by some as operating too much like a theatrical stage since it encouraged a participatory and performative exhibition approach. However, a small number of critics praised her sculptures for being revolutionary in terms of both their amazing craftsmanship and enormous size. They expanded the ways in which one might perceive and consider the body in space through their architectural designs. (Terracciano, 2020, p.8)

Mrinalini Mukherjee was able to create a language that had modernist idiom but did not entirely dependent on the modernist tropes of artistic language, in a period when narrative painting and an urge to be at par with international modernism, Mukherjee paved her path that on one hand was reflective of the international fiber-art trend but on the other hand created a language that had its individuality, that didn't shy away from adapting decorative and functional aesthetics of fiber based art practice contrary to the western fiber-artists. Throughout the discussion, it is clear that her work was unique in its merit defied many conventions both of academic as well as international trends, and was able to create a practice that was rooted in its context and indigeneity.

Her vibrant presence in the art scene of India from the 1960s to 1990s is often recalled in the writings of her peers and contemporary art critics, but it is also a fact that her art practice did not create any trends in the contemporary of that period.

She was a lone practitioner who developed her praxis that involved great dedication and strong reservation towards any categorization in the feminist art discourse or any such compartmentalization. But in her work, she developed a language that challenged the conventional idea of labor attached to masculinity and the attachment of feminine quality to fiber-based art practice or such thread-based work. Through her resistance to feminist discourse, she had created a process that involved women craftsmen contrary to the male weavers that are often found in weaving traditions of the country. Her practice often created paradoxes while resisting any feminist reading and being perturbed with the idea of being relevant in the post-modern time with modernist practice her works play a significant role in creating a junction between the changing practice and idea of art from the 1990s onwards where the social, economic, political changes had its subtle influence in the changing concept of art from modernist era to post-modernist art. "...she had understood the modernist canon and, with it, the way an art object cathects anthropological and linguistic features. So while she was far removed from the exclusivist regime of art theory that abuts modernist principles and contemporary art with disjunctive force, she arrived at contemporaneity by adducing, instead, an anachronistic mode. This made her, paradoxically, an artist of her time and place." (Kapur, 2015, p. 26, 27)

#### Embodying Memory, Navigating Space: Reading Works of Sumakshi Singh

The knotted sculptures of Mrinalini Mukherjee and the delicate skeletal thread work of Sumakshi Singh are distinctive in their appearance as well as in their process but share a common ground of exploring craft and extending the meaning and application in a new way. Sumakshi and Mrinalini are generations apart but

there is a common vigor and dedication to create a language that is not only individual but also addresses the contemporary understanding of one's own time and space. The gossamer and delicate embroidery seen in Sumakshi's works come out from the process of dealing with grief, death, memory, and space. It started from her childhood memory of her grandmother's and mother's embroidery activity which later matured into a practice that created a connection with her departed loved ones. Her mother an accomplished embroiderer became a source of inspiration when she started to unravel the memories and stories through the letters written to her when she was in Chicago. The letters being a portal to relive the memories of her mother soon started to appear in her work as embroidered words on the fabric, but it did not seem to satisfy the need of the artist who was looking beyond the mere depiction of her mother's letters. "...I kind of discovered half way through this process was that when you are embroidering something that it feels much more permanent rather than, if you are drawing it, you can rub out your drawing. But with embroidery it's like the image that you're creating is literally tied to this ground fabric in and out, like it is stuck to it and it feels so static and I think part of it was that impulse to want to kind of fix her words inside me, like they wouldn't move. But very strangely after I got done embroidering that letter it felt like those words were almost protesting being stuck like this, like they didn't like it. So you know, I was like okay! that's surprising and so what do I need to do here so then I started to embroider it on transparent fabric but even that felt to rigid and then I finally came up with this process, where I could dissolve the fabric altogether, so basically it's just the words and then the fabric is dissolved and what you're left with are these levitating words and that is what it felt like it wanted this kind of freedom in this kind of



space, this kind of weightlessness.” (S.Singh, personal communication, April 22, 2022)

Sumkashi Singh's works come out from her personal experience but can transcend into an interactive space that not only inhabits the architecture but also navigates deeper into the idea of the ephemerality of time and reality that one exists. The gossamer character of her work envelops a space in a manner that creates a layer that transforms the architecture into a different dimension. The delicate levitating threadworks can also be seen as that translucent layer between the present and the distant memory/past. The way she uses light in her installations is very strategic as they often tend to create an enigmatic space where the viewer could engage with the work creating a silent conversation with the space and the works. The fragile yet minute depiction of botanical and architectural forms create a sensory understanding of the intangibility of material existence.

The medium and technique used to create the piece represent the transience of existence in the space-time continuum. The artist can create a permeable place that is replete with the memories and histories of the people and lives associated with it by releasing the needlework from its ground(fabric). Through groundless stitching, Singh departs from the standard embroidery technique and develops a language that transcends the typical interpretation of the drawing. Singh's installations can be read as spatial drawings that suggests certain connection with a space but not restricted by it. (Bhowmik,2022,p.4,5) One of her significant thread-based installations is the *A Blueprint of Before and After* (2018), an interactive work where the viewer encounters an enigmatic garden made out of embroidery but without any attachment of fabric, as they float all across the space

unperturbed by human presence with a world of their own. The garden is made with skeletal forms that resonate a memory of a garden that once was. The sprouting, undisturbed growth of botanical forms scattered all across the gallery space is not manicured or structured rather it grows in its way where the human is invited to experience rather than intervene into the space. The fragility and intangibility of the botanical forms often recall the flowers and leaves kept inside a book or an envelope in memory of the giver of that flower, after a certain time turns brittle and disappears into the continuum of time, but its essence, its absence is archived inside that book or an envelope through the stains, marks that it leaves behind. The botanical forms are reminiscent of such memories that once enriched or brutalized the heart of someone but in the grand scheme of life, it gets lost somewhere. There are certain forms that ask the viewer to experience it, yet in reality, these plants, shrubs, weeds, and grasses are often overlooked. Singh tries to create an experience that takes the viewer on a journey of understanding the minuscule, the unobserved in a manner that is not only meditative as a practice but also ontological in its nature.

Her fascination with the unobserved, with noticing the minute details of the reality in which she exists, has led her to create a language that embodies the central concept of life and its ephemerality. The temporal nature of life and existence, where nothing is permanent in the grand scheme of time, yet humans try to preserve and archive memories, moments, and elements that cease to exist. In the work *Leaving the Terrestrial: Its own Kind of Archive*, Singh has created an archival space of varied spices of the botanical and marine world, suggesting the biodiversity of nature as well as how it is slowly disappearing from the world for multiple reasons. The glass vitrines and

walls replete with such organic forms made out of translucent, skeletal, groundless threadwork suggest an incorporeal world that only exists in the rumination of the past. She was able to transform a space into an ethereal world where even the miniscule, unobserved microcosms share an equally significant space beside the dominating presence of the intricate and delicate pieces, Black Coral. The sandwiched morphological forms inside the glass vitrines create a sense of a weightless body that may have disappeared from existence, but its fragmented skeletal memory is preserved in the wide spectrum of natural history.

### CONCLUSION

It is evident that the art practises of both artists have been able to create a knowledge system that has academic training as well as individual, conceptual, and technological understanding. The exploration of unconventional materials and processes has created new ways to develop a language that is not only distinct but also responsive to its contemporary time. On one hand Mrinalini derived her fiber-based practise from her praxis of mural and macrame-based techniques, but at the same time, her works connote modernist syntaxes with a seasoned understanding of folk and mythological concepts. On the other hand, Sumakshi Singh employs embroidery in a manner that totally changes the perception and functionality of the craft. By removing the ground and making it levitating, it plays with the idea of space and reality. It counters the rigid concept of space and materiality and permeates it with ethereal forms that create a new understanding of life and reality.

Both Mukherjee and Singh were able to create a practice that is spatial as well as conceptual in nature. On one hand Mukherjee's forms are monumental and

complex and on the other hand Singh's forms are ephemeral and almost invisible in character, where lights, vitrines, constructional frames, spatial dimensions plays a significant role in experiencing the work. From another perspective both the artists have been able to break the rigid understanding of craft and its process in their own way. Mrinalini employing women craftsmen to process the fiber and help her create the intricate knotted structure, where the notion of femininity is apparent but at the same time, she occupies the male dominated spatial dynamics of architecture, where her works changes any space with its presence may that be a wall or from the ceiling. The domesticated and often feminized medium of macramé transformed into powerful sculptural idiom that broke any boundaries of gender classification.

Sumakshi Singh's process is tenacious and delicate in nature. She has devised the process of conventional embroidery into a groundless threadwork that helps her to create objects that are permeable but at the same time potent with ontological understanding. It is interesting to find that the status of gender employment in the artistic process has changed in certain ways. With Mrinalini it was the women who had worked as craftsmen for the realisation of her fiber-based sculptural project, when weaving and dying of textiles in the craft sector were primarily done by men. Whereas in Sumakshi Singh's embroidery process, it is the men who are employed to help in the delicate process of her work, while in the craft sector, women are primarily employed for stitching in various embroidery traditions like Kantha, Chikankari, and many others. From the sociological perspective, this engagement of men and women in such artistic processes is important for the wider spread of awareness of modern and contemporary

aesthetic principles as well as going beyond the confines of gender roles in craft and artistic traditions that both artists have been able to address in their practice.

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**Image 1: Squirrel (one of the earliest fiber work), hemp,jute,cotton,sisal, bamboo and carpet brush, 1972**



**Image 2: Work in Progress on a large scale Mural for Mahatma Gandhi Institute, Mauritius, 1976**



**Image 3: Nag Devta, Dyed Hemp, 1979**



**Image 4: Yakshi, Dyed Hemp,1984**



**Image 5: Vriksh Nata (Arboreal Enactment),  
Dyed hemp, 1991-92**



**Image 6: Purush, Natural and  
dyed hemp, 1980**

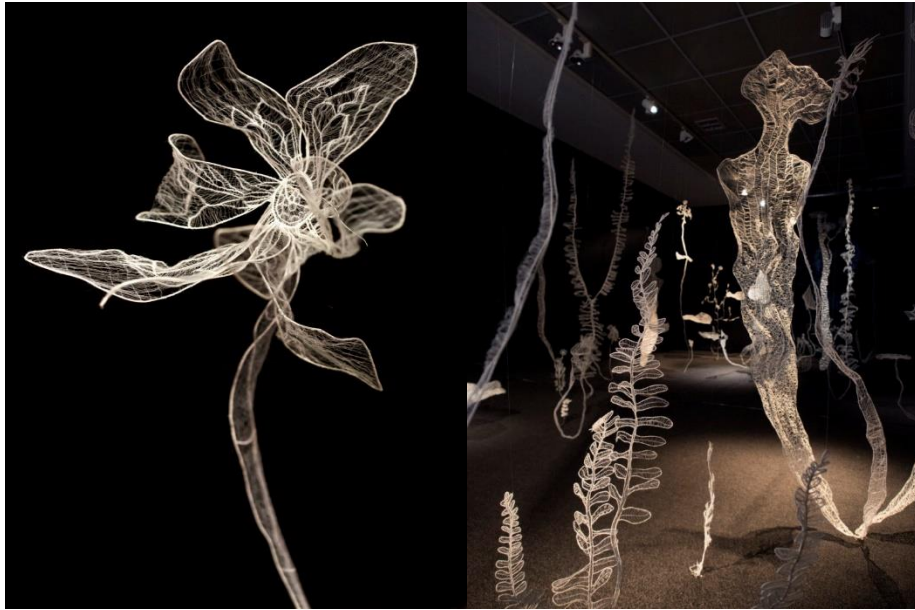


**Image 7: Rudra, dyed hemp, 1982**

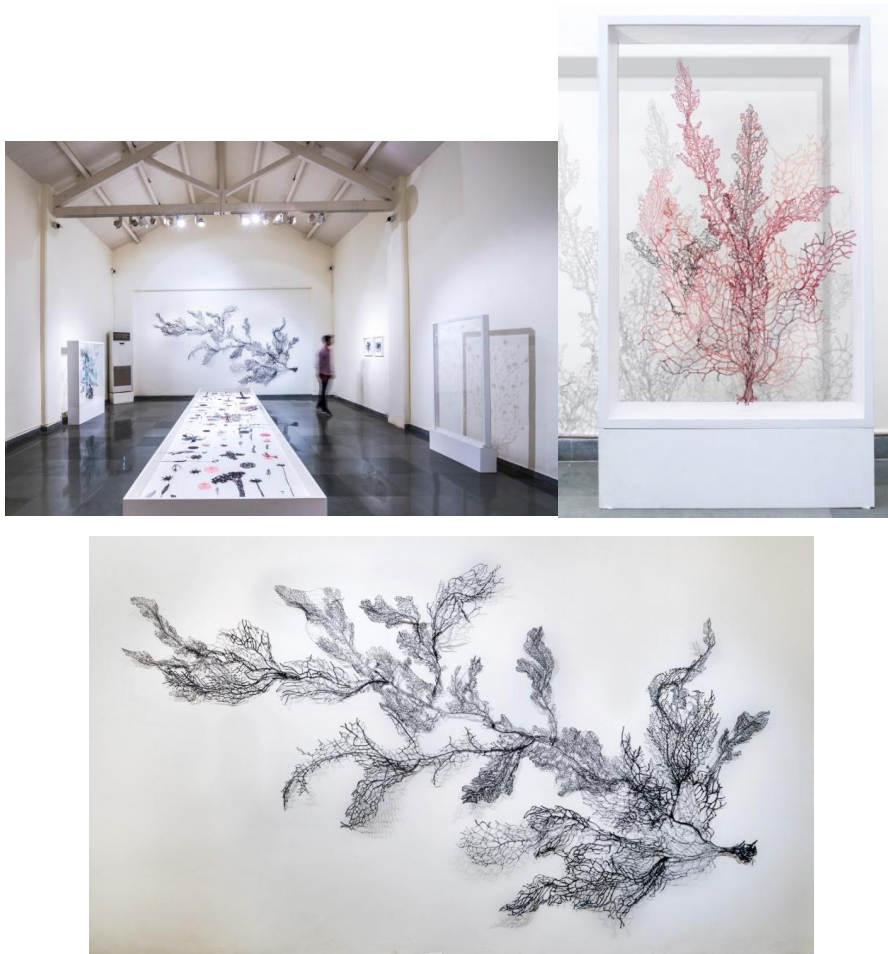


**Image 8: A Blueprint of Before and After, Thread and Wire Room, 2018**





**Image 9,10: Details of A Blueprint of Before and After, Thread and Wire, 2018**



**Image 11,12,13: Leaving the Terrestrial: Its own Kind of Archive, Thread and Wire, 2017**

## An Improved Otsu Method for Enhanced Image Segmentation with Reduced Thresholding for Target Identification

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### Abstract

OTSU is the method used for segmenting the object from the image background. Otsu method converts the image into the background and the foreground based on the threshold value. The Otsu technique is incapable of segmenting pictures having a unimodal histogram distribution because the Otsu threshold equals the mean of two classes' mean levels divided by the threshold value. In this research study, an improved Otsu approach based on weighted background variance is proposed. Parameter " $\omega$ " is weighted in the background variance to adjust the between-class variance and meet the desired threshold value. Because the threshold is primarily determined by the target object variance, the parameter " $\omega$ " spans from 0 to 1. For boundaries detection of the target, Laplacian of Gaussian operator is used. The research is validated using the experimental results of an improved Otsu method. The results are also compared with the other methods such as the basic Otsu method, Gaussian Otsu, weighted object variance (WOV) and recursive Otsu method. The elapsed time for the proposed method is 0.0139 seconds which is 0.2623 seconds faster than that of the WOVS method and 0.768 seconds faster than that of Gaussian Otsu. To test the method in the presence of noise, salt and pepper noise with variance 9 is affixed. The proposed method provides better image segmentation with an accuracy of 95.46% for detecting the target object.

**Keywords:** Otsu Thresholding, Object identification, Machine vision, Image segmentation

### INTRODUCTION

Image thresholding is performed using the Otsu method, which is named after Nobuyuki Otsu. The Otsu method computes a single threshold for intensity; this threshold divides pixels into two groups, foreground and background. The threshold is defined by maximizing the matrix called inter-class variance or minimizing the matrix intra-class variance. The Otsu approach is done differently, using just the zeroth and first-order cumulative moments of the grey level histogram, and is nonparametric and unsupervised in its threshold determination [1]. The thresholding techniques are classified based on the information they use, such as histogram shape, measurement space clustering, entropy, object properties, spatial correlation, and local grey surface [15]. The Otsu thresholding technique in two dimensions seems to be a significant improvement over

the original Otsu. The 2D histogram is projected onto a diagonal to create a 1D histogram with a clear distribution of peaks and valleys. The approach is applied vertically to the diagonal to determine the appropriate threshold value [2]. Introducing the recursive Otsu thresholding approach, where the set of background pixels obtained by regular Otsu thresholding are re-thresholded to extract more information. This may be repeated until the resultant array of foreground or background pixels is empty [3]. A thresholding system based on vision involves image capture, image processing, and binarization. It succeeds when the picture histogram is bimodal but fails when it is unimodal or almost unimodal. The Otsu approach achieves a successful segmentation when the item and picture backdrop have a comparable variance in size; however, the method fails when the object and image background have a bigger size difference.

The shuffled frog-leaping algorithm (SFLA) is a recently developed memetic meta-heuristic algorithm with strong global search capabilities. The update rule is meant to increase the duration of each frog's jump by simulating the frog's perception and action uncertainty [4]. However, the three dimensional (3-D) Otsu is very time-consuming and cannot be used for real-time application. Gaussian Otsu's approach is an expansion of Otsu's method, and it employs the greatest between-class variance as an ideal threshold. Experimental research on the Otsu and Gaussian Otsu thresholding algorithms may be found in the published literature [5]. In a segmentation method for images by reducing the threshold selection range and looking for the smallest variance ratio, the algorithm chooses the ideal threshold [6]. The modified two-stage multi-threshold Otsu (TSMO) produces the same set of thresholds as traditional Otsu. Furthermore, efficient histogram-based valley estimates are created for estimating an image's optimal number of clusters [7]. In the literature, a thorough examination of picture thresholding algorithms, their formulae in uniform notation, and performance comparison is done [9]. To avoid the issue of erroneous defect identification, the weighted object variance approach is utilised to examine defects; a parameter is weighted on the object variance while the background variance remains intact [6]. The Otsu approach is incapable of segmenting pictures having a unimodal histogram distribution because the Otsu threshold is equivalent to the average of the mean levels of two classes divided by this threshold [10].

A novel unsupervised approach for the identification of fractures on 2D pavement images using a grey-based histogram and Otsu's thresholding method. Initially, the approach separates the input picture into four independent subimages of

equal size. The search for fractures is then based on the ratio between Otsu's threshold and the largest histogram value in each sub-image[14].

This study formulates an effective thresholding method, called weighted background variance, by examining the challenges in Otsu and the enhanced Otsu methods (WBV). This research's contributions are summarised as follows:

- (1) An Improved Otsu method is formulated, in which a parameter is compounded on the background between-class variance. On recursive testing and experimentation, the value of the parameter is found to be 0.5572 multiplied by background between-class variance. It safeguards that the value of the threshold must be calculated mainly by the object variance.
- (2) NLoG (negative Laplacian of Gaussian) is used to detect the object's boundaries and features for the detection. The results are tested by adding salt and paper noise to the image.

The cogency of the method is endorsed by various image results. The results are verified and compared with the Gaussian Otsu [5] and the WOV method [6].

The remainder of the text is structured as follows: Section 2 explains the Gaussian Otsu and the WOV. The third section clarifies the mathematical model of the proposed enhanced Otsu. In section 4, the experimental results and a comparison of these three methods are presented. In section 5, the conclusion and future study are described.



## GAUSSIAN OTSU AND WEIGHTED OBJECT VARIANCE METHOD

### Gaussian Otsu Technique

OTSU is the method used for segmenting the object from the image background. Otsu method converts the image into the background and the foreground based on the threshold value. It gives a satisfactory result when the image histogram is bimodal but fails when the image histogram closes to unimodal. The Gaussian Otsu method processes the input image, obtains the image histogram (distribution of pixels), computes the threshold value, and segments the image into a binary image using the calculated threshold. In 1979, Otsu suggested a method for selecting dynamic thresholds. To calculate the best threshold, this technique maximises the weighted sum of between-class variances of foreground and background pixels.

We can partition the image into two classes  $W_1$  and  $W_2$  at grey  $T$ . such that,  $W_1 = \{0, 1, 2, \dots, T\}$  and  $W_2 = \{T+1, T+2, \dots, L-1\}$ , where  $L$  is the total number of the gray levels of the image. The pixel at the  $i$  grey level be  $n_i$ , and  $N = \sum_{i=0}^n n_i$  be the total number of pixels in a given image. The probability of occurrence of grey level  $i$  is defined as

$$p_i = \frac{n_i}{N}, p_i \geq 0, \sum_{i=0}^n p_i = 1 \quad (1)$$

$W_1$  and  $W_2$  are normally corresponding to the object of interest and the background, the probabilities of the two classes are

$$P_{w1} = \sum_{i=0}^T p_i \text{ and } P_{w2} = \sum_{i=T+1}^{L-1} p_i = 1 - P_{w1} \quad (2)$$

The means of the classes  $W_1$  and  $W_2$  can be computed as:

$$\mu_{w1} = \sum_{i=0}^T \frac{i * p_i}{P_{w1}} \quad (3)$$

$$\mu_{w2} = \sum_{i=T+1}^{L-1} \frac{i * p_i}{P_{w2}} \quad (4)$$

So we can get the equivalent variance formula:

$$\sigma^2(T) = P_{w1} P_{w2} (\mu_{w2} - \mu_{w1})^2 \quad (5)$$

The optimal threshold  $T^*$  can be obtained by maximizing between-class-and class variance.

$$T^* = \text{Arg max } \sigma^2(T) \quad (6)$$

The Otsu approach is incapable of segmenting pictures having a unimodal histogram distribution because the Otsu threshold is equivalent to the average of the mean levels of two classes divided by this threshold. [10]. The Otsu thresholding method is explained in figure 1.

### Weighted object variance method (WOV)

The segmentation of defect-free images is disregarded. Most thresholding approaches can accurately distinguish defects from their backgrounds, but they incorrectly infer that a defect-free picture is the best image. Typically, the object area is much smaller than the backdrop region. Therefore, the ideal threshold should be near a low grey level relative to the Otsu threshold. The Otsu threshold  $TH = (u_0(t) + u_1(t))/2$  makes the object and background have a similar size. The desired threshold should keep the probability of the object at a small value or even equal to 0. To get the desired threshold, the first term (the object variance) should contribute less to the between-class variance, and the threshold should be mainly decided by the second term (the background variance). The first term in OTSU Eq7.  $P_{w1}(t)(u_{w1}(t))^2$ , is defined as the object variance and the second term  $P_{w2}(t)(u_{w2}(t))^2$  is the background variance [6].

A parameter with a range of 0 to 1 may be weighted on the first term while the second term remains constant. The weighted object variance is equal to the original object variance multiplied by  $\omega$ . The formula can be written as follows.

$$Y_b(t) = \omega P_0(t)(u_0(t))^2 + P_1(t)(u_1(t)) \quad (7)$$

A weighted parameter equal to the cumulative probability of the defect occurrence is a better selection for defect detection [6]. To avoid false detection, the object variance should contribute less. The problem with using this method is that the defects are very small as compared to the background. This method is valid when the object is small compared to the background, but when the object and background are similar or bigger than that of the background, this method fails to give the desired threshold.

Generally, the main criteria are converting an image into a binary image and selecting the best threshold. The Otsu method is based on a pixel intensity distribution histogram. The colour images contain a lot of information. 3 matrices are allocated for the coloured images named red channel, green channel, and blue channel, which required a high amount of computational power and computation time. To reduce the computational time, the first image is converted into the grey level. Objects are detectable based on their grey level information. Due to the following characteristics, however, it is difficult to choose an appropriate threshold to differentiate an item from the visual background:

- (1) Because of illumination inequalities and low contrast between the object and the background
- (2) Sometimes the object is much smaller than that of the background and vice-versa, it is difficult to locate the object as the size of the object in the frame is not the same. Thus, the image histogram is not bimodal always.
- (3) Using the 2D or 3D Otsu method

may not work. As the complexity increases the computation time also increases, so cannot be used in real-time applications.

By scrutinizing the problems in the existing thresholding methods for object detection, we formulate an Improved thresholding method for object detection. This technique is an enhancement of Gaussian Otsu and Weighted object variance Otsu. The threshold value determined using the suggested Otsu approach yields superior results and is optimum.

## PROPOSED METHOD

### Methodology

The first term in eq(7),  $P_0(t)(u_0(t))^2$ , from the foregoing discussion of the Gaussian Otsu and WOV approach, is called object variance, while the second term,  $P_1(t)(u_1(t))^2$ , is called background variance. The best threshold must sit on the left rim of the unimodal histogram if the object is substantially smaller than the background. If the object and background sizes are comparable, a bimodal histogram will result, with the ideal threshold located in the trough between two peaks (the first peak is smaller than the other). The object variance is near-zero in both cases, whereas the background variance is the highest. As we go on increasing the threshold value, the background variance decreases and the object variance increases. When the grey level reaches  $TH = (u_0(t) + u_1(t))/2$ , the between-class variance reaches maximum. The results show that Otsu always give a higher threshold value than desired. This is because the Otsu method gives equal weightage to both object and background variances.

In this paper, While stating that the area with a grey level below the threshold is

defined as objects or defects (black pixels), the area with a grey level above the threshold is defined as the backdrop (white pixels). Otsu method work on the histogram distribution. The proposed method is formulated on the experiments based on the histogram of the different images. The methodology of the proposed paper is shown in Fig.2

The target object is much smaller than that of the background area, due to which the histogram of the image is unimodally distributed. Figure (3) shows the image and its unimodal distribution. The most frequent value in an image is called mode. The OTSU method fails when there is a unimodal histogram is present. The primary focus is to convert unimodal distribution. The threshold must occur in between two valleys. Figure (3) shows the image and its unimodal pixel intensity distribution.

Intensity can be better distributed on histogram if we allow areas of lower local contrast to gain higher. The intensity should be distributed over a range and not concentrate on a particular area. Grey level values in an image range from 0 to 255 (L). The pixel at the  $i^{\text{th}}$  grey level is  $n_i$ , and  $N = \sum_{i=0}^n n_i$  is the total number of pixels in a given image. The probability of occurrence of grey level  $i^{\text{th}}$  is defined as

$$p_i = \frac{n_i}{N}, p_i \geq 0, \sum_{i=0}^n p_i = 1$$

Cumulative distribution function (CDF)  
 $= \hat{O} = \sum_{i=0}^l p_i$

Multiplying max grey level value with CDF,

$$j = (\text{max gray value}) * CDF \quad (8)$$

Where  $j$  is the equalized intensity value for the pixel at the  $i^{\text{th}}$  grey level. If the histogram is concentrated on one area only, the modified histogram distribution does not work. We shift darker pixels to the lower rim and brighter ones to the higher rim to overcome this. In the above

example, fig(3) the intensity values value are concentrated over a region of 160 to 180. But our area of interest is between 160 to 180, so in modified distribution, we take 160 as 0 (zero) and 180 as 255 (max) and redistribute the intensity histogram. Fig(4) shows, the original pixel intensity distribution and the modified pixel intensity distribution.

### Boundaries detection

Edges are the discontinuities that bring change in pixel intensity which define the boundaries of an object. Edge is a line having larger gradients. For edge detection in an image, the Laplacian operator is widely used. The Laplacian operator provides the location of the edge using the second derivative. A 9-pixel sliding window is used to extract the neighbouring information. The edge detection is based on zero-crossing, i.e. the point at which the Laplacian function changes its sign from positive to negative or vice-versa. It is a linear operation so it requires only one convolution. But the drawback of the Laplacian operator is that it does not provide the magnitude as well as the direction on the edge. The Laplacian filter is also very sensitive to the noise present in the image, henceforth a Gaussian low pass filter is utilized to eliminate the noise present in the image. Variances are The Laplacian of an image that highlights a region of rapid intensity change. To reduce its sensitivity, a Gaussian smoothing filter is used. The mathematical representation of Laplacian of Gaussian is,

$$LoG = (x^2 + y^2 - 2\sigma^2) / 2\pi\sigma^6 * \exp\left(-\frac{x^2 + y^2}{2\sigma^2}\right)$$

Figure (5) shows the NLOG (Negative Laplacian of Gaussian) operator. The NLOG operator is normalized by the negative LoG operator, whose expression is as equality (9). Fig (6), fig (7) shows the results of the image captured during the flight test for this experiment, the

successive images in fig (7) show the target UAV has been identified and detected. The flight test is carried out in ambient conditions.

In figure (9) from left to right, the image source is pixabay, the successive images show the Quadcopter, as well as the background edge features, are identified and detected.

### Increased Object Variance

If the area of the target object is smaller than that of the area of the background in an image, then the intensity histogram approaches unimodal distribution. The weight of the object variance and the background variance is the same in the Otsu algorithm which makes it calculate a higher threshold than the optimized threshold value. The resulting threshold must be decided by object variance, which means more weight must be given to object variance. To overcome this we multiply the term ' $\epsilon$ ' with background variance. The value of  $\epsilon$  lies between 0 to 1. So that we can get the following equivalent formula

$$\sigma^2(T) = P_{w1} P_{w2} (\epsilon * \mu_{w2} - \mu_{w1})^2 \quad (10)$$

The optimal threshold  $T^*$  can be obtained by maximizing the between-class variance.

$$T^* = \text{Arg max } \sigma^2(T)$$

As  $\epsilon$  ranging from 0 to 1 the background variance is low and the threshold is mainly decided by the object variance.  $\epsilon$  should be optimal, if we select  $\epsilon$  close to zero most of the image features are considered in the foreground and if we select  $\epsilon$  close to 1 it is similar to Otsu when object size and background-size are the same.

### EXPERIMENTAL RESULTS

To verify the potency of the proposed algorithm, MTALB2016 software is used to simulate the results

and test the algorithm. As the object is of primary concern the object variance should contribute and the optimal threshold must be decided by object variance. The value of  $\epsilon$  lies between 0 to 1. By experimentation, we found that the optimum value of  $\epsilon$  is 0.577. substituting  $\epsilon$  equal to 0.577 in equation (10) the desired value of the threshold is obtained. The results are compared with the Gaussian Otsu method and the weighted object variance method. To test the methods with the noise, salt and paper noise with variance 9 is added to the input image. This means that 9% of the pixels change into black or white. Fig (10) shows the threshold value obtained by Gaussian Otsu, the weighted Object variance method and the proposed method.

From fig (10), the object detected by the Gaussian Otsu method is almost correct at the boundaries but the internal features of the object are missing. The Gaussian Otsu method fails to detect the internal features of the object. The WOV method predicts a threshold with lots of noise. The internal features of the object are detected but a high level of noise is present in the equivalent binary image. The threshold value obtained by the proposed method is close to desired. The object boundaries with the internal features are detected and the noise present in the WOV method is also removed. The object can be differentiated from the background.

Fig(8) shows the histogram of the pixel intensity distribution. Here the object is black (foreground) and the background is white in the equivalent binary image. The threshold value obtained by the Otsu method is 120 which is higher than that of desire. This is because Otsu assume the object variance and background variance of the same size. The threshold obtained by the WOV method is 98, which is lower than the Otsu threshold as the parameter

equal to the cumulative probability of the occurrence of the object is weighted to the object variance. The threshold calculated by the proposed method is lower than the WOV method and is close to desired. The threshold calculated by the proposed method is 80.

Fig(9) shows the histogram of the pixel intensity distribution. Here the object is white (foreground) and the background is black in the equivalent binary image. The threshold value obtained by the Otsu method is 71 which is lower than that of desire. Due to this internal features of the target objects are not scanned up as a complete target. The threshold obtained by the WOV method is 79, which is higher than the Otsu threshold as the parameter equal to the cumulative probability of the occurrence of the object is weighted to the object variance. The threshold calculated by the proposed method is higher than the WOV method and is close to desired. The threshold calculated by the proposed method is 139.

From the above table, when the object size is much smaller than that of the background the weighted object variance method and the proposed method give satisfactory results as seen in rows 1,5 and 6. The threshold value obtained by the weighted variance method is lesser than the Otsu method but higher than that of the proposed method. As the size of the object increases the Otsu method gives better results but the WOV method failed to deliver the desired results as seen in rows 2,3 and 4. Though Otsu predicts a threshold close to desire but failed to detect a complete object and misses internal features of the object as seen in row 7. The threshold obtained by the proposed method is less than that of the Otsu and WOV method considering the target object is dark and the background is white, as shown in rows 1,4,5 and 6. Similarly, The threshold obtained by the proposed

method is more than that of the Otsu and WOV method considering the target object is dark and the background is white, as shown in rows 2,3 and 7.

The proposed method calculates the threshold value in both cases close to desired i.e. when the target object is smaller compared to the background as well as when the target object is of similar size that of the background. Table (1) shows the threshold value calculated by the proposed method gives satisfactory results and detects compared with the Otsu method and WOV method.

The method is simulated on the Matlab R2021a, The Elapsed time is the time required to detect the target object in an image. The Elapsed time for the Gaussian Otsu method is 0.7823 seconds. Elapsed time for the Weighted object variance method is 0.2762 seconds. Whereas the elapsed time of the proposed method is 0.0139 seconds. This shows that the computational time of the proposed methods is lesser than that of the Gaussian Otsu and WOV methods.

To verify the proposed algorithm different types of images with different types of backgrounds are tested. this includes images from the tests conducted in the outside environment, objects placed in indoor conditions and some images from the internet. To verify the adaptability of the proposed method images with different resolutions such as 400x400 pixel, 1600x1600 pixel, 480x850 pixel, 640x1024 pixel with horizontal and vertical resolution 96dpi, are selected. The mean computation time for the Gaussian method results as 0.7823 seconds with a maximum of 1.3465 seconds and a minimum of 0.057 seconds, whereas the mean computation time for the WOV method is 0.2762 seconds with a maximum and minimum of 0.4863 seconds and 0.0434 seconds respectively. The mean computational time for the proposed method is 0.0139 seconds

with a maximum of 0.0212 seconds and a minimum of 0.009886 seconds. From graph (1), it is verified that the elapsed time of the proposed method is less than that of Gaussian Otsu as well as the WOV method.

### CONCLUSION

This paper presents an improved Otsu method to detect the object by selecting the Optimal threshold value. A parameter equal to 0.577 is accumulated with the background variance for better selection of the threshold value. The methodology involves the negative LoG operator to detect the boundaries of an object and the pixel shifting algorithm to enhance the histogram of the pixel distribution of an image. Comparing the proposed method with the Otsu method, Gaussian Otsu method and weighted object variance method, the proposed method accurately differentiates the object and the background. When the object is much smaller than that of the background, the OTSU method always concludes higher threshold value, whereas the weighted variance and proposed method give the threshold value lower than that of OTSU and nearer to the desired.  $Th_{otsu} > Th_{wov} > Th_{proposed}$  when the object is black and the background is white and vice-versa. When the object is equal to or bigger than that of the background, the weighted variance method always gives a much lower value than the desired threshold. OTSU method predicts a higher value than the WOV method but fails to separate objects, the Proposed method gives a value near the desired threshold.

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Figure 1 from left to right, the original image; pre-processed image; histogram of the input image; image after thresholding

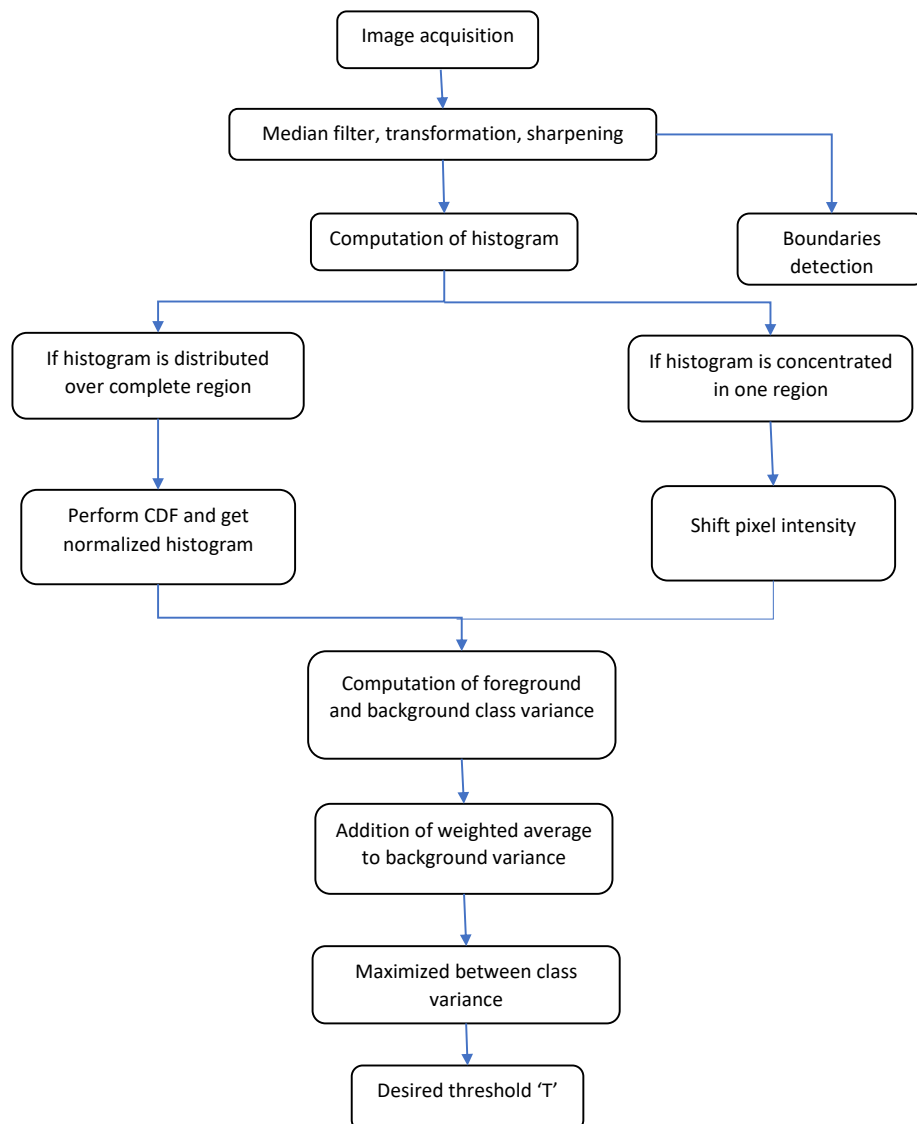


Figure 2Flow chart of the proposed method



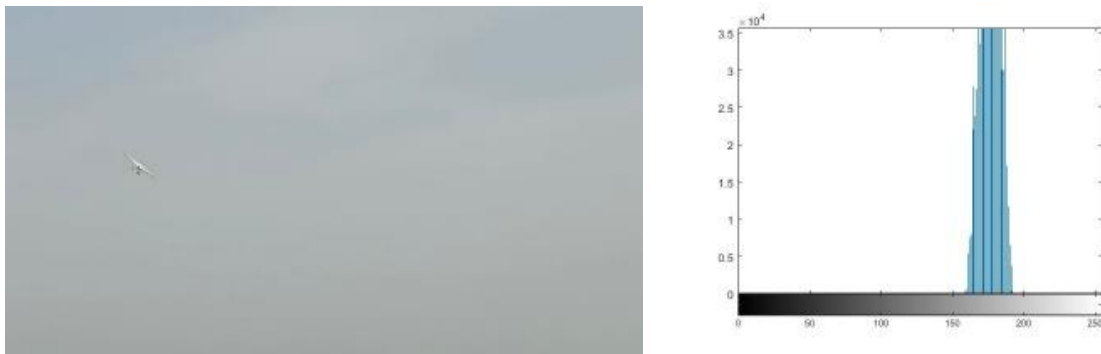


Figure 3 left image is a flight test of a fixed-wing UAV, the right image is the pixel intensity distribution of the image.

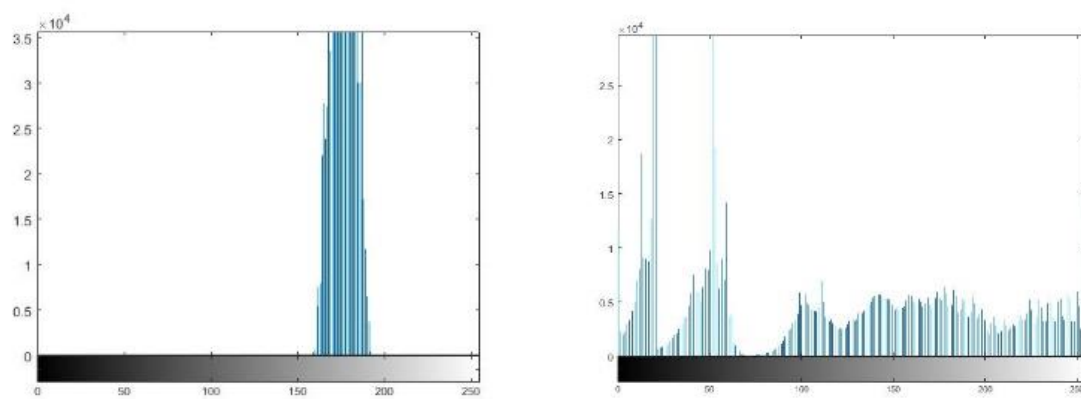
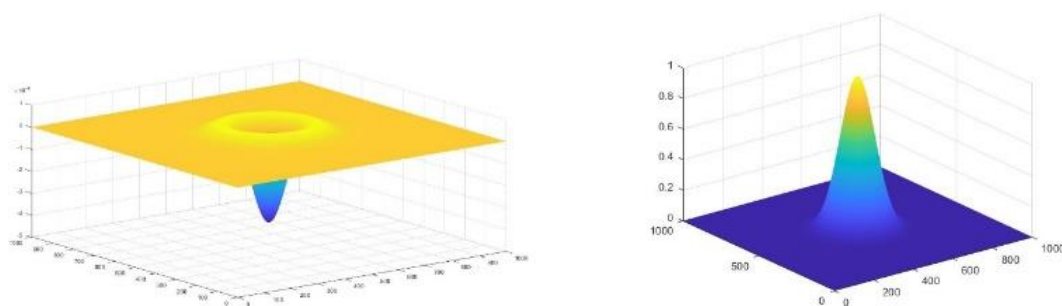


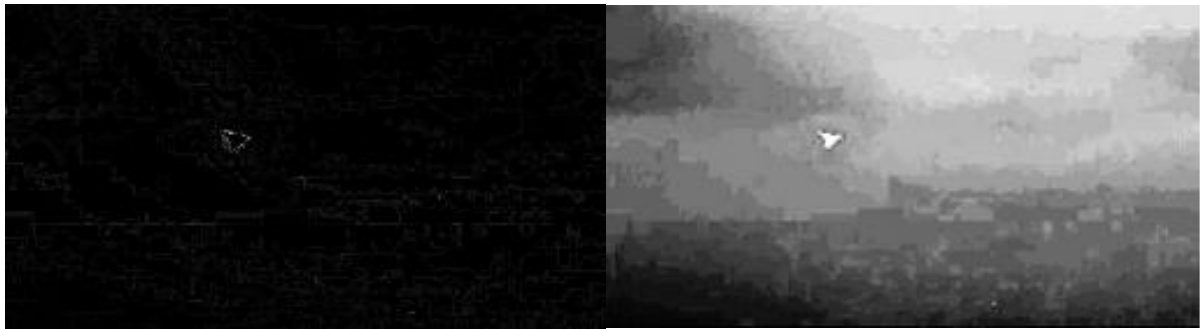
Figure 4 from left to right original pixel intensity distribution, the modified pixel intensity distribution of the image after the pixel-shifting operation.



In figure5 the left image is a Laplacian filter and the right low pass Gaussian filter.



*Figure 6 image is captured during the flight test.*



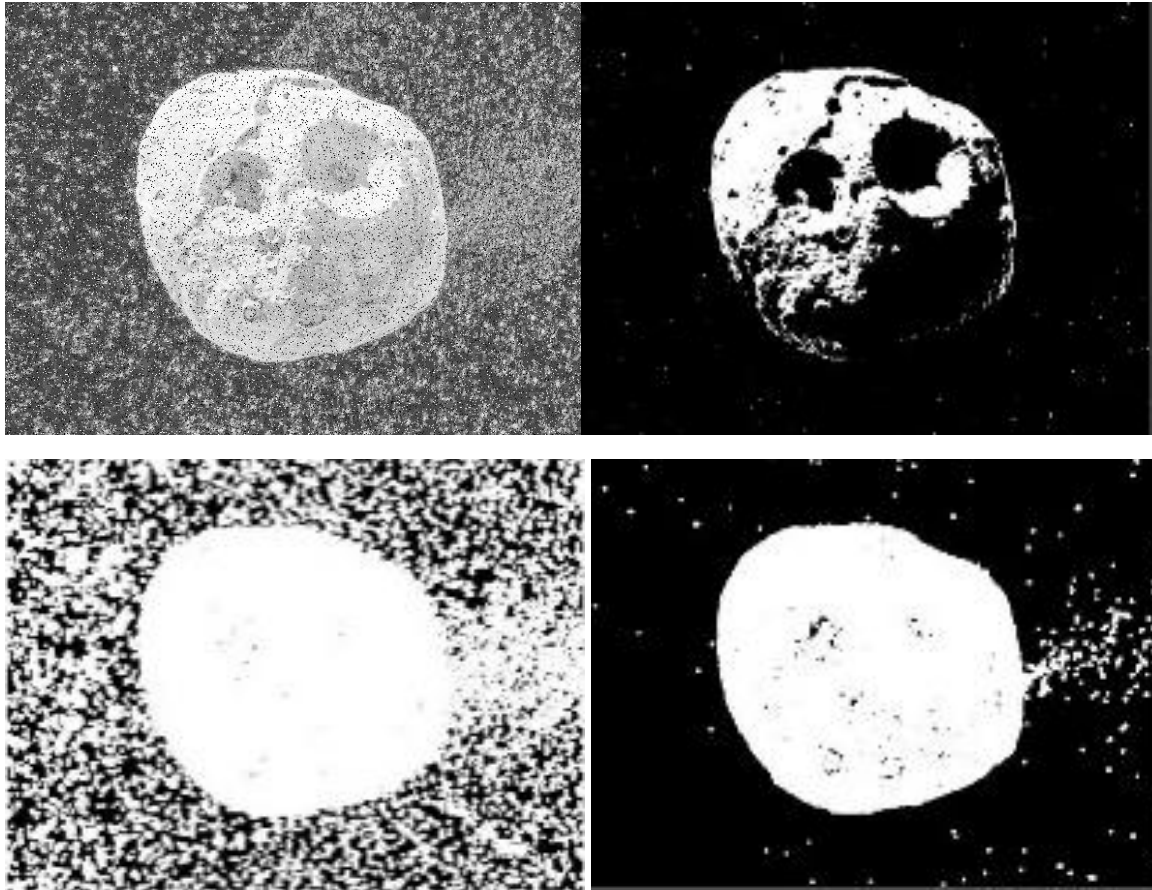
*Figure 7 from left to right, flight test of fixed-wing UAV, the successive images show the UAV is identified in and detected.*



*In figure 8 from left to right, the image source is pixabay, the successive images show the Quadcopter, as well as the background edge features, are identified and detected.*



*Figure 9 picture is taken from Pixabay for the experiment purpose*



In figure 10 from left to right, salt and paper noise is added with a variance of 9, the threshold value ( $th=71$ ) by the Gaussian Otsu method, the threshold value ( $th=79$ ) by the Weighted variance method and the threshold value ( $th=138$ ) obtained by the proposed method.

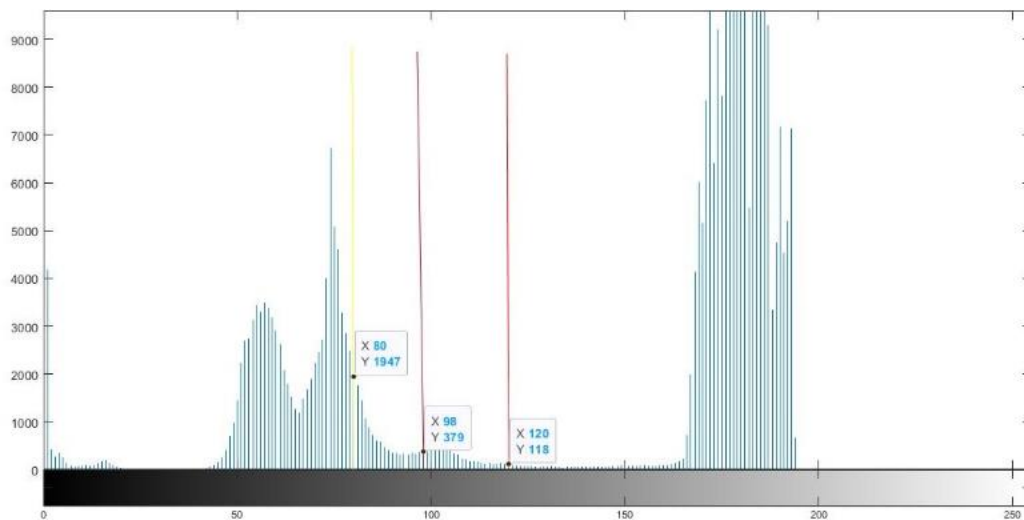


Figure 11 histogram intensity distribution of fig(6) showing the threshold value of the Otsu method ( $Th=120$ ), weighted variance method ( $Th=98$ ), proposed method ( $Th=80$ )

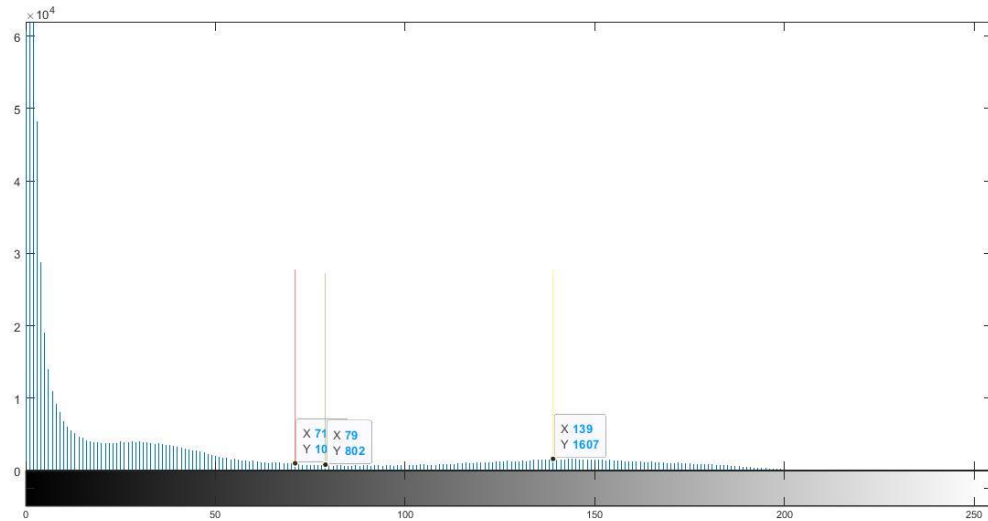





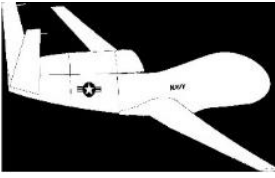

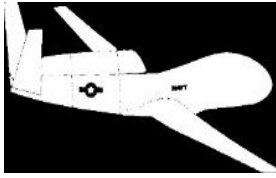






Figure 12 histogram intensity distribution of fig(7) showing the threshold value of the Otsu method ( $Th=71$ ), weighted variance method ( $Th=79$ ), proposed method ( $Th=139$ )

Table (1) shows the image and its binary image after thresholding using Gaussian Otsu, the WOV method and the proposed method with respective thresholding values ( $Th$ ).

Original Image	Otsu Method	WOV Method	Proposed Method
 Multirotor UAV	 $Th = 91$	 $Th = 72$	 $Th = 68$
 Source- Pixabay	 $Th = 155$	 $Th = 73$	 $Th = 163$
 Fixed-wing uav	 $Th = 68$	 $Th = 45$	 $Th = 119$



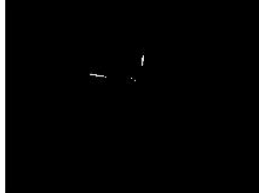











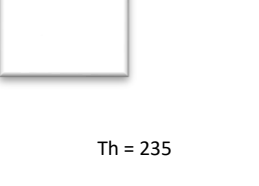
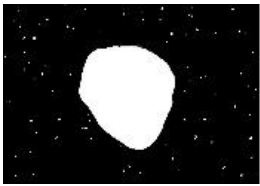
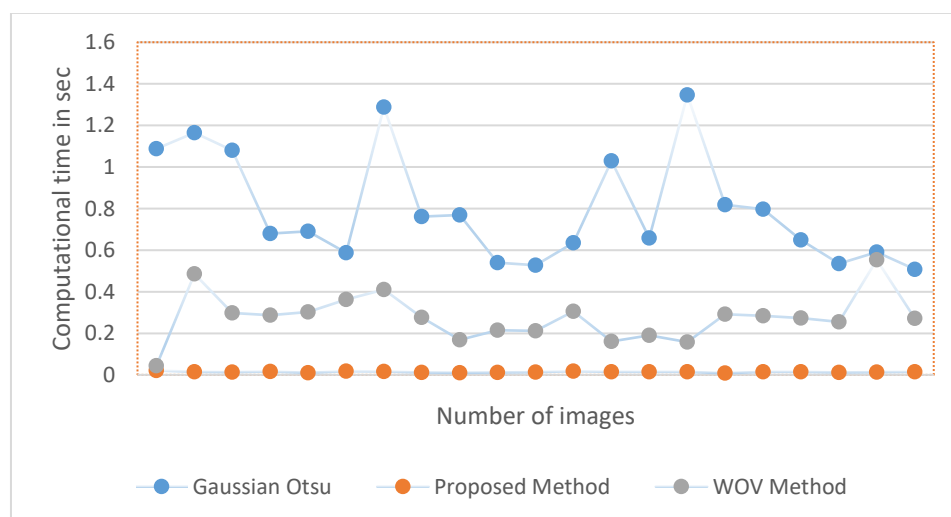
 Source- Pixabay	 Th = 115	 Th = 175	 Th = 67
 Fixed-wing uav	 Th = 176	 Th = 88	 Th = 61
 Fixed-wing uav	 Th = 120	 Th = 98	 Th = 80
 Source- pixabay	 Th = 65	 Th = 235	 Th = 203

Table 1, from left to right, original image, the threshold value (Th) obtained by the Otsu method, weighted object variance method and the proposed method.



Graph 1, Graph shows the computational time for the Gaussian method, WOV method and proposed method. On the x-axis sample, the image number is labelled and on the y-axis, the computational time is labelled in seconds.

## A Designers Guide to Creating a Humanoid 3D Character for the *Metaverse*

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### **Abstract**

The research aims to explore the new possibilities of the existing process of making a playable 3D character for games. Instead of a conventional process, it will be complete, from conceptualizing the character sheets to modelling and importing them into the game engine. This article is practice-based that explores 3D character creation by going through the process of making a humanoid game character. There are four sections in the paper; the first section explains the process in theory. The second focuses on good practices to be kept in mind while making a 3D character. The third will discuss a basic introduction to the programs used in the guide so a person can use the guide. The fourth contains the final guide to creating a step-by-step process of making the character. This guide begins with creating reference artworks based on Lord Ram from the Indian scripture Ramayana. After completing the reference images, the next phase is to make the 3D model itself. The section describes how to start sculpting the character and optimizing the digital sculpture for the game. The reader can visualize each step with pictures from the sample character. The later part of the paper illustrates how to add textures to the model. Lastly, the guide quickly goes through a unique rigging process—it will allow the model to use almost any motion capture libraries available online in the game engine. The model rigged this way will be able to do various actions that animators have already made. Nonetheless, the model could later be animated manually.

**Keywords:** 3D modelling, 3D game character, Game design, Visual Design, 3D Rigging, 3D Animation.

## Internationalization of Higher Education in India: Strategy Implications

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### Abstract

Education is one of the predominant keys to leading the global in this EdTech era. India is a country that can offer knowledge nationally and contribute globally. Internationalization of education in India is the most important factor for educationalists and education providers. For that, there are many strategies and ideas have been taken into consideration, because education providers in India have acknowledged internationalization to be the most eminent feature of higher education going ahead and have made efforts toward internationalizing their institutions. National Education Policy (2020) is the evidence that internationalization of Indian education with a multidisciplinary approach, can help the students bring it their practical knowledge and skill of the students. India is now focusing to correct its adverse inbound–outbound international student mobility to increase its attractiveness to the international Higher Education community; India aims to strategically “prepare to host,” which is subject to institutional abilities to implement new schemes and programs. It is a good strategy for instituting acceptable quality concerns which are focused on Education Quality Regularity Authorities in India. This augmentation helps the public universities who can improve their capacity for producing quality graduates in India. This research focus that the various policies and decisions undertaken by the government as well as educational institutions to provide quality internationalized higher education in India.

**Keywords:** National Education Policy (NEP) 2020, Higher Education, Students, Educationalist, Educational Institutions

### INTRODUCTION

The higher education system in India is growing into an extraordinary revolution driven by economic and demographic changes among students. “Internationalization” of higher education in India has in the last 20 years arose as a major component of the economy, and it has created a lot of interest among the educationalist and students. Most of the students have gone abroad for higher education and professional studies along with research programs.

Internationalization of better training may be able to be sustained within a long time with some necessary inner adjustments, but the middle traits will remain in location. Those modifications may want to consist of an extended position for ‘internationalization at home,

unique recognition of global citizenship training and the growth of significance given to digital structures and e-studying modes. The latter might show to be difficult in the Indian context, for the reason of the capacity of universities throughout the globe Belousova, T. (2020, April 11). Getting admission to the modern generation is variable. Even though, the Ministry of Human Resource Development in India has tried to make certain that scholars can maintain their getting to know from home at some point of the current disaster through the online virtual schooling projects (SWAYAM) and approximately 50,000 people have accessed SWAYAM on account that 23 March 2020. Some Indian Universities have mentioned internationalization to be the destiny of better education in India and feature voiced the want to internationalize. The representatives, mindful of the several



blessings of internationalization have taken steps to promote the internationalization of better education in India through numerous coverage tasks (Sanjay Pawar 2016). It has now ended up essential for Indian HEIs to chart out an avenue map to internationalize their better schooling in an environment of increasing competition. The latest many years have seen quite a few interests being generated and research being accomplished on the "Internationalization" thing of higher schooling. The elements that have generated interest amongst stakeholders encompass the definition, motives, methods and challenges concerning the internationalization of better training (F. Maringe and P. Gibbs 2009).

Given the significant utilization of long-haul transatlantic passengers that foreign students used to make and their consequent detrimental impact on the environment, the connection between the environment and the globalization of higher education is also a significant problem. India can profit from this by positioning itself as a study destination for students from the area, which would significantly cut down on lengthier trips and the associated carbon pollution.

### IMPORTANCE OF THE STUDY

The internationalization of higher education in India is more valuable and taking next level of education standards in India. The learning competency has major attractive factor among the stakeholders. This study focused and detailed analysis about the internalization of higher education in India after the National education Policy-2020, and the strategies has followed by government of India and University grants commission.

### RESEARCH METHODOLOGY

This study has followed the qualitative approach about the various

strategies has adopted by government of India for converting the higher education into internationalization in India. This study relies on secondary sources of material from Ministry of Higher education, All India Survey on Higher education from Government of India, Published research articles and magazines etc... Most of the discussion based on the policy makers and practitioners about the strategies has followed/accepted towards the internationalization of higher education in India.

### Internationalization of Higher Education in India

Through connections across various training systems, the internationalization of better training facilitates and stimulates the allocation of enjoyable academic and research methods. In emerging worldwide citizens through the flexibility of college students and scholars. It has long been a tradition for students to move throughout the world to pursue their academic interests and have access to the vast resources of the higher education system. This aspect of the globalization of better education is as old in the Indian setting as education itself. In ancient India, student mobility and international trade began in Takshashila, drawing thousands of students from around the world to this university to study a variety of challenging subjects. Later on, the university of Nalanda also attracted many Scholars from various components of the globe. **(Panchamukhi 2008; Kapur 2008)**. Internationalization of higher education is already in progress in India. The following evidence, though not comprehensive, will give us a sense of the directions and trends on the ground. A total of 1,00,000 Indian students are presently studying abroad, at an annual cost of over \$4 billion **(S Paul 2009)**.



In modern times, globalization has been one of the most transformative forces **(De Wit, H., & Altbach, P. G. 2021)**. It has altered every workable element of our lives including better schooling. The improved rate of globalization in the Eighties has brought back the focal point on internationalization of higher training albeit in a broader way. It has been a trap word for the reason that among the Worldwide higher schooling network. Internationalization of better schooling is a response to globalization to raise the first-class of education to catch up to The worldwide requirements with the alignment of curriculum to instil the form of ability to improve Productiveness in a globalized competitive financial system. This is also vital for graduating College students to navigate the increasingly interconnected world.

Chances to draw worldwide college students, academics and funding are developing and many Indian better training institutions are devoted to the growth of their international outreach. Aided through authorities' regulations/schemes, concerted efforts are on to beautify the development of India's studies and innovation capabilities, and enhance their institutional rating globally, while specializing in enhancing the satisfaction of its coaching and learning techniques. Some Indian better training institutions already seem within the 'international rankings of universities. In the QS 2022 international university ranking, 35 institutions have featured within the ranking and 63 higher training establishments have figured in Times Higher Education (THE) global university ranking 2021. Which is more critical but is to the consciousness of the latent capacity of many more Indian HEIs to do equally properly in these scores. Further, the rating for internationalization among all the indicators is found to be fairly poor for Indian better education institutions.

Internationalization of better schooling can also consequently be visible as the catalyst to spur many Indian universities to put themselves strategically to cater to the needs of the worldwide know-how society.

### **NEP- 2020 and Internationalization**

India is dedicated to overhauling and strengthening the higher education system via the new National Education Policy (NEP), 2020 to charming its rightful place among the first-rate higher education systems within the international. The National Education Policy, 2020 constructed at the foundational pillars of getting right of entry to, fairness, quality, Affordability and responsibility recommends "course-breaking reforms that aim at paradigm shift through equipping our students, teachers and academic establishments with the proper talents and abilities and growing an enabling and reinvigorated training eco-system for a vibrant new India". The NEP considerably makes a speciality of achieving the very best worldwide requirements within the pleasant of better education.

This policy also targets to make our young era of newbies aware and understand international problems and make them surely global citizens dedicated to human rights, sustainable development and global properly-being. The tactics to selling the internationalization of better training in NEP, 2020 contain facilitating student and faculty mobility, organising worldwide partnerships for research, easing the techniques via which institutions can enrol college students from around the world, as well as the feasibility of carrying credits throughout institutions in multiple countries, and different such measures. The intention of NEP- 2020 requires promoting India as a worldwide take a look at vacation spot. With the vision of elevated internationalization of better training in

India, the university offers commission has formulated these guidelines for Internationalization of better training in the framework of national schooling coverage, 2020.

### Students from Different countries

The recent figures, provided by the Ministry of Human Resource Development, show that the top 10 home countries of international students in India are Nepal, Afghanistan, Bangladesh, Sudan, Bhutan, Nigeria, the United States, Yemen, Sri Lanka and Iran (**Yeravdekar, V. R 2014**). Given the options these students find in higher education in India, it is probable that these trends will persist. The majority of foreign students come from nearby nations; for example, 26.8% of them are from Nepal. Only slightly more than 3% of those who are from the US are enrolled in undergraduate programmes. Many are transient visitors, while some are non-resident Indians looking to enroll in Indian universities.

In Kerala, research revealed that 75% of international students interviewed had received scholarships from the Indian Council for Cultural Relations (ICCR), and that was one of the primary incentives for foreign students to come to India to pursue their studies. The study revealed that 81% of respondents had come to India to pursue their studies because they were looking for an international experience. After all, scholarships were available, and because there were scholarships available (**Belousova, T. 2020**).

According to the latest **ICCR** statistics, in the academic year 2022-23, more than 3900 new international students got the scholarship for doing their studies in various universities in India. Currently, in India, more than 7000 students from 190 countries are studying under the ICCR scholarship. (**Sahoo, N. & Khan, J. 2020**)

India should keep working to establish itself as a regional centre for education in South Asia. It needs to make the most of its comparative advantages in the area of global higher education and spread awareness more widely. The government's goal of raising the number of overseas students in India from the current 47,500 to 200,000 in the following two years may be delayed as a result of this unanticipated global health disaster. However, it should also be seen as a chance for India to reinvent itself as a key participant in the "post-COVID" global education system.

According to the All India Survey on higher education <sup>[19]</sup> 2019-2020, around 49,348 foreign students come to India for better education, which is less than Indian students studying in foreign countries as per **MEA 2021**. Pupil mobility is the most visible factor of the internationalization of higher Training. There's an exponential increase in a wide variety of college students enrolled in better Schooling out of doors in the United States and this fashion is possible to preserve.

The above chart reveals that our neighboring countries Contributes Nepal 28.1% of the total, followed by Afghanistan 9.1%, Bangladesh 4.6% and Bhutan 3.8%. The top 10 countries in terms of number of students come from also includes Sudan (3.6%), U.S. (3.3%), Nigeria (3.1%), Yemen (2.9%), Malaysia (2.7%), United Arab Emirates (2.7%).

**Strategic Programs and Initiatives (Raman, R. 2019)** Intending to solve these aims and harness the whole ability of our higher education scheme, skilled is a want to make bigger a vital method. Full-size drives requirement are anticipated captured collectively at the institution and regulatory/ government. This connection middle from national policy and institutional strategy will present a thrust for the internationalization of higher education in

India. Therefore, these recommendations cowl miscellaneous calculated programs/pushes for internationalization of university and higher education institutions are heartened to strive these pushes containing however not limited to as conferred in those suggestions.

Internationalization of higher education in India has many facets to it which include global mobility of students, International citizenship, ICT revolution, Academic Research collaboration, Brand/ intellectual Building program, collaboration with reputed foreign universities, online & distance learning programmes, all-time connection with Alumni etc... **Dr Sanjay Pawar (2016)** over the past years Indian HEIs have made attempts to accumulate ability to draw global college students. Internationalization of better education in India can have one-of-a-kind pathways and a group need to Select the only this is most ideal to its middle abilities and individual. In India, the internationalization of Higher education at the HEI level can come about in extraordinary and multiple pathways.

### 1. Student Mobility

Global student mobility is seen as the most known, seen and favorite measurement to internationalize higher schooling. The range of college students enrolled in tertiary training overseas has accelerated from 1.3 million in 1990 to nearly 4.3 million in 2011. It is predicted that this parent will be 8 million employing 2025 (**A.D. Bohm et al 2016**). It can as a result be stated that student mobility is the most essential cog for internationalization to manifest and that it is vital for education companies and policymakers to plan strategies to sell international pupil mobility. The enrolment of college students in the Indian higher training machine is all fairness big. As consistent with the statistics of the All India Survey on better education (AISHE), the overall enrolment

in better education has been estimated to be 32.2 million (**AISHE 2014**).

### 2. Global Citizenship

The awareness of interconnections is more and more sought after nowadays, the global committee has brought its International size to the curriculum, providing global exposure, global skills in college and students and so forth. The best leading qualitative adjustments are encouraging global ethos in universities and converting them into 'global Citizens'. An international citizen is a person who is having wider global and actively works towards making our planet extra same, truthful and sustainable<sup>[15]</sup>.

### 3. ICT Revolution

Information and communication technology (ICT) has escorted new potentials in the system and shipping of higher education. ICT has extension has affected honestly all extents of higher training and it has the main function to perform in the internationalization of better training. ICT brings with it New instructional possibilities alongside gives in the method. ICT can triumph over Conventional obstacles to internationalization. The borderlines nature of ICT has the Possible to convert the internationalization manner<sup>[15]</sup>.

### 4. Academic Research Collaboration

Teachers and researchers in higher training establishments around the arena face a Wide variety of extensive extending and interweaved international experiments such as meal protection, energy Protection, communicable illness and so on. Collaboration with a number of the pinnacle universities is critical to pick out reasons, lecturing fears and coping with the influences<sup>[15]</sup>. They accelerate the growth of our establishments and beautify the greatness of our training (**VAJRA 2021**).

## 5. Brand Building

A scientific emblem constructing campaign using the higher training establishments may be very important for the worldwide stand-up of the higher education establishments and additionally for interesting college students from overseas. This could contain all methods of conversation and outreach, which include social media. Good education organizations are recommended to accept emblem constructing exercising to brand India and their establishments as good-looking and have a look at destinations <sup>[15]</sup>.

## 6. Collaborative with Reputed Foreign University

Some Indian Universities are going through Memorandums of Understanding (MOU) with their counterparts in special nations. Amity University has taken this route to internationalization and has connections with over 100 worldwide Universities. The connections are within the areas of tutorial tours for students, pupil and school exchange and curriculum improvement amongst others. Amity University has worldwide courses in conversation, engineering, fashion and management, wherein the benefits for the scholars include stages from Universities of the sector and opportunities to work abroad<sup>[22]</sup>. The Amrita college has its "Amrita Centre for worldwide applications" in which it has tie-America with more than eighty institutions and offers twin degree programmes semester have a look at overseas possibilities <sup>[23]</sup>.

## 7. Online / Off-Campus Learning

The online & offline mode is more priceless than the physical mode of in outside the country of India. The number of online admissions is growing in the USA, and a bigger range of beneficiaries has gotten benefited from the feature. Moreover, the unnecessary fee collection

also makes the students motivated by this mode past the spread of the much less well-off college students. The chances right now to move this platform for benefits fewer nicely and rural-primarily based college students. Online educations are accessible to rural and small metropolis, get admission to high-quality education could be received by the students concerned <sup>[16]</sup>.

## 8. Alumni Connect

The Alumni are robust backing for the college and universities. A lively Alumni affiliation can contribute to instructional topics, pupil assistance and utilization of assets both monetary and non-monetary. Having a relationship with Alumni helps the establishments to consume the benefits of the alumni as logo representatives to show off the assets of Indian education. Alumni of overseas foundations in addition to Indian alumni residing overseas can be an important position in the emblem of the global spot. The good universities in India have to generate a subculture for alumni's connect with institutions <sup>[16]</sup>.

## 9. Faculty Mobility

The relevant University is progressively promoting faculty mobility through research agreements, underscoring its significance as a crucial internationalization component. Through exchange programs, research collaborations, and conferences, the numerous international initiatives promote faculty mobility and growth. Collaboration in research and faculty exchanges can advance knowledge, which in turn can raise the standard of instruction. Faculty development. Faculty mobility may allow for the exchange of best practices from around the world in the classroom and may aid in the grassroots internationalization of the home campus<sup>[16]</sup>.

## CONCLUSION

An overview of the mechanisms of higher education internationalization that are functioning in key areas of the field. It contends that India's internationalization plan should be founded on its ability to effectively help to mitigate the fundamental challenges affecting our higher training sub-sector. Global legislation that allows for foreign investment in the industry and unrestricted admission of private companies may only have a minimal effect on the fundamental difficulties facing the arena, such as first-class and access. Until recently, these policies have led foreign suppliers to concentrate solely on advantageous technical and professional domains of observation that may bring them the correct kind of market returns. When comparing these ways, it is much better to develop a plan that makes use of foreign universities and institutes of appropriate calibre to collaborate with Indian universities and institutes to enhance both accessibility and quality. **(Paul, S. 2009).**

The worldwide components of internationalization in higher education are combined. Human beings' flexibility and the alternative time-honored lanes like setting up instructional combinations, establishing traditional and Informal activities connections, and studies alliances have constantly been taken into consideration as top priorities and elements of Internationalization. So far gradually being acknowledged and also along with principal control, additionally want to take up proprietorship and the pressure of global condition at their campus. Tasks related to including globalization scopes need organized assistance through financially, presenting amenities and Carrying out schooling programmes to popularize the college and body of workers approximately the HEI's

internationalization objectives And techniques **(Sanjay Pawar 2016).**

Indian Higher education institutions could discover approaches to marketplace their schooling products overseas and invent techniques for attracting college students now growing international locations through entire nations **(Sanjay Pawar 2016).** Successful advertising and marketing of schooling desire a nice notion out advertising method which would be based totally at the centre capabilities of the person HEI and an in-depth examination of the important thing drivers for the respective global pupil to return and take a look at in India. Every other factor which an HEI must take a look at is, constructing surroundings that are conducive for college students fit to be employed everywhere in and outside India. India should have forward by enlightening the infrastructural amenities, supplying Precise satisfactory and globally relevant education and growing a suitable ambience for her global college students. Indian HEIs need to undertake measures to feature a couple of internationalization dimensions to their better schooling And reap the various educational and monetary blessings that internationalization gives **(Sanjay Pawar 2016).**

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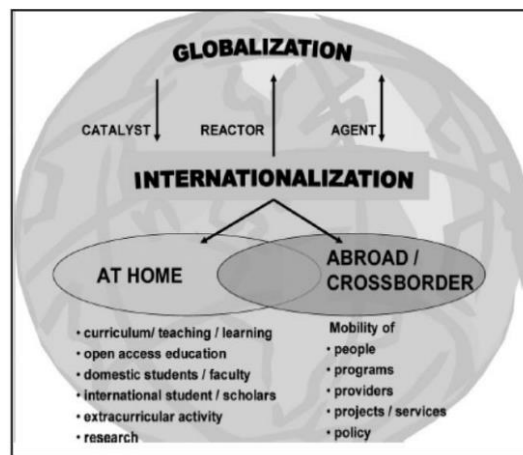
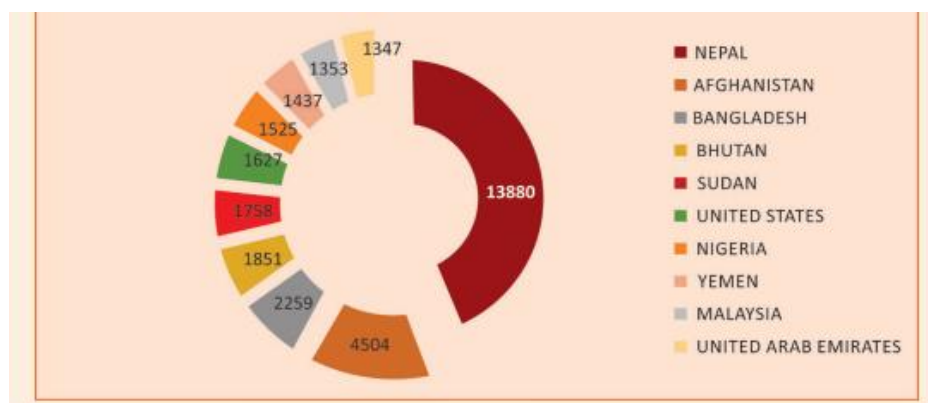
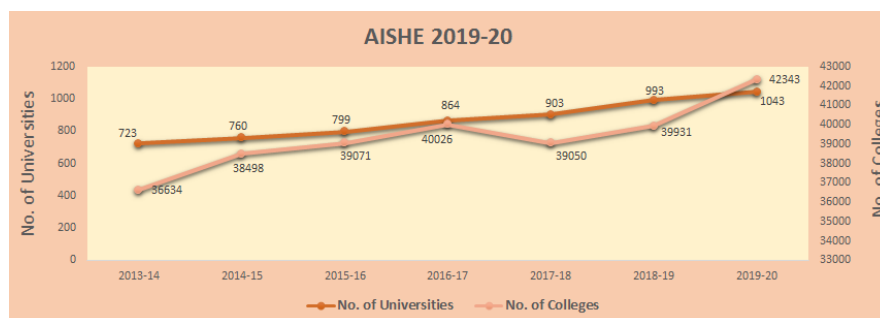
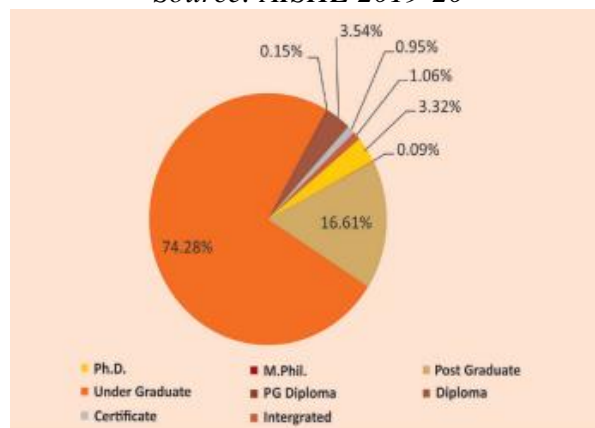


Figure-1 Source: Dr Sanjay Pawar



Source: AISHE 2019-20



Source: AISHE 2019-20

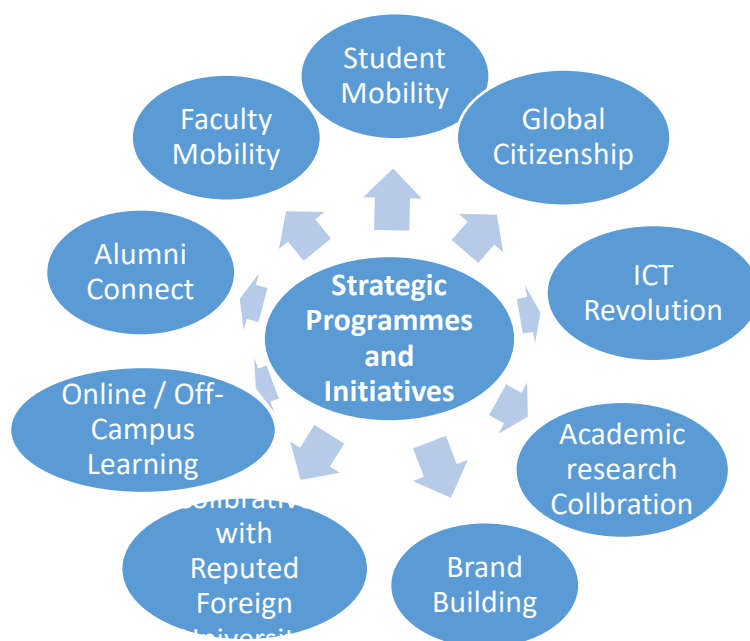


## Foreign student's enrollments of the course

### State-wise Foreign Students

S.No	State Name	Total Number
1	Karnataka	10231
2	Uttar Pradesh	5089
3	Punjab	4966
4	Maharashtra	4599
5	Tamil Nadu	4461
6	Delhi	2345
7	Haryana	2321
8	Telangana	2261
9	Gujarat	2227
10	Andhra Pradesh	2094
11	Other States	8754

Source: AISHE 2019-20



Source: Author Compilation

# Spur Gears-Gear Geometry, Applied Theory and Practice

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## Abstract

Gears are commonly used for transmitting motion and power. The most common gears are spur gears and are used in series for large gear reductions, speed reductions. In precision machines, in which a definite velocity ratio is of importance, the only positive drive is by means of gears or toothed wheels. Spur gears are used to transfer motion and power from one shaft to another in a mechanical setup. This transference can alter machinery's operating speed, multiply torque, and allow for the fine-tuned control of positioning systems. Their design makes them suitable for lower speed operations or operational environments with a higher noise tolerance. Spur gears or straight-cut gears are the simplest type of gear. They consist of a cylinder or disk with teeth projecting radially.

## INTRODUCTION

The design and construction of a spur gear significantly influence its performance. To do their jobs effectively and efficiently, they need to be fabricated from high-quality materials and to precise dimensions. The dimensional measurements of each feature are integral to how a specific gear functions. As such, when an industry professional requires a new spur gear design or a replacement spur gear, it is imperative that they are familiar with the terms for each gear part and their respective measurements to ensure clarity and accuracy in the production or purchase order. Gears are used for a wide range of industrial applications. They have varied application starting from textile looms to aviation industries. They are the most common means of transmitting power. They change the rate of rotation of machinery shaft and also the axis of rotation. For high-speed machinery, such as an automobile transmission, they are the optimal medium for low energy loss and high accuracy. Their function is to convert input provided by prime mover into an output with lower speed and corresponding higher torque. Toothed gears are used to transmit the

power with high velocity ratio, high efficiency, reliability in service, compact layout... During this phase, they encounter high stress at the point of contact. A pair of teeth in action is generally subjected to two types of cyclic stresses:

- i. Bending stresses inducing bending fatigue
- ii. Contact stress causing contact fatigue. Both these types of stresses may not attain their maximum values at the same point of contact. However, combined action of both of them is the reason of failure of gear tooth leading to fracture at the root of a tooth under bending fatigue and surface failure, due to contact fatigue. When loads are applied to the bodies, their surfaces deform elastically near the point of contact. Stresses developed by Normal force in a photo-elastic model of gear tooth. The highest stresses exist at regions where the lines are bunched closest together. The highest stress occurs at two locations:

1. At contact point where the force  $F$  acts
2. At the fillet region near the base of the tooth.
3. The surface failures occurring mainly due to contact fatigue are pitting and

scoring. It is a phenomenon in which small particles are removed from the surface of the tooth due to the high contact stresses that are present between mating teeth. Pitting is actually the fatigue failure of the tooth surface. Hardness is the primary property of the gear tooth that provides resistance to pitting. In other words, pitting is a surface fatigue failure due to many repetitions of high contact stress, which occurs on gear tooth surfaces when a pair of teeth is transmitting power. Gear teeth failure due to contact. Fatigue is a common phenomenon observed. Even a slight reduction in the stress at root results in great increase in the fatigue life of a gear. For many years, gear design has been improved by using improved material, hardening surfaces with heat treatment and carburization, and shot peening to improve surface finish etc.

Few more efforts have been made to improve the durability and strength by altering the pressure angle, using the asymmetric teeth, altering the geometry of root fillet curve and so on. Some research work is also done using the stress redistribution techniques by introducing the stress relieving features in the stressed zone to the advantage of reduction of root fillet stress in spur gear. This also ensures interchange ability of existing gear systems. The studies in which combination of circular and elliptical stress relieving features are used obtained better results than using circular stress relieving features alone which are used by earlier researchers. In this research work, an aero-fin shaped stress relieving feature is tried. A finite element model with a segment of three teeth is considered for analysis and a stress relieving feature of various sizes are introduced on gear teeth at various locations.

## PURPOSE

Gearing is one of the most critical components in mechanical power transmission systems. The transfer of power between gears takes place at the contact between the mating teeth. During operation, meshed gears' teeth flanks are submitted to high contact pressures and due to the repeated stresses, damage on the teeth flanks, in addition to tooth breakage at the root of the tooth are one of the most frequent causes of gear failure. This fatigue failure of the tooth decides the reliability of the gear. However, by introducing stress relieving features to the gear, the points of stress concentration can be decreased which enhances life of gear. A study is done on spur gear with involute profile by adding stress relieving features of different shapes and best among them is proposed....Involute Gear Profiles are used as they are easy to manufacture, compared to Cycloidal tooth profiles..

**Spur Gears:** Spur gears are one of the most popular types of precision cylindrical gears. These gears feature a simple design of straight, parallel teeth positioned around the circumference of a cylinder body with a central bore that fits over a shaft..The spur gear is the economically the least expensive gear to manufacture and is the most commonly used. It can be manufactured to close tolerances and is used to connect parallel shafts that rotate in opposite directions. There are three main classes of spur gears:

1. External tooth,
2. Internal tooth, and
3. Rack-and-pinion.

1) Pitch surface: The surface of the imaginary rolling cylinder that replaces the toothed gear. Pitch circle: A normal section of the pitch surface.

2) Addendum circle: A circle bounding the ends of the teeth, in a normal section of the gear. 3) Dedendum circle or Root circle: The circle bounding the spaces between the teeth, in a normal section of the gear.

3) Addendum: The radial distance between the pitch circle and the addendum circle.

4) Dedendum: The radial distance between the pitch circle and the root circle.

5) Clearance: The difference between the Dedendum of one gear and the Addendum of the mating gear.

6) Face of a tooth: That part of the tooth surface lying outside the pitch surface. Flank of a tooth: The part of the tooth surface lying inside the pitch surface. Top land: The top surface of a gear tooth. 7) Bottom land: The bottom surface of the tooth space.

8) Circular thickness: The thickness of the tooth measured on the pitch circle. It is the length of an arc and not the length of a straight line. 9

9) Tooth space: The space between successive teeth.

10) Width of space: The distance between adjacent teeth measured on the pitch circle.

11) Backlash: The difference between the tooth thickness of one gear and the tooth space of the mating gear.

12) Circular pitch (P): The width of a tooth and a space, measured on the pitch circle. It is equal to the pitch circumference divided by the number of teeth.

13) Diametrical pitch (P): The number of teeth of a gear per unit pitch diameter. The diametric pitch is hence the number of teeth divided by the pitch diameter.

14) Module (M): Pitch diameter divided by number of teeth. (PCD/NOT). The pitch diameter is usually specified in millimeters.

15) Fillet Radius: The small radius that connects the profile of a tooth to the root circle.

16) Base circle: An imaginary circle used in involute gearing to generate the involutes that form the tooth profiles.

17) Contact Ratio: The average number of gear tooth pairs in contact on a pair of meshing gears.

18) Pitch point: The point of tangency of the pitch circles of a pair of mating gears. Common tangent: The line tangent to the pitch circle at the pitch point. 19) Line of action: A line normal to a pair of mating tooth profiles at their point of contact.

20) Path of contact: The path traced by the contact point of a pair of tooth profiles.

21) Pressure angle: The angle between the common normal at the point of tooth contact and the common tangent to the pitch circles. Pressure angle is also the angle between the line of action and the common tangent.

22) Crowning: Grinding of tooth edges to prevent edge loading is known as crowning.

### **SPUR GEAR:**

Spur gears are the most common type of gears. They are used to transmit rotary motion between parallel shafts i.e., they are usually cylindrical in shape, and the teeth are straight and parallel to the axis of rotation. Sometimes many spur gears are used at once to create very large gear reductions. Spur gears are used in many devices but not in cars as they produce large noises. ..The tooth profiles are designed so as to produce a constant angular-velocity ratio during meshing, they are said to have conjugate action. A geometric relationship can be derived for the form of tooth profiles to provide

conjugate action which is summarized as Law of Gearing as follows: "A common normal to the tooth profiles at their point of contact must, in all positions of the contacting teeth, pass through a fixed point on the line-of-centres called the pitch point." Any two curves or profiles engaging each other and satisfying the law of gearing are conjugate curves. The angular-velocity ratio between the two arms is inversely proportional to their radii to the point P. Circles drawn through point P from each centre are called pitch circles, and the radius of each circle is called the pitch radius. Point P is called the pitch point...

### **Tooth profile:**

**Cycloid AL :-** The cycloid AL gear profile is a form of toothed gear used in mechanical clocks. A Cycloid is the curve traced by a point on the circumference of a circle which rolls without slipping on the fixed straight line..The gear tooth profile is based on the epicycloids and hypocycloid curves, which are the curves generated by a circle rolling around the outside and inside of another circle, respectively. An advantage of the cycloid AL teeth over the involute one is that wear of Cycloid AL tooth is not as fast as with involute tooth. For this reason, gears transmitting very large amount of power are sometimes cut with cycloid AL teeth.

Nearly all practical gears now have involute tooth profiles. The involute tooth has great advantages in ease of manufacture, interchangeability, and variability of centre-to-centre distances. Originally, however, cycloidal profiles were used. Cycloidal profiles are as technically suitable as involute profiles, perhaps even slightly superior in some respects. They were satisfactory when gears were specially made in mating pairs, and were expensive. Accurate involute teeth became much easier and cheaper to produce; together with their other advantages, they

have completely supplanted cycloidal gears. Many modern engineering texts and handbooks at most only mention cycloidal gears in passing. The inventor of cycloidal gears does not appear to be known; there are claims for Desargues, de la Hire, Roemer and Camus. They probably came into use early in the 17th century. The *common cycloid* is the curve traced by a point on the circumference of a circle as the circle rolls without slipping on a straight line. Parametric equations are  $x = r(t - \sin t)$ ,  $y = r(1 - \cos t)$ , where  $t$  is the angle of rotation. This graceful curve has several interesting properties. The one of most interest with respect to cycloidal gears is that the normal to the curve at any point passes through the point where the describing circle passing through the given point is in contact with the straight line. It is easy to see why this is the case, since the point of contact with the straight line is instantaneously at rest, and the circle is instantaneously rotating about this point. Therefore, the velocity of the point must be normal to a line from this instantaneous centre to the point. It is very important to grasp this notion, since it is the very basis of the use of cycloidal curves as gear tooth profiles.

Since the cycloid AL teeth have wider flanks, therefore the cyclical gears are stronger than the involute gears, for the same pitch. These are preferred for cast teeth.

In cycloid AL gears, the contact takes place between a convex flank and concave surface, where as in involute gears, the convex surface are in contact. This condition results in less wear in cycloid AL wear and however the difference in wear is negligible.

The interference in cycloid AL gears does not occur at all. Though there advantages of cycloid AL gears they are

outweighed by the greater simplicity and flexibility of the involute gears.

**Involute:** The involute gear profile is the most normally used system for gearing. In an involute gear, the profiles of the teeth are involutes of a circle. The involute of a circle is the spiraling curve traced by the end of an imaginary taut string unwinding itself from that stationary circle called the base circle. In involute gear design, contact between a pair of teeth occurs at a single instantaneous point. Rotation of the gears causes the location of this contact point to move across the respective tooth surfaces.

Two involute gears, the left driving the right: Blue arrows show the contact forces between them. The force line (or line of action) runs along a tangent common to both base circles. (In this situation, there is no force, and no contact needed, along the opposite common tangent not shown). The involutes here are traced out in converse fashion: points (of contact) move along the *stationary* force-vector "string" as if it was being unwound from the left *rotating* base circle, and wound onto the right *rotating* base circle.

Involute teeth are very easy to manufacture and the actual distance between the centres may deviate slightly from the theoretical distance without affecting the velocity ratio or general performance. Because of this distinct advantage, gears with involute profile teeth are used more than those with cycloid AL teeth.

In involute gears, the pressure angle, from the start of the engagement of teeth to its end remains constant. It is necessary for smooth running and less wear of gears. But in cycloid AL gears, the pressure angle is maximum at the beginning of engagement, reduces to zero at pitch point, starts increasing again and becomes maximum at the end of

engagement. This does not yield smooth running of gears.

The face and flank of involute teeth are generated by a single curve where as in cycloid AL gears, double curves are required for the face and flank respectively.

Thus the involute teeth are easy to manufacture than cycloid AL teeth. The only disadvantage of involute teeth is that the interference occurs with pinions having smaller number of teeth.

**System of Gear Teeth:-**The Following Gear systems of gear teeth are commonly used in practice:

1)  $14\frac{1}{2}^\circ$  Composite system 2)  $14\frac{1}{2}^\circ$  Full depth involute system 3)  $20^\circ$  Full depth involute system and 4)  $20^\circ$  Stub involute system...

The  $14\frac{1}{2}^\circ$  Composite system is used for general purpose gears. It is stronger but had no interchangeability. The tooth profile of this system has cycloidal curve at the top and bottom and involute curve at the middle portion. The teeth are produced by form milling cutters or hobs.

The tooth profile of  $14\frac{1}{2}^\circ$  Full depth involute system was developed for use with gear hobs for spur and helical gears.

The tooth profile of  $20^\circ$  Full depth involute system may be cut by Hobs. The increase of the pressure angle from  $14\frac{1}{2}^\circ$  to  $20^\circ$  results in a stronger tooth, because the tooth acting as the beam is wider at the base. The  $20^\circ$  Stub involute system has a strong tooth to take heavy loads....

**Force Analysis:-**To transmit power from one gear to the other, force is applied by the tooth of the driving gear on the mating tooth of the

driven gear. This force, called as Normal Force (  $F_n$  ) acts along the pressure line and is always normal to the tooth surface. This normal force can be resolved into two components:

1. Tangential component ( $F_t$ )– helps in transmission of torque and determines its magnitude.
2. Radial component ( $F_r$ )– tends to push the gears apart, has no contribution in power transmission.

If torque to be transmitted,  $T$  is known, tangential component of force can be calculated as,

$$F_t = \frac{T}{d/2}$$

Where  $d$  is pitch circle diameter

$F_n$  acts along the pressure line and  $F_r$  along the common tangent, therefore angle between  $F_n$  and  $F_t$  is  $\phi$ , the pressure angle. Referring to Figure 23.1, following relations can be written:

$$F_r = F_t \tan \phi \text{ and } F_n = F_t / \cos \phi$$

Above analysis is based on the following assumptions:

1.  $F_n$  remains constant in the power transmission ( $F_n$  changes with change in position of the point of contact).
2. Only one pair of teeth takes the entire load (Load is often shared by more than one pair).
3. Loads are static i.e. gears run at a low speed (There are dynamic loads in actual practice).

### Gear Material

As for any other component, selection of material depends upon performance requirements, material

properties, manufacturing aspects & cost and availability. Gear material should have good strength, high endurance limit, good wear resistance, low coefficient of friction and good manufacturability. Gears are subjected to dynamic loads and very high bending and contact stresses.

Cast iron can be used for lighter stress conditions. It has good castability, machinability and wear properties. Also its vibration damping property makes the operation quieter. For light to medium duty gears steel castings and structural steels may be used. Hardened and tempered steel or case-hardened steels are used for heavy duty applications. For working conditions where special properties, like resistance to heat, corrosion or wear, are desired, alloy steels can be used. Bronzes, aluminium and zinc alloys are some other materials that are used for manufacturing gears, due to their high strength and good sliding properties. Non-metallic materials like acetal, nylon and other plastics are also used for manufacturing gears. These are quieter, durable, cheaper and don't require lubrication also but their load carrying capacity is low. Gears can be manufactured with the help of casting, forging or machining.

### Gear Tooth Failure

Gear tooth may fail in two ways – breakage of tooth due to overloading or fatigue or Surface damage of the tooth due to wear, pitting or scoring. These are discussed below:

#### Breakage of Tooth

Each tooth of gear is subjected to bending stress, which is maximum at the fillet of its base. Gear tooth may fail, if this stress reaches the yield strength of the material. Also as the load on the tooth is dynamic in nature, it leads to variable stresses and the tooth may fail due to fatigue.

## Surface Damage of the Tooth

Surface of gear tooth is subjected to very high contact stresses at the point of contact between two mating gears, where the normal force acts. Surface of the tooth may get damaged due to these very high contact stresses. Gear-tooth surface damage is a very complex phenomenon as excessive loading and lubrication breakdown may lead to various combinations of abrasion, pitting, and scoring. These three basic types of surface deterioration are briefly discussed below:

Abrasion (Abrasive wear) is a type of wear caused by the presence of foreign particles on the surfaces of contact between two mating gears. These foreign particles may be present at the time of assembly or may enter along with the lubrication oil if it is not filtered properly.

Scoring is a form of adhesive wear, which is generally caused due to the failure of lubrication film between the two surfaces i.e. due to inadequate lubrication and occurs in gears rotating at very high speeds. Inadequate lubrication leads to increase in coefficient of sliding friction that combines with high sliding velocity and very high tooth loads to produce a high rate of localized heat generation. This high temperatures and pressure condition causes welding and tearing apart of the tooth surface, which is called scoring. It can be prevented by providing good surface finish and using an appropriate lubricant.

Pitting and Spalling are types of surface fatigue failures that are characterized by the separation of small bits of material from the surface of the tooth. Due to very high localized stresses, cracks are initiated on and under the contacting surfaces of the teeth, which start propagating, finally resulting in loss of material from the surface in the form of bits. If this phenomenon starts with surface

cracks resulting in pits of relatively smaller size, it is called pitting. And if it originates with subsurface cracks resulting in thin flakes of surface material, it is called Spalling.

## Beam Strength of Gear Tooth

Wilfred Lewis presented first recognized analysis of bending stress in gear tooth in 1892, which serves as the basis of bending stress analysis of gear teeth, even today. Lewis considered the gear tooth as a cantilever beam, subjected to bending moment due the tangential force acting on it, as shown in Figure

Lewis Analysis is based on following assumptions:

1. Only one pair of teeth takes the entire load (Load is often shared by more than on pairs).
2. The effect of radial component,  $F_r$ , is negligible ( $F_r$  induces compressive stress).
3. The load is uniformly distributed across the full face width. (Gear should be rigid and accurately machined for this).
4. Tooth sliding friction forces are negligible.
5. Effect of stress concentration is negligible.

Cross-section of the gear tooth, considered as a cantilever beam, varies from the free end to the fixed end. A parabola can be constructed within the tooth profile, as shown in Figure 23.1, giving the outline of a beam of uniform strength. Cross-section at XX is critical, where this parabola is tangent to the tooth profile. If  $b$ ,  $t$  and  $h$  are width, thickness and height of the gear tooth, Bending Stress at section XX can be given by,



$$\sigma_b = \frac{My}{I} = \frac{F_t h(t/2)}{bt^3/12} = \frac{6F_t h}{bt^2}$$

Multiplying nominator and denominator by 'm' and rearranging,

$$F_t = mb\sigma_b \left( \frac{t^2}{6hm} \right) = mb\sigma_b Y$$

where  $Y = t^2 / 6hm$  = Lewis Form Factor

Above equation gives the relation between tangential force and bending stress in the tooth. increases with increase in . The maximum tangential load that can be transmitted by the tooth without bending failure is called its Beam Strength . Therefore in the above relation, if is replaced by allowable bending stress, of the tooth, corresponding value of is the beam strength.

$$\therefore S_b = mb[\sigma_b] Y$$

Value of for different systems can be taken as given below:

$$\begin{aligned} Y &= \pi \left[ 0.124 - \frac{0.684}{Z} \right] \text{ for } 14.5^\circ \text{ involute teeth} \\ &= \pi \left[ 0.154 - \frac{0.912}{Z} \right] \text{ for } 20^\circ \text{ full depth teeth} \\ &= \pi \left[ 0.175 - \frac{0.950}{Z} \right] \text{ for } 20^\circ \text{ stub teeth} \end{aligned}$$

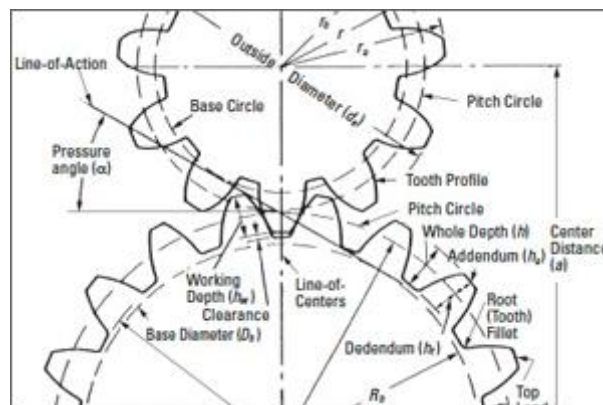
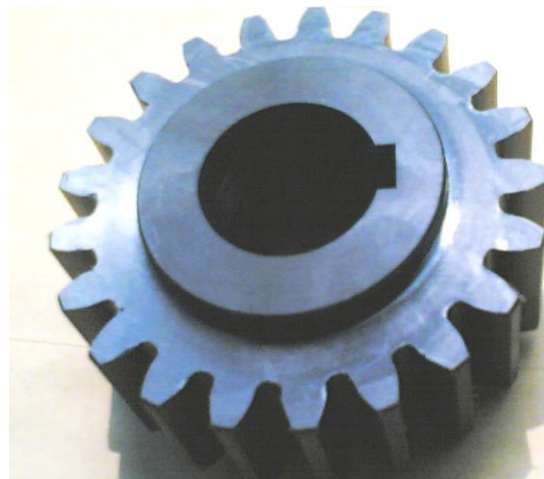
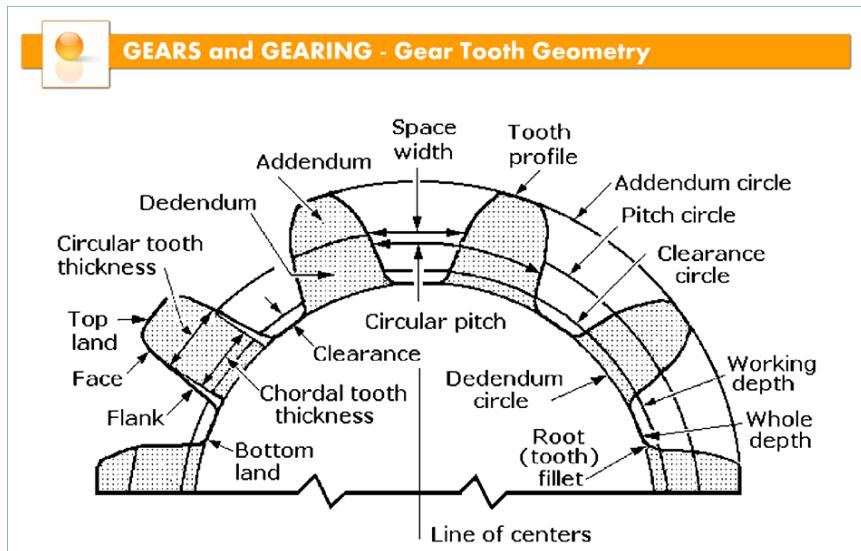
For the gears to be safe in bending,  $\sigma_b$  should be less than  $[\sigma_b]$  or  $F_t$  should be less than  $S_b$  . If gear and pinion are made

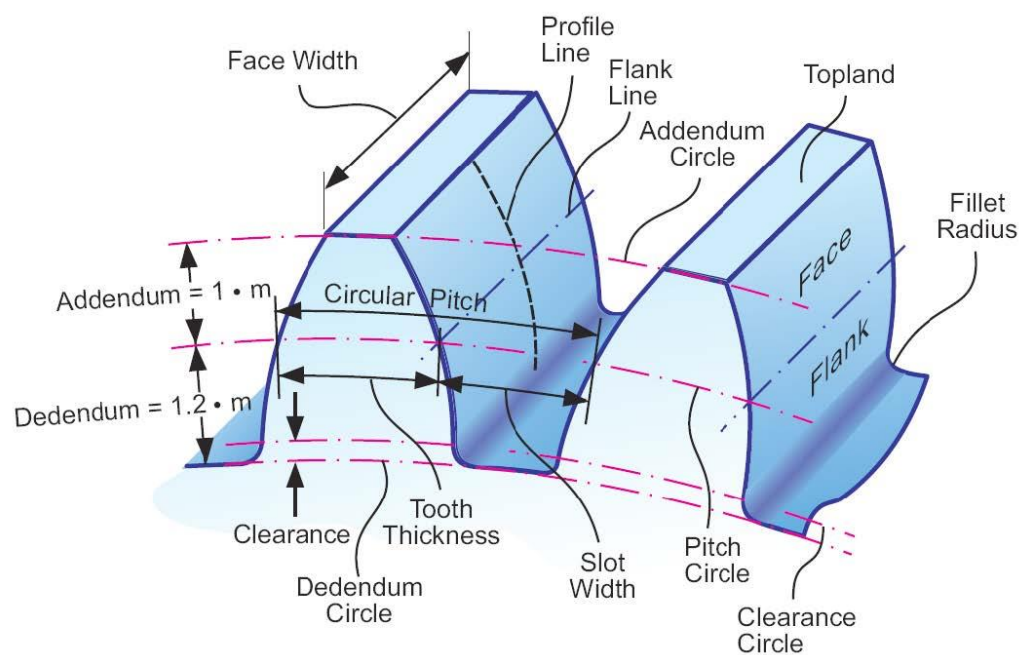
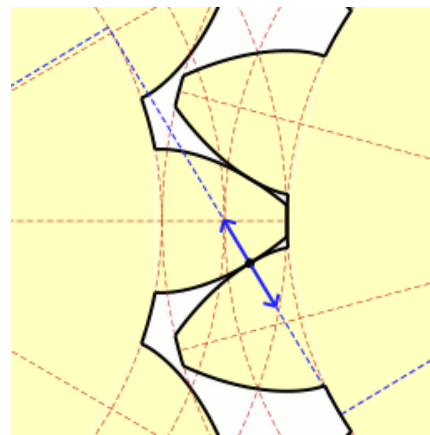
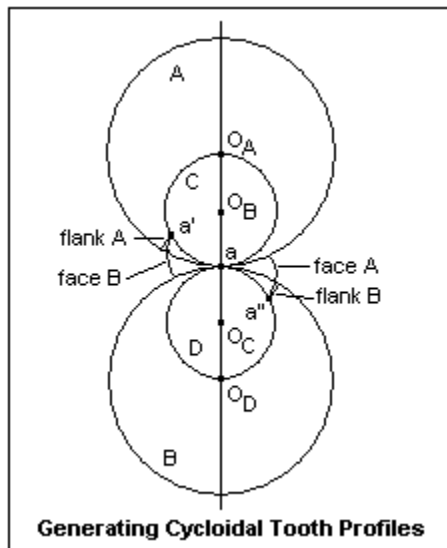
of same material, pinion is the weaker member and design is based on its strength. But if those are made of different materials, it is evident from the Lewis Equation that the gear or pinion having lesser value of product  $[\sigma_b] \times Y$  is weaker, as m and b are same for pinion and gear. Also as the gears are subjected to variable stresses, design is based on the endurance limit and allowable bending stress can be taken as,  $[\sigma_b] = S_e/f_{os}$

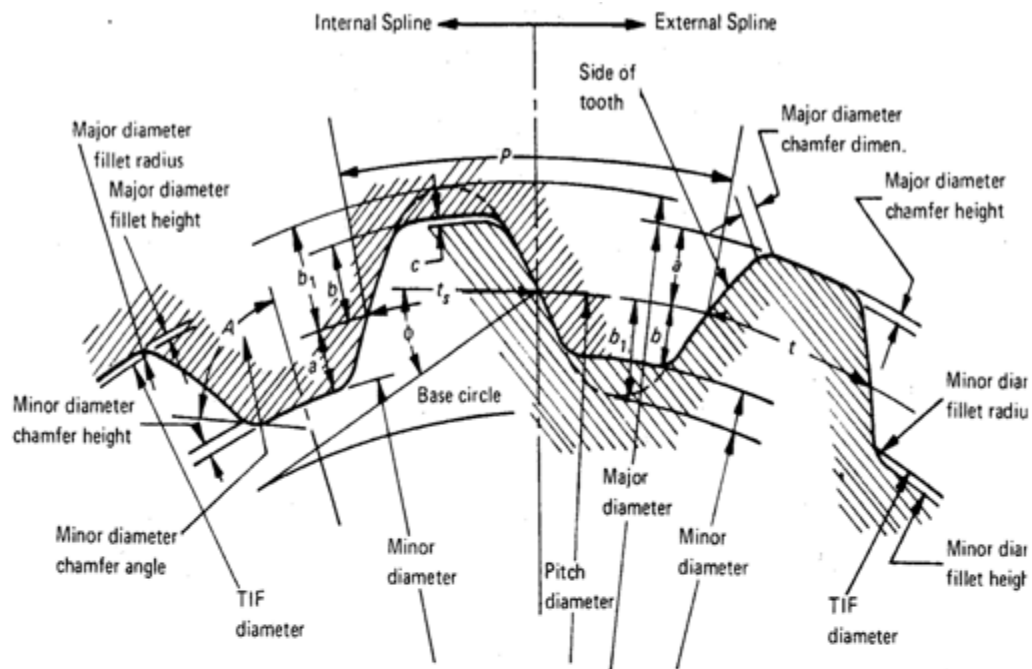
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### III. Gear Nomenclature:





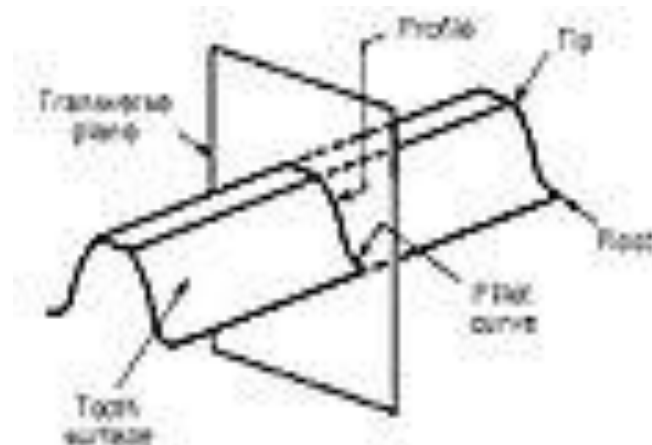


$a$  = addendum  
 $b$  = dedendum-flat root  
 $b_1$  = dedendum-fillet root  
 $c$  = clearance  
 $d$  = pitch diameter  
 $d_b$  = base circle diameter  
 $d_0$  = major diameter  
 $d_r$  = minor diameter  
 $N_t$  = number of teeth  
 $p$  = circular pitch  
 $P$  = diametral pitch  
 $t$  = circular tooth thickness  
 $t_s$  = circular space width  
 $\phi$  = pressure angle  
 TIF = diameter at junction of involute form with fillet

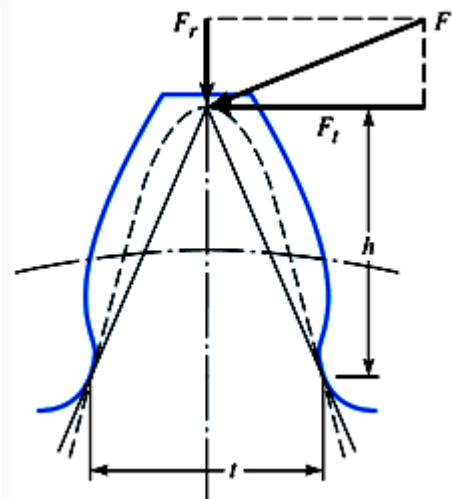
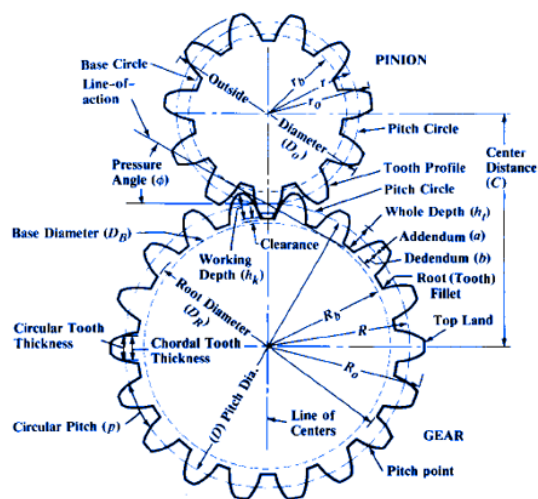
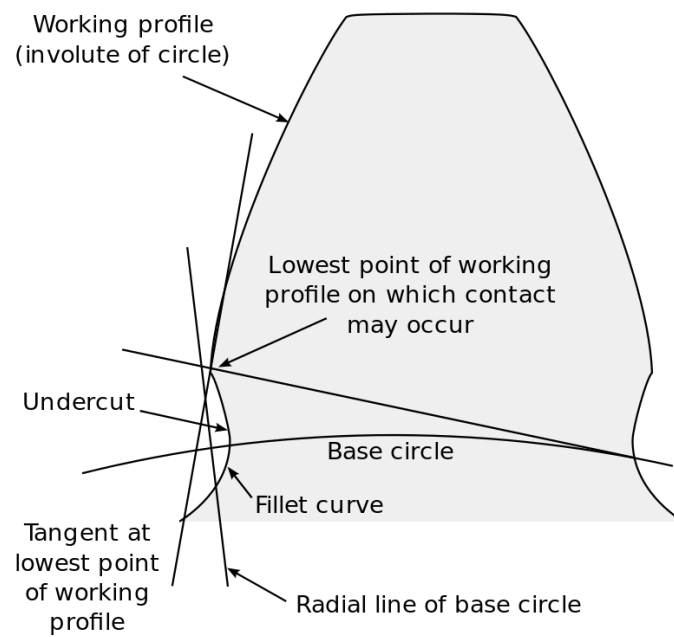
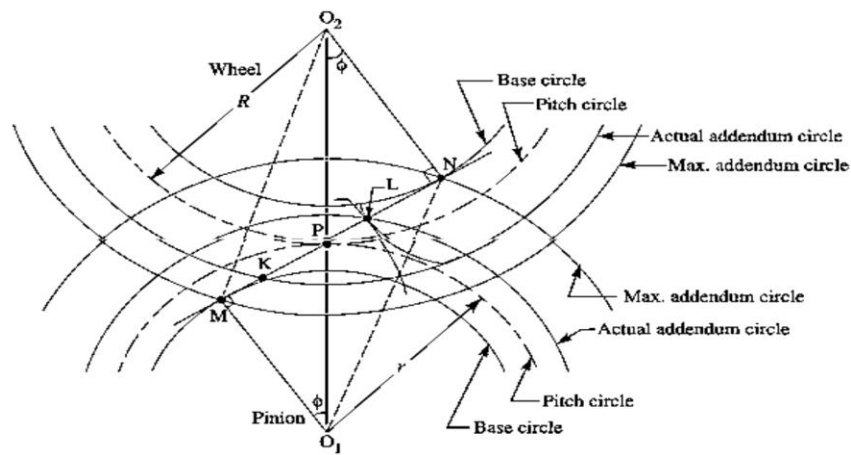
Dimensional relations;

$$d = N_t/P, p = \pi/P, t = \pi/2P, a = 0.500/P$$

Diameter Pitch →	$\frac{1}{2}$ through $\frac{12}{24}$	$\frac{6}{32}$ through $\frac{48}{96}$
Major dia. (internal)	$d_{oi} = (W_t + 1.8) \div P$	$d_{oi} = (W_t + 1.8) \div P$
Minor dia. (external)	$d_{re} = (W_t - 1.8) \div P$	$d_{re} = (W_t - 2.0) \div P$
Dedendum (internal)	$b_1 = 0.900 \div P$	$b_1 = 0.900 \div P$
Dedendum (external)	$b_1 = 0.900 \div P$	$b_1 = 1.000 \div P$



## Interference in InvoluteGear:-



## Minimum Number of Teeth on the Pinion in Order to Avoid Interference

- We have already discussed that in order to avoid interference, the addendum circles for the two mating gears must cut the common tangent to the base circles between the points of tangency. The limiting condition reaches, when the addendum circles of pinion and wheel pass through points *N* and *M*

$t$  = Number of teeth on the pinion,,

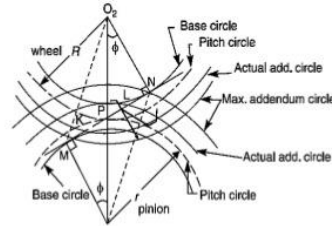
$T$  = Number of teeth on the wheel,

$m$  = Module of the teeth,

$r$  = Pitch circle radius of pinion =  $m.t / 2$

$G$  = Gear ratio =  $T / t = R / r$

$\phi$  = Pressure angle or angle of obliquity.



From triangle  $O_1NP$ ,

$$\begin{aligned}(O_1N)^2 &= (O_1P)^2 + (PN)^2 - 2 \times O_1P \times PN \cos O_1PN \\ &= r^2 + R^2 \sin^2 \phi - 2r.R \sin \phi \cos (90^\circ + \phi) \quad \because \therefore PN = O_2P \sin \phi = R \sin \phi\end{aligned}$$

3/31/2016

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## MINIMUM NUMBER OF TEETH TO AVOID INTERFERENCE

On pinion

$$\therefore t = \frac{2A_p}{\sqrt{1 + \frac{T}{t} \left( \frac{T}{t} + 2 \right) \sin^2 \phi} - 1} = \frac{2A_p}{\sqrt{1 + G(G + 2) \sin^2 \phi} - 1}$$

On wheel

$$T = \frac{2A_w}{\sqrt{1 + \frac{t}{T} \left( \frac{t}{T} + 2 \right) \sin^2 \phi} - 1} = \frac{2A_w}{\sqrt{1 + \frac{1}{G} \left( \frac{1}{G} + 2 \right) \sin^2 \phi} - 1}$$

# Herd Behaviour and its Impact on Indian Stock Market Returns: An Empirical Analysis Pre and During COVID

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## Abstract

The objective of this paper is to examine the trading behaviour of the Foreign Institutional Investors (FIIs) before and during the Pandemic Periods in the Indian Stock Markets applying the daily close level data of Nifty50 as the representative of the Indian Stock Market. Investors' irrational investment behaviour in their investment decisions lead to herding. Herding investment behaviour driven by mimicking the behaviour of certain group. To test the presence of herding behaviour in Indian Stock Market returns during 1st January 2018 to 31st December 2021. 1st January 2018 to 31st December 2019 considered to be the Pre-Covid Period, whereas 1st January 2020 to 31st December 2021 considered as the Pandemic Period. Cross-Sectional Standard Deviation (CSSD) methods were suggested by Christie and Huang (1995) and Cross-Sectional Absolute Deviation (CSAD) developed by Chang, Cheng, and Khorana (2000) applied to examine the behaviour of the investor.

**Key Words:-** Herding Behaviour, Foreign Institutional Investors, Cross-Sectional Absolute Standard Deviation (CASD), Indian Stock Market, Market Efficiency, Volatility

JEL Classification: - G11, G12, G14

## INTRODUCTION

The traditional frame work for finance is largely build on the Efficient Market Hypothesis (EMH) and its applications Fama (1970) and EMH suggests stock market said to be efficient if prices fully reflect all available information. However, Behavioural Finance mainly focused on investors' psychology. Behavioural Finance is said to have developed in response to a host of anomalies that cannot be explained by traditional financial models.

Investor Investment behaviour and its relationship with stock market return have been debated in the literatures of Behavioural finance. Efficient Market Hypothesis (EMH) suggests markets are efficient and reflects all information in the market prices. The theory of EMH has been challenged by empirical research made in the field of Behavioural Finance.

The outcome of Behavioural Finance Literatures have the opinion that market price movement may not necessarily move by the rational behaviour of the investors, however investors are also guided by their sentiments driven by different noises. Irrational investment decision leads to defy the Efficient Market Hypothesis (EMH) and therefore market equilibrium is not reached and application of Capital Asset Pricing Model (CAPM) would be difficult in applying to get the fair price of all securities traded in market.

When an investor completely disregards his prior beliefs and blindly follows other investors, it is consider as irrational herding behaviour (Devenow and Welch, 1996), however if an investor mimics other investors without considering their private information due to concerns for reputation or having incomplete information is considered rational herd



behaviour (Bikhchandani & Sharma, 2000).

## REVIEW OF LITERATURES

The herd behaviour of investors is mostly being researched in developed economies; however, limited research is done in the Indian context. So this study focuses on the herding behaviour of Foreign Institutional Investments in India. A significant amount of volatility has been seen in Indian Stock Market during the COVID, so this paper also addresses the trading behaviour of Investors during the period of Pandemic. Few Important studies in India which addresses the herding behaviour are Khanna (2002), Chakrabarti (2001), Mukherjee et. al. (2002), Naik and Padhi (2016), Kadanda & Krishna (2017) and Katturman (2017). Some important global studies which addresses on herding behaviour are Chang et. al (2000), Bonser-Neal et. al. (2002), Bohl et. al (2015) and Vidal-Tomas et. al (2019). No evidence of herding behaviour is found in US Stock Market and Latin American

Market, however, herding behaviour are found in other advanced countries and Asian markets out of total 18 countries (Chiang and Zhang, 2010). Prevalence of herding in both Indian and Chinese Stock Markets confirmed (Lao and Singh 2011). Indian Market show significant herding behaviour (Poshakwale and Mandal 2014). This study emphasize on the herding behaviour of Investors in Indian Stock Market during the Pre and Covid Periods.

## DATA AND METHODOLOGY

Nifty 50 close prices are taken as the representative of the Indian Stock Market and the data are collected from National Stock Exchange (NSE) websites. To make the time series data stationary Close prices of both the indices are then converted into return data to avoid any non-sense regression

by applying the natural logarithmic return formula

$$r_t = \ln(P_t / P_{t-1}) * 100 \quad (1)$$

$r_t$  = logarithmic index return;  $\ln$  = Natural logarithm ;  $P_t$  = Current Closing Price;  $P_{t-1}$  = Previous Day Closing Price.

Normality test of the descriptive statistics is carried on by using an asymptotic or large size Jarque-Bera (1981) test in order to know whether the return distribution of the index considered in the study follow normal or non-normal distribution. The formulae of Jarque-Bera (JB) statistics is stated below:

$$JB \text{ statistics} = T \left[ \frac{S^2}{6} + \frac{(K-3)^2}{24} \right] \quad (2)$$

Where,  $T$  = No. of Observations,  $S$  = Skewness Coefficient and  $K$  = Kurtosis coefficient. For a normal distribution, skewness( $S$ ) must be zero and kurtosis ( $K$ ) is equal to three. Therefore, the JB test of normality is the test of the joint null hypotheses if  $S$  and  $K$  are 0 and 3, respectively. If  $S$  is zero and  $K$  is three, the JB statistics will be equal to zero. This test statistic asymptotically follows a chi-square distribution with 2 degree of freedom [ $\chi^2(2)$ ].

Test of Stationarity of the return series is done Augmented Dickey-Fuller (ADF) test (1976). Hence the ADF model can be stated as:

$$\Delta y_t = \beta_1 + \beta_2 t + \delta y_{t-1} + \sum_{i=1}^m \alpha_i \Delta y_{t-i} + \varepsilon_t \quad (3)$$

Where,  $y_t$  = log return series of index,  $\Delta y_t$  = first difference of  $y_t = y_t - y_{t-1}$   $\delta$  = coefficient of  $y_{t-1}$ ,  $\beta_1$  = Drift parameter,  $t$  = time or the trend variable,  $\beta_2$  = coefficient of the regressor 't',  $\varepsilon_t$  = a pure white noise error term. In the above model under ADF, the null and the alternative to null hypothesis are taken as  $H_0: \delta = 0$  (i.e.



return series is non-stationary),  $H_1: \delta \neq 0$  (i.e. return series is stationary)

To investigate herding behaviour of Investors in India Equity Market, Cross Sectional Standard Deviation (CSSD) is employed to measure the dispersion of equity returns

$$CSSD = \sqrt{\frac{\sum_{i=1}^N (r_{it} - r_{mt})^2}{N-1}} \quad (4)$$

Where,  $r_{it}$  = return of a stock at time  $t$ ,  
 $r_{mt}$  = return of Market (Index) at time  $t$ ,  
 $N$  = number of stocks included in the Index.

The above expression measures the degree to which individual stock returns tend to deviate (rise or fall) in relation to the overall market return. A low dispersion suggests that security return will not stray too far away from the aggregate market return indicating presence of herding. However to observe the asymmetry in the herding behaviour this study included following Cross-Sectional Absolute Deviation of Returns proposed by Chiang & Zheng (2010).

$$CSAD_t = \gamma_0 + \gamma_1 R_{mt} + \gamma_2 |R_{mt}| + \gamma_3 R_{mt}^2 + \varepsilon_t \quad (5)$$

CSAD = Cross Sectional Absolute Deviation at time  $t$   
 $\gamma_0$  = the intercept or Constant Term  
 $\gamma_1, \gamma_2, \gamma_3$  = Coefficients for Market index Return, Absolute Market Index Return and Squared Return of Market Index  
 $R_{mt}$  = is the Return of Market Index  
 $|R_{mt}|$  = is the Absolute Value of Return on Market Index  
 $R_{mt}^2$  = is the Squared Return on Market Index  
 $\varepsilon_t$  = is the Error Term

This model addresses non-linearity between equity return dispersion and market returns. If the investors tend to follow aggregate market behaviour thereby ignoring their own priors during significant market movement then establishes a non-linear relationship, deviating from the rational of Asset Pricing Models which predicts that equity returns dispersions are an increasing function of the market return and relationship is linear. The model captured by a negative and statistically significant  $\gamma_2$  co-efficient, so significant  $\gamma_2$  implies herd behaviour.

## RESULTS AND DISCUSSION

This study is divided into two periods i.e., before the Covid-19 and during the Covid-19 period. Jarque-Bera test statistics suggest the data differ significantly from normal distribution as the value of skewness and kurtosis found not equal to 0 and 3 respectively. Nifty and all constituent stocks of the Index return series data found to be stationary however closing level prices are non-stationary. No significant difference being found under CSSD and CSAD tests in the herding behaviour of the investors in Indian Stock Market, however it is found that herding behaviour prevailed when the market remained bullish and no evidence of herding being observed when the market remained bearish.

## CONCLUSION

It can be concluded that during the bear phase of the market investors remained more informed in comparison to the bull phase that may be due to the investors' psychology towards the positive information to maximise profit.

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## Disconfirmation Model

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### Abstract

Customer satisfaction can be addressed as a strategic business development tool and it does have a positive effect on an organization's profitability. Satisfied customers form the foundation of any successful business as customer satisfaction leads to repeat purchases, brand loyalty, and positive word of mouth. The essence of every marketing activity is to attract customers and increase their desires for a specific product or service. This study thus evaluated the customer satisfaction towards India Cements Limited, Madurai. To this end, the survey research design was adopted. The respondents consist of customers of India cements Limited, Madurai. Primary data were collected through the use of a research questionnaire and were analyzed statistically using percentage analysis, and chi-square test. The results of the analysis revealed the customer satisfaction level towards India cements limited, Madurai. On the bases of my research, I recommend organizations implement a customer satisfaction model to enhance their business development and improve their overall level of quality.

**Key Words:** Expectations, Perceived performance, Satisfaction, profitability

### INTRODUCTION

Customer satisfaction is a term frequently used in marketing. It is a measure of how products and services supplied by a company meet or surpass customer expectations. Customer satisfaction is defined as "the number of customers, or percentage of total customers, whose reported experience with a firm, its product, or its service (ratings) exceeds specified satisfaction goals." It is seen as a key performance indicator within a business and is often part of a balanced scorecard. In a competitive marketplace where business competes for customers, customer satisfaction is seen as a key differentiator and increasingly has become a key element of business strategy. "Within organizations, customer satisfaction ratings can have powerful effects. They focus employees on the importance of fulfilling customers' expectations. Furthermore, when these ratings dip, they warn of problems that can affect sales and profitability. These metrics quantify an important dynamic. When a

brand has loyal customers, it gains positive word-of-mouth marketing, which is both free and highly effective.

"Customer satisfaction provides a leading indicator of consumer purchase intentions and loyalty."

### The Disconfirmation Model

The disconfirmation model is based on the comparison of customers' [expectations] and their [perceived performance] ratings. Specifically, an individual's expectations are confirmed when a product performs as expected. It is negatively confirmed when a product performs more poorly than expected. The disconfirmation is positive when a product performs over the expectations (**Churchill & Suprenant 1982**).

There are four constructs to describe the traditional disconfirmation paradigm: expectations, performance, disconfirmation, and satisfaction."

"Satisfaction is considered as an outcome of purchase and use, resulting from the

buyers' comparison of expected rewards and incurred costs of the purchase about the anticipated consequences.

In operation, satisfaction is somehow similar to attitude as it can be evaluated as the sum of satisfactions with some features of the product." "In the literature, cognitive and affective models of satisfaction are also developed and considered as alternatives (pfafl, 1977). **Churchill and Suprenant 1982** evaluated various studies in the literature and formed an overview of the disconfirmation process".

### LITERATURE REVIEW

**Hunt (1982)** reported that by the 1970s, interest in customer satisfaction had increased to such an extent that over 500 studies were published. This trend continued and by 1992, Peterson and Wilson estimated the amount of academic and trade articles on customer satisfaction to be 15,000.

Several studies have shown that it costs about five times to gain new customers as it does to keep an existing customer (Naumann, 1955) and this results in more interest in customer relationships. Thus, several companies are adopting customer satisfaction as their operational goal with a carefully designed framework. Hill and Alexander (2000) wrote in their book that "companies now have a big investment in database marketing, relationship management and customers planning to move closer to their customers". Jones and Sasser (1995) wrote that "achieving customer satisfaction is the main goal for most service firms today".

Increasing customer satisfaction has been shown to directly affect companies' market share, which leads to improved profits, positive recommendation, lower marketing expenditures (Reichheld, 1996; Heskett et

al., 1997), and greatly impact the corporate image and survival (Pizam and Ellis, 1999).

Customer satisfaction, as a construct, has been fundamental to marketing for over three decades. As early as 1960, Keith (1960) defined marketing as "satisfying the needs and desires of the consumer". Hunt (1982) reported that by the 1970s, interest in customer satisfaction has increased to such an extent that over 500 studies were published. This trend continued and by 1992, Peterson and Wilson estimated the amount of academic and trade articles on customer satisfaction to be over 15,000. Thus, several companies are adopting customer satisfaction as their operational goal with a carefully designed framework. Hill and Alexander (2000) wrote in their book that "companies now have a big investment in database marketing, relationship management and customer planning to move closer to their customer". Jones and Sasser (1995) wrote that "achieving customer satisfaction is the main goal for most service firms today" increasing customer satisfaction has been shown to directly affect companies' market share, which leads to improved profits, positive recommendations, lower marketing expenditures (Reichheld, 1996; Heskett et al., 1997), and greatly impact the corporate image and survival (Pizam and Ellis, 1999). Parker and Mathew (2001) expressed that there are two basic definitional approaches to the concept of customer satisfaction. The first approach defines satisfaction as a process and the second approach defines satisfaction as an outcome of a consumption experience. These two approaches are complementary, as often one depends on the other.

Yi (1990) expressed that customers buy products or services with pre-purchase expectations about anticipated performance, once the bought product or service has been used, outcomes are

compared against expectations. If the outcome matches expectations, the result is confirmed. When there are differences between expectations and outcomes, disconfirmation occurs. Positive disconfirmation occurs when product or service performance exceeds expectations. Therefore, satisfaction is caused by positive disconfirmation or confirmation of customer expectations, and dissatisfaction is the negative disconfirmation of customer expectations (Yi, 1990).

While several studies support the disconfirmation paradigm, other does not. For instance, Churchill and Surprenant (1982) found that neither disconfirmation nor expectations had any effect on customer satisfaction with durable products. Weiner (1980, and 1985); and Folks (1984) proposed the attribution theory, which stated when a customer is convinced that the supplier causes the dissatisfaction. The complaining customer is focused on restoring justice and the satisfaction outcome is driven by the perceived fairness of the outcome of complaining.

Westbrook and Reilly (1983) proposed the value-percept theory, which defines satisfaction as an emotional response caused by a cognitive-evaluative process, which is the comparison of the product or service to one's value rather than expectations. So, satisfaction is a discrepancy between the observed and the desired. Fisk and Young (1985); Swan and Oliver (1985) proposed the equity theory, which stated that individuals compare their input and outcome ratios with those of others and feel equitable treated. Equity judgment is based on two steps; first, the customer compares the outcome to the input, and second, performs a relative comparison of the outcome to the other party.

## RESEARCH METHODOLOGY

The Research Design Undertaken for the study is a Descriptive one. The study was undertaken around the area of India Cements, Madurai district. and Convenience sampling was used to identify the samples. The sample size of the study is 200. Primary data is collected through a structured questionnaire. A pilot study was undertaken to check the validity and reliability (Cronbach's  $\alpha = 0.85$ ) of the questionnaire with few respondents. Relevant secondary data were collected from books, magazines, articles, and journals.

### Major Objectives of the study:

- To understand the expectations of Existing customers
- To examine how brand ambassadors can influence sales promotion.
- To identify the customer's perception about the price of the product
- To analyse the reasons for the discomforts of customers.
- To find out the promotion tools and satisfaction level of customers.
- The above table shows that 28% of respondents are between the age group of 20 to 30 yrs, 49% of respondents are between 30 to 45 yrs, and 23% of respondents are above the age group of 40 years. The above table shows that 62% of respondents are uneducated, 16% of respondents are SSLC qualified, 16% of respondents are UG qualified, and 6% of respondents are PG qualified. The above table shows that 47% of respondents are direct consumers, 22% of respondents are engineers, 24% of respondents are masons, and 7% of respondents are others. The above table shows that 16% of respondents have purchased Sankar

cement, 13% of respondents have purchased Ramco cement, 9% of respondents have purchased Dalmia cement, and 55% of respondents have purchased all the brands mentioned above. The above table shows that 21% of respondents purchase cement directly from the company, 64% of respondents purchase cement from dealers, and 15% of respondents purchase from sub-dealers.

### **CHI-SQUARE TEST**

Chi-square test to test the significant relationship between the period of usage and the level of satisfaction.

#### **Null Hypothesis**

There is no relationship between the usage period and the satisfaction level.

#### **Alternate Hypothesis**

There is a relationship between the usage period and the satisfaction level.

#### **Cross tabulation between the period of usage and the level of satisfaction.**

#### **Chi-Square Tests**

Since the significance value is less than at 5% (0.05) level, so the null hypothesis is rejected at the 5% significance level. It indicates that the Alternate hypothesis is accepted (i.e.) there is a relationship between the usage period and the satisfaction level.

#### **Discomfort Model Analysis:**

The above table shows that 24% of respondents will consider the price factor during the purchase of cement, and 76% of respondents will consider the quality factor during the purchase of cement. The above table shows that 7% of respondents refer to the dealer while a purchase of cement, 45% of respondents refer to masons while the purchase of cement, 12% of respondents refer to friends while purchasing cement, and 36% of

respondents refer to engineers while purchasing cement. The above table shows that 6% of the customers use Sankar cement from 0 to 12 months, 24% of the customers use Sankar cement from 1 to 3 yrs, 27% of the customers use Sankar cement from 3 to 5 yrs, 86% of the customers using Sankar cement for more than 5 yrs. The above table shows that 74% of respondents frequently purchase from 0 to 12 months, 16% of respondents purchase from 1 to 3 yrs, 4% of respondents purchase from 3 to 5 yrs, 6% of respondents purchase from more than 5 yrs. The above table shows that 11% of the respondents expect 3 to 5 hrs delivery, 19% of the respondents expect 5 to 10 hrs delivery, and 70% of the respondents expect delivery within a day. The above table shows that 28% of the customers are highly satisfied with Sankar cement, 56% of the customers are satisfied with Sankar cement, and 16% of the customers have a neutral level of satisfaction with Sankar cement.

The following factors varied from the company's data, which they presumed to use for all their projection purposes. The study offered a new dimension in developing new product strategies for the company. The price and quality are very highly rated by the company, but the customers were also keen on the advertisement. Also, the Dealer and the Mason are the biggest points of sales reference as identified by the company but the customers perceived engineers and friends are also to be considered.

When it comes to expectations, the company only people buy the product after 3-5 years of their purchase, but it seems 1-3 years itself customers are coming for repeat purchases, which will make the company revisit their advertising and marketing strategies on short visit customers also. Customers are expecting a 3-5 hour delivery schedule, but the

company has not even thought about it. So in the future, the company should take efforts to deliver immediately by increasing the number of dealers and suppliers.

When it comes to satisfaction, about 16% of the customers stayed neutral, which needs to be addressed, Also the highly satisfied ratio is reducing, so the company needs to lay hands and develop strategies to improve the satisfaction level of the customers.

### CONCLUSION

Today in the competitive world, every product has more than 5 alternate products. So customers have got a wide chance to choose the product. When the customers are not satisfied with the product, they would go for alternate products. The satisfaction level of the customers with the product of India cements is fair. The company should increase the level of satisfaction by providing discounts & offers, concentrating on advertisements, and creating strategies to retain the customers.

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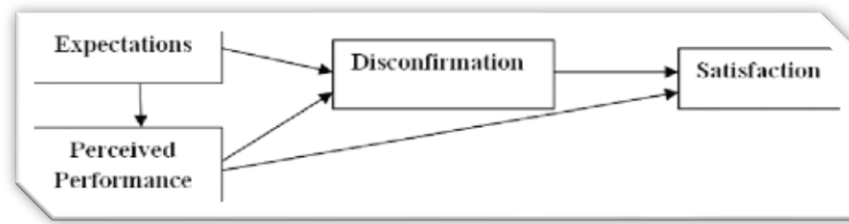
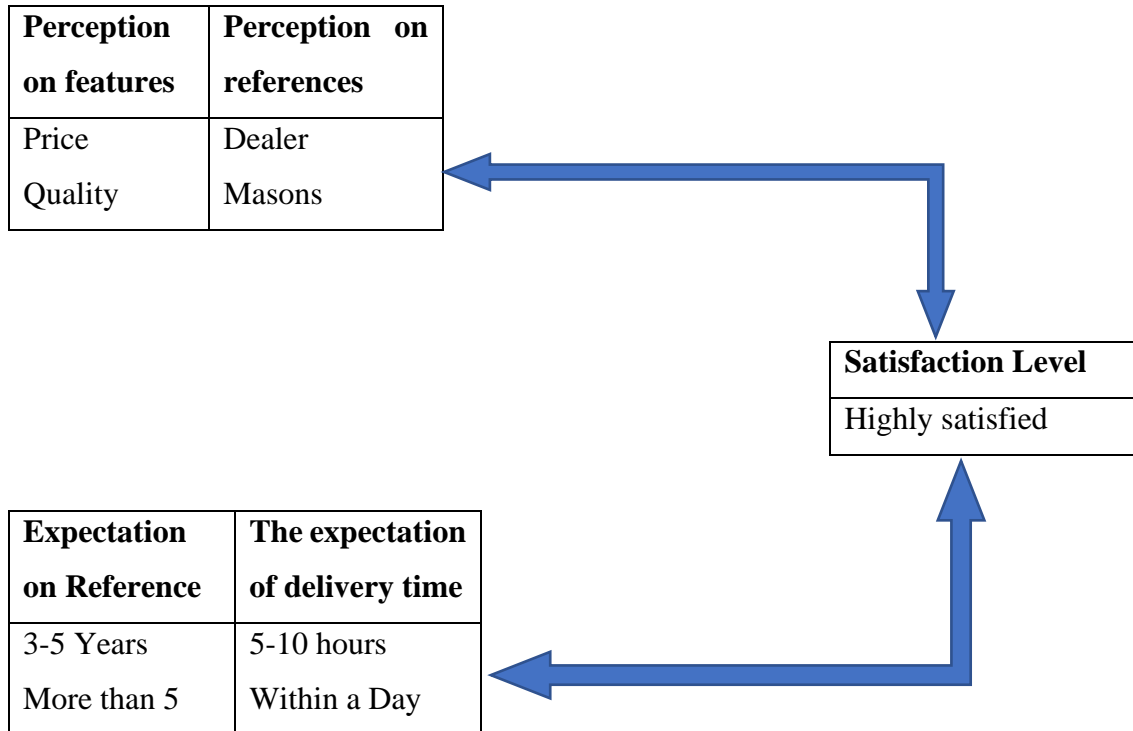


Figure-1

**Discomfort MODEL****Table -1: Demographical Profile**

S.No	Variable	Respondents	Frequency	Percentage
1	Age	20 to 30 Years	56	28
		30 to 40 Years	98	49
		Above 40 Years	46	23
		<b>Total</b>	<b>200</b>	<b>100</b>
2	Educational Qualification	Uneducated	80	40
		SSLC	32	16
		UG	64	32
		PG	24	12
		<b>TOTAL</b>	<b>200</b>	<b>100</b>
3	Occupation	Direct consumer	94	47
		Engineer	43	21.5
		Masons	47	23.5
		Others	16	8
		<b>Total</b>	<b>200</b>	<b>100</b>

<b>4</b>	Brands of cement	Sankar	34	17
		Ramco	25	12.5
		Dalmia	18	9
		Ultratech	13	6.5
		All the above	110	55
		<b>TOTAL</b>	<b>200</b>	<b>100</b>
<b>5</b>	Mode of purchase of cement	Direct from company	42	21
		Dealers	128	64
		Sub dealers	30	15
		<b>TOTAL</b>	<b>200</b>	<b>100</b>

### Cross tabulation between the period of usage and the level of satisfaction.

Period of Usage		Highly satisfied	Satisfied	Neutral	Total
0-12 Months	Nos	5	4	3	12
	%	42	33	25	100
1-3 yrs	Nos	15	21	12	48
	%	31	44	25	100
3-5 Yrs	Nos	18	28	8	54
	%	33	52	15	100
More than 5 yrs	Nos	18	59	9	86
	%	21	69	10	100
Total	Nos	56	112	32	200
	%	28	56	16	100

### Chi-Square Tests

Chi-square	Value	Degree Freedom	Significance value
Pearson Chi-Square	<b>12.79</b>	6	0.002

### Discomfort Model Analysis:

Discomfort Factors	Variables	No. of respondents	%	Company's DATA
<b>Customer's Perception of the Product Features</b>	Price	48	<b>24</b>	<b>27</b>
	Quality	112	<b>56</b>	<b>60</b>
	Brand image	18	9	<b>09</b>
	Advertisement	22	<b>11</b>	<b>04</b>
	<b>TOTAL</b>	<b>200</b>	<b>100</b>	<b>100</b>
<b>Perception of Reference Before Purchase</b>	Dealer	13	<b>7</b>	<b>10</b>
	Masons	89	<b>45</b>	<b>50</b>
	Friends	25	12	5
	Engineers	73	<b>36</b>	<b>35</b>
	<b>TOTAL</b>	<b>200</b>	<b>100</b>	<b>100</b>

<b>Expectations on Frequency of Purchase</b>	Less than 1 year	12	6	7
	1 to 3 years	48	<b>24</b>	<b>13</b>
	3 to 5 years	54	<b>27</b>	<b>35</b>
	More than 5 years	86	<b>43</b>	<b>45</b>
	<b>TOTAL</b>	<b>200</b>	<b>100</b>	<b>100</b>
<b>Delivery Time Expected by Customer</b>	3 to 5 hrs	23	11	0
	5 to 10 hrs	37	<b>19</b>	<b>25</b>
	Within a day	140	<b>70</b>	<b>75</b>
	<b>TOTAL</b>	<b>200</b>	<b>100</b>	<b>100</b>
<b>Satisfaction Level</b>	Highly satisfied	56	<b>28</b>	<b>40</b>
	Satisfied	112	56	55
	Neutral	32	<b>16</b>	<b>5</b>
	<b>TOTAL</b>	<b>200</b>	<b>100</b>	<b>100</b>

## Impact of Social Media Advertising Among Young Adult Consumers

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### Abstract

Internet empowered, young adult consumers with more choices, digital became the new battleground for brands to test their advertising skills and retain their connect with young consumers whose preferences were changing faster than ever. The aim of this research is to examine the effect of social media advertising activities on brand familiarity, brand preference and brand loyalty. In addition, it has been aimed to analyses the effect of brand familiarity and brand preference on brand loyalty in this research. It also identifies the impact of social media advertising compared to television advertising. The population of the research consists of the young adult consumers between the age of 18 to 26, who are actively involved in social media platforms like Facebook, YouTube, WhatsApp, Instagram, WeChat, TikTok, QQ, Douyin and Sino Weibo. Then, research hypotheses have been explained. In this research, quantitative method has been used and research data has been obtained via online questionnaires shared on social media by applying convenience sampling method. The obtained data is analysed by structural equation modeling (SEM). The intended result of the analysis are social media advertising activities have been found as effective factors on brand preference and brand loyalty, the most obvious effect will be also seen on the brand awareness. In addition, it will be found out that brand awareness and brand preference have a significant effect on brand loyalty. Furthermore, in the research, it can be achieved that the brand awareness is effective in social media advertising compared to television advertising.

**Keywords:** Social Media Advertising, Television Advertising, Brand Awareness, Brand Preference, Brand Loyalty

## Petro Politics in India – Myth and Truth

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### Abstract

One of the Energy source is Petroleum Products. The pricing of the petroleum products plays an important role in Economic Activities of a country. India is importing more than 90% of its Crude Oil from Oil Producing countries spending valuable Foreign Exchange. In this study an attempt is made to find out the petroleum pricing strategy for the past 20. The Tax charged by the government plays an important role in the determination of the price of petroleum products. There was no subsidy on Petrol during this 2 decades. But the NDA govt has increased the taxes on petrol by 3 times and on diesel by 7 times compared with UPA period. The tax increase was in the name of various cess and additional taxes which will not be shared with the state governments. The NDA govt had withdrawn the subsidy on Diesel, Kerosene and LPG which was consumed by the Poor and the input cost for transportation of essential items. Crude Oil Price had significant high positive correlation with Petrol and Diesel Prices during the UPA Period and Crude Oil Price had significantly low positive correlation with Petrol and Diesel Prices during the NDA Period. The Petrol, Diesel and LPG price was hiked by the NDA govt during its 8 years rule though the Crude Oil price was very low during this period, whenever the crude price was coming down the Govt was levying taxes to increase the price of Petrol, Diesel and LPG. It is high time the Government of India realizes its responsibility towards its citizens and lower the price of Petrol, Diesel and LPG atleast to keep at par with the countries like Pakistan, Bangladesh, Sri Lanka and Nepal.

**Key Words:** Crude Oil, Petrol, Diesel, Subsidy, Taxes, UPA period and NDA Period.

### INTRODUCTION

Energy is essential for the human race to move its life. This is available as a natural resource. Energy sources are Solar Power, Wind Power, Coal, Crude Oil etc. Coal and Crude Oil are extracted from the mother earth with the use of advanced technology of mapping the availability through satellites from forest, deserts, deep sea and shallow waters. Oil is available across the world in various quantities. The advancement of technology is improving the availability from all regions of the world. Climate policies of the various governments will determine the demand and supply of oil for various needs. The climate policy will force the human race to find alternatives for Oil. The Nuclear technology improvements are reducing the demand for Oil to some extent. The advancement in Solar

Technology will also act as a substitute for Oil in the future.

### REVIEW OF LITERATURE

**Ankita Sarmah and Debi Prasad Bal (2021)**, the study is based on data from 1997 to 2016 about the relationship between Crude Oil price and Inflation and Economic Growth. The results showed that there is positive relation between Crude Oil Price and Inflation, where as it had inverse relation with Economic Growth.

**Dr. Manoj P. K and Sruthi Sreenivas (2019)**, are trying to find out the effect of deregulation of Fuel Pricing in India. The study takes into account Crude Oil prices from 2001 to 2019 and brought the effect of changes in Crude price on petrol and diesel. The conclusion is that the complete deregulation is not in the interest of the ultimate consumer and especially in the case of Diesel it has

resulted in increase in price of essential commodities which had affected the common man.

**Betcy Theodore and Martin L William (2019)**, the authors have built a regression model with time series data from 2010 to 2018. Increasing the domestic production will help India to reduce import dependency and in the long run it will also help in reducing the price of Petroleum products. The study had taken into account the consumption, import and export of Petroleum products of India.

**Dr. K. Soundarapandiyan, and Dr. M. Ganesh (2017)**, the study explains that the crude import by India is around 100 million tones and 4<sup>th</sup> largest consumer in the world. The Crude prices have fallen around 55% from 2014 onwards and it has resulted in savings to Indian government and also helped the Government of India to bridge the current account deficit. The study concludes that there is significant difference Crude Oil price and GDP of India.

**Narendra Punati, Raghavender Raju. G, (2017)**, monthly time series data from April 1994 to December 2015 has been used for study. The determinants of Crude Oil prices are Brunt Crude Oil Price, Index on Industrial Production, Exchange Rate and Inflation. The authors used the Econometric technique of Ordinary Least Square Method.

## RESEARCH METHODOLOGY

### Objectives of the Study

1. To describe the characteristics of the Crude, Petrol, Diesel, Subsidy, Tax Collection Variables.
2. To analyze the trends in Crude, Petrol, Diesel over a period of time from 2001-2022.

3. To find out the significance of correlations between Crude and Petrol and Diesel.
4. To find out the impact of Crude, Petrol, Diesel prices during UPA and NDA Periods.

## DATA COLLECTION

The study is based on secondary data collected for the Period from 2000 to 2022 from official websites of Petroleum Planning and Analysis Cell (PPAC), Reserve Bank of India etc.,

After collecting the data from 2000, the data from 2006 was used for comparison purposes into UPA Period i.e 2006 to 2014 and 2014-2022 NDA period.

The data collected were analysed using Excel, SPSS Version 26 and graphs.

## ANALYSIS OF DATA

### DESCRIPTION OF CRUDE, PETROL AND DIESEL PRICES IN INDIA FROM 2006-2022

The descriptive statistics analysis has been used to describe the characteristics and distributions of Crude, Petrol and Diesel Prices in India for the period from 2006-2014 and 2014-2022 and the results are shown in Table

**Interpretation:** The Descriptive statistics clearly shows that during the UPA period the Crude Price was very high but they maintained the Petrol and diesel prices at moderate levels with subsidies and lower taxes. The NDA government was reckless in fixing the petrol and diesel prices though the crude price was very low and the government continued to tax very high on petrol and diesel.

### COMPARISON OF PRICE OF CRUDE, PETROL AND DIESEL FROM APR 2001 TO MAR 2022

**Interpretation: (a)** The Crude Oil Prices remained almost same in 2001 to 2003, gradually started increasing atleast 50% each 2004 to 2006 stabilising in 2007 and due to global financial crisis it almost doubled during 2008. 2009 and 2010 saw reduction and moderation but again during 2011 to 2014 it peaked to 2008 levels. By beginning of 2015 the prices fell below \$50 and it was stable with moderate increase during 2015 to March 2020 and it fell below \$20 during Covid 19 period and gradually gained momentum month after month in 2020 to 2021 and again peaked its peak price of above \$ 100 from the beginning of 2022.

The Government of India was determining the Petrol Prices in India based the base crude prices upto 2014-2015 was kept under control. i.e the Government was recovering the cost of crude with limited taxes by Central and state Governements. There was no subsidy extended by the Governement on Petrol. But from 2015 onwards the Government of India doubled the Customs and Excise duty on petrol with Cess duties keeping the basic duty at the same rates. The GOI collected exorbitant tax amount on Petrol which resulted in high rates and some of the Refineries started exporting Petrol to other countries. The GOI kept the Petrol Prices high eventhough there was fall in Crude Prices in the world market by manipulating the taxes. Whenever there was increase in Crude Price, the Oil marketing companies were given free hand to increase the price, but the Crude Price decreased in the world market, GOI increased the taxes to compensate the reduction in prices without passing on the benefit to the consumer.

GOI had kept the diesel prices under control irrespective of the world Crude prices by extending subsidies on Diesel from 2001-2014. There was gradual increase in price of Diesel over the

years and GOI was extending subsidy to marginalize the increase or abnormal market price of Crude Oil in the world market. The Excise and Customs duty were kept constant for the period 2001-2014 with negligible increase over the period. But during 2015 the Excise and Customs duty was doubled and again doubled in 2016 over 2015 rates. The Duty structure was also altered with basic duties remaining the same with only increase of Cess. From 2015 the Diesel prices have been increased irrationally to double the rates of 2015 irrespective of crude prices.

The introduction of fixing Petroleum products prices on daily basis from 16<sup>th</sup> June 2017 gave the Union Government a nuclear weapon which is used against the common man on daily basis. We can openly see how after the Uttar Pradesh Elections on a daily basis the price of Petrol and Diesel was increased Rs. 0.80 per day and within 15 days the Price was almost increased by more than Rs 12 per Ltr.

#### **SUBSIDY ON PETROL, DIESEL, KEROSENE, LPG AND TOTAL FROM APR 2002 TO MAR 2021**

**Interpretation: (a)** GOI was extending subsid on Diesel, Kerosene and LPG to domestic Customers to make the products affordable for common man for consumption and to reduce the multiplier effect of energy induced inflation in the country.

Around Rs 4 lakh crores was extended as diesel subsidy during the period 2004-05 to 2014-15. After June 2014 the Subsidy on Diesel was withdrawn and the subsidy for the year 2014-15 was reduced to Rs. 10,935 crores compared to subsidy of Rs 62,837 crores for the year 2013-14. From 2015-16 onwards it was completely withdrawn and the taxes on

diesel was increased to 8 times. The poor and middle class people are made to suffer with withdrawal of subsidy which kept the food prices and other commodities prices under control. On withdrawal of subsidy and increasing the taxes and price of diesel resulted in unchecked inflation in the economy, but the Union government resorted to manipulation of data to show that the inflation is under control by shifting and altering the base values for calculation of inflation.

(Around Rs 2.44 lakh crores was extended as Kerosene subsidy during the period 2004-05 to 2014-15. After June 2014 the Subsidy on Diesel was reduced considerably. Rs. 0.32 lakhs crores subsidy is given from 2014 to 2020 and it is also almost negligible for the year 2020. The Kerosene subsidy was utilised by the rural poor and urban poor where the governments failed to provide electricity and even if it is provided it is not usable for major portion of a day.

Around Rs 3.10 lakh crores was extended as Domestic LPG subsidy during the period 2004-05 to 2014-15. The Subsidy on Domestic LPG was reduced to Rs. 1.29 lakhs crores for the Period from 2014 to 2021. Initially the Domestic LPG subsidy was deposited to the beneficiaries account as Direct Benefit Transfer, subsequently it was withdrawn and extended only to 25 crore beneficiaries under PM Ujwala Scheme. Even to PM Ujwala Scheme beneficiaries only first cylinder for the year is given as free of cost and subsequent cylinders there are not able to refill by paying.

**FIG – 5 Union Govt Tax Rates on Petro and Diesel for the period 2014-15 to 2021-2022**

**Interpretation:** The Union government Taxes on Petrol was increased by 3 times and on Diesel by 7 times during the NDA

period apart from removing the subsidy extended by UPA government on Diesel. Only for political reasons of election for Uttar Pradesh and for Gujarat the taxes are reduced. But after Uttar Pradesh elections the basic rate was increased and only taxes were reduced with Gujarat election in mind, again after elections the prices will be increased.

**COMPARISON OF CONSUMPTION FOR THE PERIOD 2004-13 AND 2014-2021**

**UNION AND STATE TAXES ON PETROL AND DIESEL AS % OF REVENUE RECEIPTS FOR THE PERIOD 2016-17 TO 2020- 2021**

**Interpretation:** The State Governments Tax collection had remained almost same from 2016 to 2022. The Union Government without any basis increased the Petroleum Products taxes in relation to total revenue receipts.

**LPG PRICE FOR GOVT, CONSUMER AND SUBSIDY FOR THE PERIOD DEC 2013 TO JAN 2022**

**RELATIONSHIP BETWEEN CRUDE OIL PRICE AND PETROL AND DIESEL PRICE**

The correlation analysis has been applied to find out the significant correlation between Crude Oil Price on one hand and Petrol & Diesel Price on the other hand in India. The Karl Pearson Coefficients and P-Values of all correlations are shown in Table 9.

Table 9 shows that (a) Crude Oil Price has significant high positive correlation with Petrol and Diesel Prices during the UPA Period.

(b) Crude Oil Price has significantly low positive correlation with Petrol and Diesel Prices during the NDA Period.



## **ANALYSIS OF PAIRED T TEST FOR SIGNIFICANT EFFECT OF VARIOUS VARIABLES DURING UPA AND NDA PERIODS**

### **Hypothesis Formation for the Study:**

1.  $H_0$ : Nul Hypothesis: There is no significant difference in Crude price, Petrol and Diesel during UPA and NDA period of governance.

$H_1$ : Alternate Hypothesis: There is significant difference in Crude price, Petrol and Diesel during UPA and NDA period of governance.

2.  $H_0$ : Nul Hypothesis: There is no significant difference in Petrol and Diesel Consumption during UPA and NDA period of governance.

$H_1$ : Alternate Hypothesis: There is significant difference in Petrol and Diesel Consumption during UPA and NDA period of governance.

3.  $H_0$ : Nul Hypothesis: There is no significant difference in Subsidy on Petroleum Products during UPA and NDA period of governance.

$H_1$ : Alternate Hypothesis: There is significant difference in Subsidy on Petroleum Products during UPA and NDA period of governance.

4.  $H_0$ : Nul Hypothesis: There is no significant difference in Central Govt Tax Collection (Customs and Excise duty) during UPA and NDA period of governance.

$H_1$ : Alternate Hypothesis: There is significant difference in Central Govt Tax Collection (Customs and Excise duty) during UPA and NDA period of governance.

5.  $H_0$ : Nul Hypothesis: There is no significant difference in State Tax

Collection (VAT) during UPA and NDA period of governance.

$H_1$ : Alternate Hypothesis: There is significant difference in State Tax Collection (VAT) during UPA and NDA period of governance.

6.  $H_0$ : Nul Hypothesis: There is no significant difference in Central Govt Direct Taxes and Indirect Taxes during UPA and NDA period of governance.

$H_1$ : Alternate Hypothesis: There is significant difference in Central Govt Direct Taxes and Indirect Taxes during UPA and NDA period of governance.

7.  $H_0$ : Nul Hypothesis: There is no significant difference in State Govt Direct Taxes and Indirect Taxes during UPA and NDA period of governance.

$H_1$ : Alternate Hypothesis: There is significant difference in State Govt Direct Taxes and Indirect Taxes during UPA and NDA period of governance.

8.  $H_0$ : Nul Hypothesis: There is no significant difference in Total Direct Taxes and Indirect Taxes during UPA and NDA period of governance.

$H_1$ : Alternate Hypothesis: There is significant difference in Total Direct Taxes and Indirect Taxes during UPA and NDA period of governance.

Crude Price mean during UPA period was \$ 88.71 compared to \$ 60.55 NDA period, the relationship between the UPA and NDA period is negative and there is significant difference between the two periods since the P value is 0.000 at 5% significance. Alternate Hypothesis is proved, since there is significant difference between UPA and NDA periods in Crude Oil Prices. (b) Petrol Price mean during UPA period was Rs. 55.07 compared to Rs. 73.67 NDA period, there is significant difference between the two periods since

the P value is 0.000 at 5% significance. Alternate Hypothesis is proved, since there is significant difference between UPA and NDA periods in Petrol Prices. © Diesel Price mean during UPA period was Rs. 38.28 compared to Rs. 63.42 NDA period, the Diesel Price almost doubled during the NDA period and there is significant difference between the two periods since the P value is 0.000 at 5% significance. Alternate Hypothesis is proved, since there is significant difference between UPA and NDA periods in Diesel Prices.

Petrol Consumption mean during UPA period was Rs. 13,780.66 compared to Rs. 25,298.55 NDA period, there is significant difference between the two periods since the P value is 0.000 at 5% significance. Alternate Hypothesis is proved, since there is significant difference between UPA and NDA periods in Petrol Consumption. (b) Diesel Consumption mean during UPA period was Rs. 77,143.77 compared to Rs. 59,698.07 NDA period, there is significant difference between the two periods since the P value is 0.000 at 5% significance. Alternate Hypothesis is proved, since there is significant difference between UPA and NDA periods in Diesel Consumption.

Subsidy Amount given to Consumers mean during UPA period was Rs.1,10,021.57 compared to Rs. 37,465.86 NDA period, there is significant difference between the two periods since the P value is 0.000 at 5% significance. Alternate Hypothesis is proved, since there is significant difference between UPA and NDA periods in Subsidy Amount given to Consumers. UPA Government had extensively extended huge subsidy on Diesel, Kerosene, Domestic LPG to support the Poor people who has to bear the burden of Indirect taxes levied by the Governments. Petrol was sold at market Price without subsidy by the successive governments irrespective UPA and NDA

since Petrol was considered to be consumed by reasonably well to do population. NDA Government withdrew the Subsidies right from June 2014 immediately after taking over the Union Government. Diesel Price was increased to market price after withdrawing the subsidy and domestic LPG's subsidy was withdrawn from March 2019 and it has extended only Direct Benefit Transfer to PM Ujwala scheme only to the extent of one or two cylinders per family.

Union Government Tax Collection (Customs and Excise duty) mean during UPA period was Rs. 1,31,503.71 compared to Rs. 3,20,601.57 NDA period, there is significant difference between the two periods since the P value is 0.000 at 5% significance. Alternate Hypothesis is proved, since there is significant difference between UPA and NDA periods in Central Govt Tax Collection (Customs and Excise duty). NDA Government had increased the taxes almost 2.5 Times compared with UPA Government. Over and above this the duty structure was also manipulated with low basic duty with high Cess, effectively entire taxes collected will be retained by the Union government without sharing with the states.

State Tax Collection (VAT) mean during UPA period was Rs. 1,23,353.71 compared to Rs. 1,97,920.71 NDA period, there is significant difference between the two periods since the P value is 0.000 at 5% significance. Alternate Hypothesis is proved, since there is significant difference between UPA and NDA periods in State Tax Collection (VAT). Practically there was no increase in state government taxes, the increase was mainly due increase in basic value of petroleum products by Union Government led by NDA.

Union Government Direct Tax Collection mean during UPA period was Rs. 4,23,871.75 compared to Rs.

9,34,171.00 NDA period, there is significant difference between the two periods since the P value is 0.000 at 5% significance. Alternate Hypothesis is proved, since there is significant different between UPA and NDA periods in Union Government Direct Tax Collection. The direct Taxes Collection has doubled during the NDA period compared to UPA period. (b) Union Government Indirect Tax Collection mean during UPA period was Rs. 3,42,326.38 compared to Rs 9,14,343.13 NDA period, there is significant difference between the two periods since the P value is 0.000 at 5% significance. Alternate Hypothesis is proved, since there is significant different between UPA and NDA periods in Union Government Indirect Tax Collection. The direct Taxes Collection has almost tripled during the NDA period compared to UPA period. This results in proportion of Indirect tax vs Direct Tax collection. i.e The Indirect Tax collection from the poor is increasing compared with the direct tax collection which is from fairly rich segment of the society. The Poor are subsidising the rich in India.

### **SUGGESTIONS**

To Union Government of India: (a) The tax structure should be such that the indirect tax should be lower than direct tax. Mostly the Indirect tax will be burden for the common man and the inflation will go out of control. In order to control Inflation the Union Government should keep the Indirect Taxes under check so that the common man will not suffer. The Petroleum Product pricing should be reasonable which will keep the prices of essential products under balance. The democratically elected government should keep the prices at-least at the prices of our neighbor countries like Pakistan, Bangladesh and Sri Lanka. Subsidy extended is not begging by the common man and it is the responsibility of an

elected government to keep the prices of essential commodities under control.

The Indian government should include Petroleum products under the highest slap of 28% GST as early as possible without further delay. The petroleum products are not luxury items and its GST should be kept as low as possible since they are essential items used by the common man and Industry as input.

The Union government had collected total of Rs.28 Lakh Crore as GST on Petroleum Products in the last 8 years from the common man, according to government the amount so collected was spent on infrastructure projects especially for Road Construction, but ultimately the common man has to pay toll for using the roads. More than 90% of the amount spent on roads goes back to the rich people only 2 to 3% is maximum rotates back to society as wages for the labour force employed in these projects. 10% i.e approximately 3 Lakh crore is retained by the contractors and the politicians as profit from the projects. Instead of this it is high time government brings down the price of the petroleum products to reduce the burden on the common man.

The government of India should encourage people who are inventing substitute for the petroleum products. The govt should encourage invention in this field. An individuals like Shri. Ramar pillar from Tamil Nadu who had come out with alternate fuel at a cheaper price should be encouraged instead of punishing them with some excuse of failing cases against them. Already now he had sold his invention to a Member of Parliament from Tamil Nadu for his invention, at-least now the Government should encourage the alternatives to petroleum imports.

(e) Tamil Nadu people have come out with alternate methods for LPG with wooden stoves with efficiency. The Price increase is driving the common man to jungle life instead of adopting modern technology and fuel for their survival. If the other methods are more efficient, the government should encourage such techniques to reduce the burden on the common man.

To General Public: The common man should feel his responsibility to keep the mother earth from global warming. The Usage of Petroleum products should be kept under control as far as possible. To the extent possible people should use public transport, Pooling of cars etc to avoid usage of Petrol or diesel which will save the precious foreign exchange for this country.

### CONCLUSION

Only solution lies with alternate technology and tools to reduce the burden on the precious foreign exchange which is spent on import of Crude Oil for the country. It is high time the government should encourage research on war footing basis so that the common man gets the energy required at a cheaper price at the same the carbon emission is also less.

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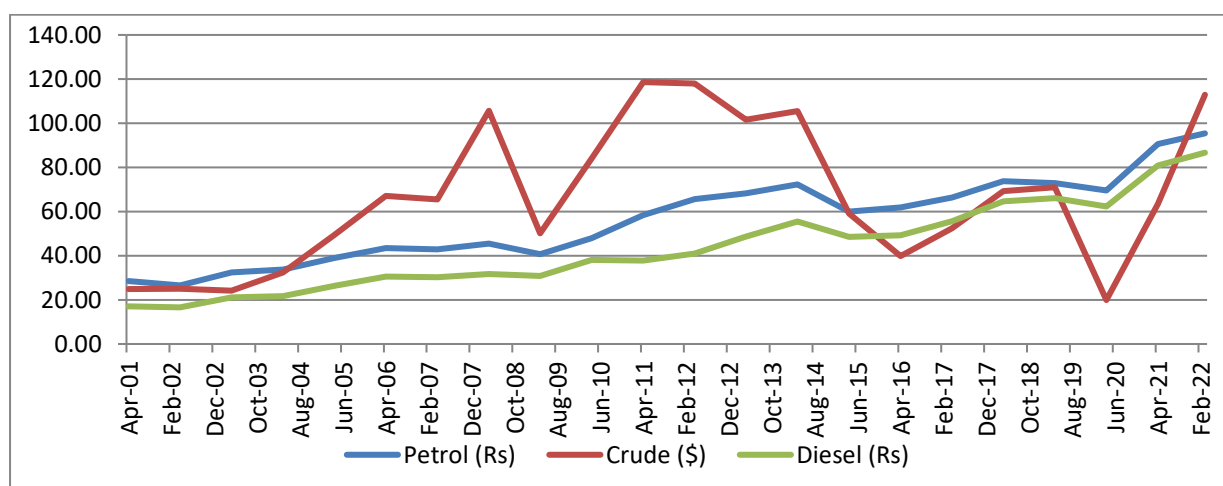
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**Table 1: Descriptive Statistics of CRUDE, PETROL AND DIESEL PRICES IN INDIA**

Descriptive Statistics	Crude (\$)		Petrol (Rs)		Diesel (Rs)	
	2006-2014	2014-2022	2006-2014	2014-2022	2006-2014	2014-2022
Mean	93.64	60.98	55.19	73.79	39.22	64.24
Median	103.57	61.23	53.15	71.23	37.93	63.44
Minimum	50.14	19.90	40.62	60.00	30.25	48.50
Maximum	118.64	112.87	72.26	95.41	55.49	86.67
Count	8	8	8	8	8	8

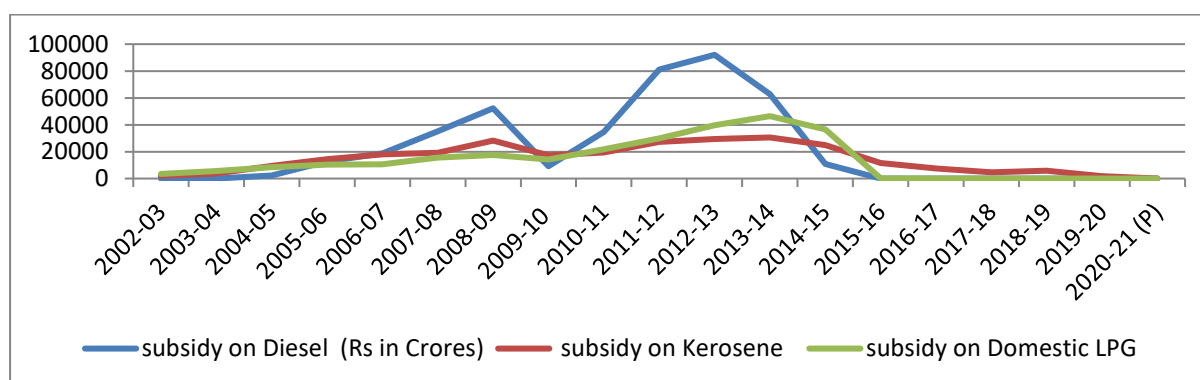
**TABLE – 2 COMPARISON OF PRICE OF CRUDE, PETROL AND DIESEL FROM APR 2001 TO MAR 2022**

Year	Crude (\$)	Petrol (Rs)	Diesel (Rs)	Year	Crude (\$)	Petrol (Rs)	Diesel (Rs)
Apr-01	24.82	28.44	17.06	Apr-12	117.97	65.64	40.91
Apr-02	25.03	26.54	16.59	Apr-13	101.57	68.31	48.63
Apr-03	24.21	32.49	21.12	Apr-14	105.56	72.26	55.49
Apr-04	32.37	33.71	21.74	Apr-15	59.07	60.00	48.50
Apr-05	49.43	39.00	26.28	Apr-16	39.88	61.87	49.31
Apr-06	67.06	43.51	30.47	Apr-17	52.49	66.29	55.61
Apr-07	65.48	42.85	30.25	Apr-18	69.22	73.73	64.58
Apr-08	105.72	45.52	31.76	Apr-19	71.00	72.86	66.09
Apr-09	50.14	40.62	30.86	Apr-20	19.90	69.59	62.29
Apr-10	84.08	47.93	38.10	Apr-21	63.40	90.56	80.87
Apr-11	118.64	58.37	37.75	Mar-22	112.87	95.41	86.67

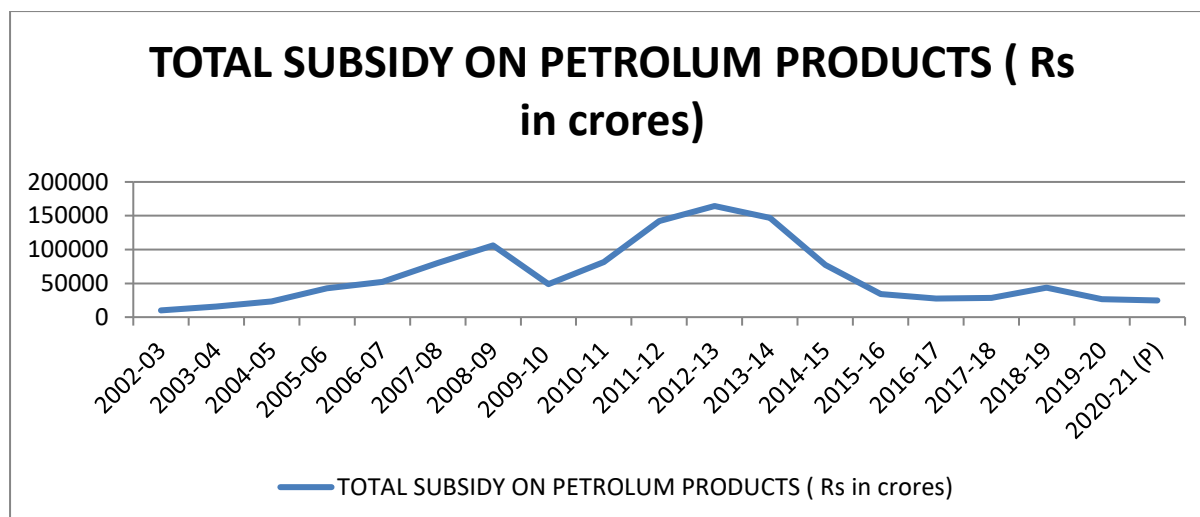
**FIG-1 COMPARISON OF PRICE OF CRUDE, PETROL AND DIESEL FROM APR 2001 TO MAR 2022**

**TABLE – 3 Subsidy on Petrol, Diesel, Kerosene,LPG and Total FROM APR 2002 TO MAR 2021 (Rs in Crores)**

Year	subsidy on Petrol	subsidy on Diesel	subsidy on Kerosene	subsidy on Domestic LPG	subsidy on Others	Total Subsidy On Petroleum Products
2002-03	0	0	2,067	3,363	4,558	5,430
2003-04	0	0	3,752	5,523	6,351	9,274
2004-05	150	2,154	9,480	8,362	2,957	20,146
2005-06	2,723	12,647	14,384	10,246	2,683	40,000
2006-07	2,027	18,776	17,883	10,701	2,700	49,387
2007-08	7,332	35,166	19,102	15,523	2,824	77,123
2008-09	5,181	52,286	28,225	17,600	2,853	1,03,292
2009-10	5,151	9,279	17,364	14,257	2,948	46,051
2010-11	2,227	34,706	19,484	21,772	3,375	78,190
2011-12	0	81,192	27,352	29,997	3,542	1,38,541
2012-13	0	92,061	29,410	39,558	3,358	1,61,029
2013-14	0	62,837	30,574	46,458	7,156	1,39,869
2014-15	0	10,935	24,799	36,580	4,759	72,314
2015-16	0	0	11,496	18	22,792	11,515
2016-17	0	0	7,595	0	19,695	7,595
2017-18	0	0	4,672	0	23,899	4,672
2018-19	0	0	5,950	0	37,766	5,950
2019-20	0	0	1,833	0	24,746	1,833
2020-21 (P)	0	0	0	0	12,231	12,231



**FIG – 2 Subsidy on Diesel, Kerosene and LPG FROM APR 2002 TO MAR 2021**

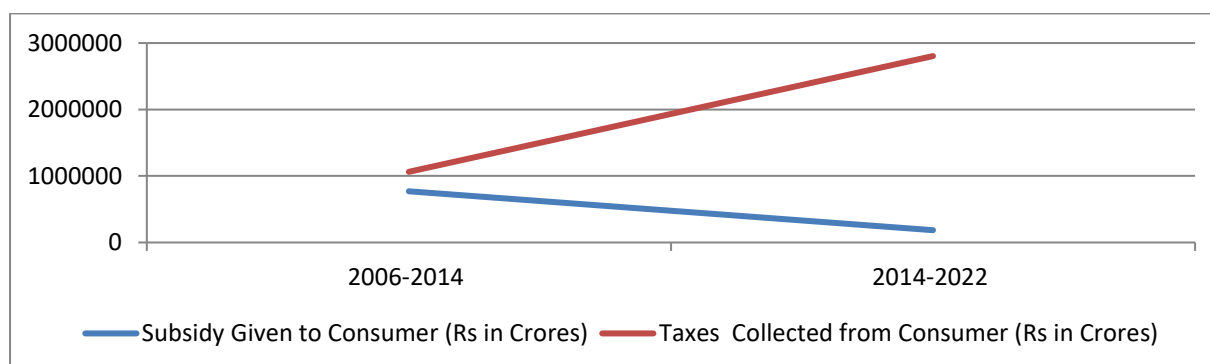


**FIG – 3 TOTAL SUBSIDY ON PETROLUM PRODUCTS FROM APR 2002 TO MAR 2021**

### 3.3.4 COMPARISON OF SUBSIDY AND UNION GOVT TAX COLLECTION FOR THE PERIOD 2006-14 AND 2014- 2022

**TABLE – 4 Comparison of Subsidy and Union Govt Tax Collection For the period 2006-14 AND 2014- 2022**

Subsidy and Union Government Tax collection	2006-2014	2014-2022
Subsidy Given to Consumer (Rs in Crores)	770152	185187
Taxes Collected from Consumer (Rs in Crores)	1063152	2804211
Net Union Government Tax Collection (Rs in Crores)	293000	2619024



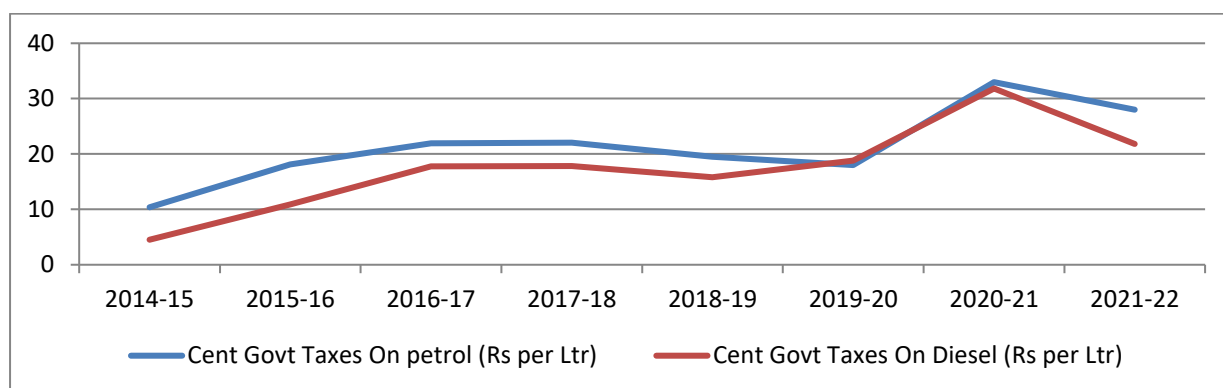
**FIG – 4 Comparison of Subsidy and Tax Collection For the period 2006-14 AND 2014- 2022**

**Interpretation:** From the above chart we can see the widening of gap between the subsidy and Union government tax collection on Petroleum products. In 8 years period (2006-2014) of UPA government Net Taxes on Petroleum Products was only Rs. 2.93 Crores as against Rs. 26.19 crores during NDA Period of 8 years (2014-2022). Almost 9 times taxes have been collected on Petroleum Products by the NDA 8 years in rule compared to UPA government of the similar period.

### 3.3.5 UNION GOVT TAXE RATES ON PETRO AND DIESEL FOR THE PERIOD 2014-15 TO 2021-2022

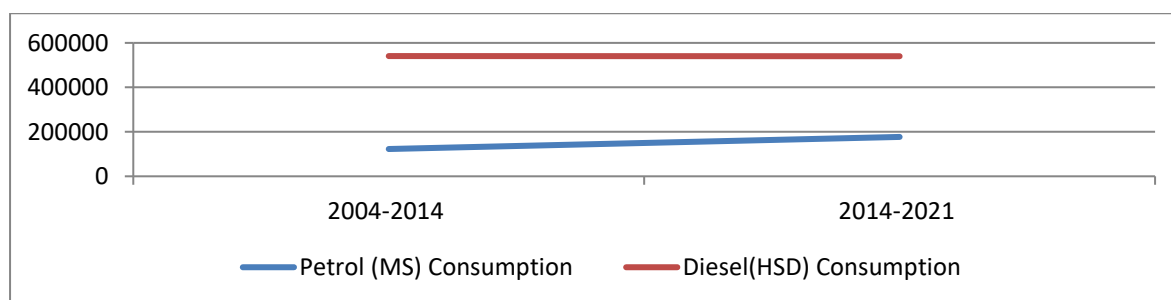
**TABLE – 5 Union Govt Taxe Rates on Petro and Diesel for the period 2014-15 to 2021-2022**

Year	Union Government Taxes On petrol (Rs per Ltr)	Union Government Taxes On Diesel (Rs per Ltr)
2014-15	10.38	4.52
2015-16	18.13	10.91
2016-17	21.94	17.79
2017-18	22.03	17.84
2018-19	19.48	15.83
2019-20	17.98	18.83
2020-21	32.98	31.83
2021-22	27.98	21.83



**TABLE – 6 Comparison of Consumption For the period 2004-13 AND 2014- 2021**

year	2004-2013	2014-2021
Petrol (MS) Consumption (MT)	122648	177090
Diesel(HSD) Consumption (MT)	540624	540006

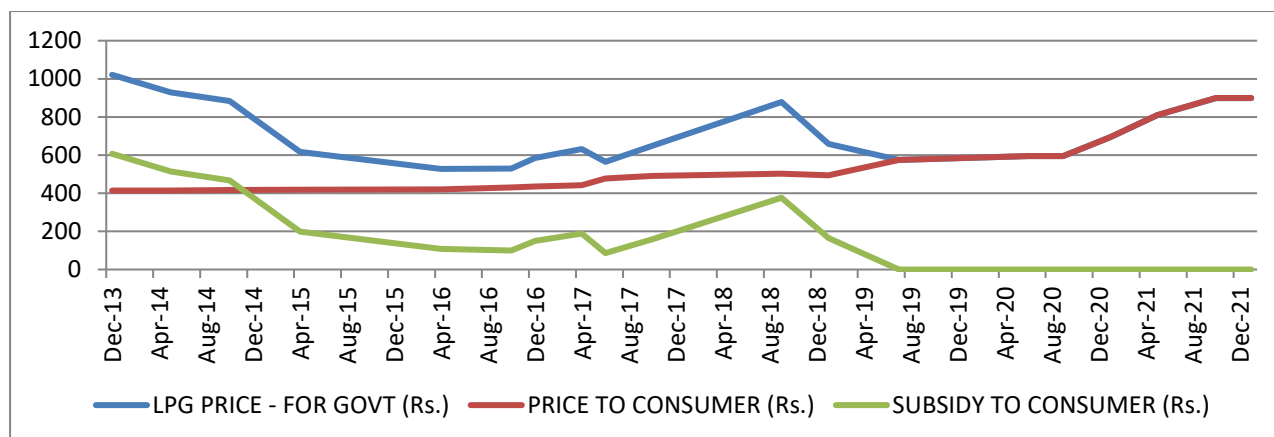


**FIG – 6 Comparison of Consumption For the period 2004-13 AND 2014- 2021**

**Interpretation:** The consumption pattern of Petrol and Diesel had not changed during the UPA and NDA periods.







**FIG – 8 LPG Price for Govt, Consumer and Subsidy for the period Dec 2013 to Jan 2022**

**Interpretation:** Domestic LPG price was kept under control by Union Government by extending Subsidy to poor and Middle class Consumers during UPA period. But NDA Government had slowly reduced the subsidy during 2015-2018 and completely withdrawn the subsidy from 2019. Even the Prime Minister Ujjwala Scheme beneficiaries are not extended with proper subsidy for 6 cylinders per annum. The Union Government had been extended only to the extent of 1 Cylinder which is not as per the scheme.

**Table 9 Karl Pearson Correlation between Crude Oil Price and Petrol & Diesel Price**

Independent Variables	Correlation	Dependent Variables	
	and		
	P-Value	Petrol_Price_UPA	Diesel_Price_UPA
Crude_Price_UPA	Pearson Correlation	<b>0.826</b>	<b>0.745</b>
	P-Value	0.000	0.000
Crude_Price_NDA		Petrol_Price_NDA	Diesel_Price_NDA
	Pearson Correlation	<b>0.265</b>	<b>0.208</b>
	P-Value	0.010	0.043

**TABLE – 10 Performance of Crude, Petro, Diesel, LPG, Subsidy, Taxes etc., Variables in UPA and NDA Period**

Variables	Group	Mean	S.D	Correlation	t Value	P Value	Inference
Crude	UPA	88.71	22.64	-0.134	8.87	0.000	Significant
	NDA	60.55	18.26				
Petrol	UPA	55.07	11.23	0.754	-22.50	0.000	Significant
	NDA	73.67	11.71				
Diesel	UPA	38.28	7.45	0.933	-38.68	0.000	Significant
	NDA	63.42	12.69				
Petrol Consumption	UPA	13780.66	2445.54	0.937	-16.66	0.000	Significant
	NDA	25298.55	3909.07				
Diesel Consumption	UPA	77143.77	5366.98	0.614	7.07	0.000	Significant
	NDA	59698.07	8258.60				

Subsidy Amount given to Consumers	UPA	-1,10,021.57	42437.85	-0.248	-3.80	0.009	Significant
	NDA	-37,465.86	18646.63				
Union Govt Tax Collection (Customs & Excise duty)	UPA	1,31,503.71	13184.57	0.893	-6.55	0.001	Significant
	NDA	3,20,601.57	87846.23				
State Tax Collection (VAT)	UPA	1,23,353.71	16,359.71	0.769	-10.42	0.000	Significant
	NDA	1,97,920.71	28,343.94				
Union Govt Direct Taxes	UPA	4,23,871.75	1,36,201.57		-13.33	0.000	Significant
	NDA	9,34,171.00	1,57,549.67	0.738			
Union Govt Indirect Taxes	UPA	3,42,326.38	1,01,835.07		-10.81	0.000	Significant
	NDA	9,14,343.13	2,22,580.55	0.828			
State Govt Direct Taxes	UPA	61,827.13	21,616.02		-12.84	0.000	Significant
	NDA	1,37,725.75	35,919.39	0.952			
State Govt Indirect Taxes	UPA	3,89,444.38	1,52,748.92		-12.58	0.000	Significant
	NDA	10,36,991.13	2,97,100.95	0.996			
Total Direct Taxes	UPA	4,85,699.00	1,56,977.45		-4.72	0.002	Significant
	NDA	15,48,096.75	7,85,831.04	0.965			
Total Indirect Taxes	UPA	7,31,770.50	2,52,736.88		-5.81	0.001	Significant
	NDA	24,20,381.38	0,68,984.11	0.983			

**Interpretation: General:** There is a significant difference on all variables taken up for study between UPA and NDA period of 8 years of each taken for study. The NDA period was worst for the common man compared with UPA period under study.

# A Novel Codification Technique for Tacit Knowledge in Software Industry using Opinion Mining

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## Abstract

Tacit knowledge is an important resource which comes from experience and insight and is not in any recorded form. The Tacit knowledge has a crucial influence on the success of innovation processes in companies. Tacit knowledge is an important driver in the innovation process and its application has significant impact on the Knowledge management process as it plays a prominent role as a company resource and success factor. Tacit knowledge is mobilized through a dynamic combination of the different modes of knowledge conversion in a process. This paper focuses on the summarization of various efforts of codification methodologies to convert tacit to explicit knowledge, where the later plays a key role in growth of an IT company. In that process, this paper also tries to bring out the lacuna or technical gaps of those methodologies and propose a novel method to capture the technical knowledge hidden in tacit form, so that the technical knowledge transfer in case of staff relocation does not affect the growth of the small-scale IT industry. The challenge that occurs during a software development life cycle is clearly captured by product management software tools like JIRA. We are using opinion mining techniques on these reports to gather all the tacit knowledge which is available only with the technical person assigned to the project. Added to that from our uniquely designed lesson learnt questionnaire, we will extract consolidate generic knowledge. These two, will ensure that most of the needed tacit knowledge will be codified for the usage of any further projects in future. The opinion mining results from the data are promising and further study can be done to include sentimental analysis too.

## INTRODUCTION

Knowledge relates to all the capital owned by people and staff of a company. Knowledge management helps companies turn the human capital into intellectual capital by creating value. Unlike content management, Knowledge Management (KM) is not only about storing documents but is about increasing people skills and expertise thanks to sharing. Knowledge management enables people collaboration and connects all of them to expertise. The ability to quickly find a subject matter expert and get the answer to a question or assistance in solving a problem is a priority in knowledge management. Knowledge management (KM) prevents companies from constantly reinventing the wheel, hence the decreasing supply of talent, the retiring boomers, the staff turnover etc. Knowledge which is new to

an organization must either be invented internally or acquired from external sources. As most of KM technologies emerged from document-centric approaches and support KM cycle such as classifying, storing and retrieval of knowledge. Knowledge can be shared in the form of data, scientific formula, manuals, and such like. Tacit knowledge is personal and hard to formalize, it is rooted in action, procedures, commitment, values, and emotions etc.

There are two kinds of knowledge management, explicit knowledge, and tacit knowledge. Explicit knowledge (EK) can be codified, recorded, or actualized into some form outside of the head. The explicit knowledge management can be done using clear policies, goals and strategies. This explicit knowledge can be maintained in the form of papers and

reports and that can be codified. In a software company the explicit knowledge can be spread using Books, periodicals, journals, maps, photographs, audio-recordings, Webpages, websites, portals. The tacit knowledge comes from experience and insight, not in a recorded form, but in our heads, intuition. Tacit knowledge is the kind of knowledge that is difficult to transfer to another person by means of writing it down or verbalizing or explaining it. For instance, stating to someone that Bangalore is an IT city in India is a piece of explicit knowledge that can be written down, transmitted, and understood by a recipient. However, the ability to master an art, express a feeling in poetic form [2] or design and use complex musical instrument requires all sorts of knowledge that is not always known explicitly, even by expert practitioners, and which is difficult or impossible to explicitly transfer to other users. While tacit knowledge appears to be simple, it has far reaching consequences and is not widely understood.

The employees and an optimal utilization of their knowledge, capacities, and motivation are essential for small-scale business success. The small-scale companies tend to do faster and more streamlined decision-making process with less bureaucracy and lower fixed costs. Also, these companies have more agility in responding to new customer needs and changes in the business climate. These advantages make a small-scale company well suited to innovation and new product development particularly when it comes to technology and software.

It is very important to maintain the tacit knowledge in small scale IT Company since it has very limited number of employees and the attrition rate is more. We can summarize that Explicit

actualized into some form; revolves around objective, rational and technical concepts, involves policies, goals, strategies, papers and reports; can be codified as in books, periodicals, journals, maps, photographs, audio-recordings, Webpages, websites and portals. The Tacit Knowledge from experience and insight, not in a recorded form, but in our heads or intuition; they are subjective, cognitive, and experiential learning; highly personalized and difficult to formalize or simply called as sticky knowledge. In the field of knowledge management, the concept of tacit knowledge refers to a knowledge possessed only by an individual and difficult to communicate to others via words and symbols. Therefore, an individual can acquire tacit knowledge without formal symbols or words, but by observation, imitation, and practice.

The key to acquiring tacit knowledge is experience. Without some form of shared experience, it is extremely difficult for people to share each other's thinking processes [1]. Tacit knowledge can be distinguished from explicit knowledge [3] in three major areas. The first one is codifiability and mechanism of transferring knowledge: while explicit knowledge can be codified, and easily transferred without the knowing subject, tacit knowledge is intuitive and unarticulated knowledge that cannot be communicated, understood, or used without the 'knowing subject'. Unlike the transfer of explicit knowledge, the transfer of tacit knowledge requires close interaction and the buildup of shared understanding and trust among them. The second main difference lies in the methods for the acquisition and accumulation: Explicit knowledge can be generated through logical deduction and acquired through practical experience in the relevant context. In contrast, tacit knowledge can only be acquired through

practical experience in the relevant context. The third differentiation is the potential of aggregation and modes of appropriation: Explicit knowledge can be aggregated at a single location, stored in objective forms and appropriated without the participation of the knowing subject. Tacit knowledge in contrast, is personal contextual, which is distributive, and cannot easily be aggregated. The realization of its full potential requires the close involvement and cooperation of the knowing subject with complete details.

The process of transforming tacit knowledge into explicit or specifiable knowledge is known as codification, articulation, or specification. The tacit aspects of knowledge are those that cannot be codified but can only be transmitted via training or gained through personal experience. There is a view against the distinction, where it is believed that all propositional knowledge: knowledge that is ultimately reducible to practical knowledge.

### LITERATURE SURVEY

Martin Schindler, Martin J. Eppler [4] present an overview of proven methods to record experiences from projects and discusses their use in project management. They basically distinguish between process-based and documentation-based debriefing methods. Process-based methods focus on a procedural approach to capture key learnings from a project. Documentation-based methods serve as appropriate representation formats or structures for project insights. The article bridges the current gap between theoretical insights into this topic and the managerial reality today. It discusses central project debriefing problems such as the lacking willingness to learn from mistakes or the lacking discipline in the use of project management manuals.

The technical gap identified in this work is that the management of project insights requires significant improvements about the format, process, and use of lessons learned. Various formats, process steps, and usage scenarios exist that can enable project-centered learning in a company.

Marzanah A. Jabar, et.al[5] In managing knowledge and competencies as a strategic advantage to an organization, there are difficulties in capturing, storing, sharing and reusing all this knowledge. Researchers have agreed that assessing tacit knowledge is difficult because knowhow of an employee are elusive and what more to assess them. It is compounded when employees leave the organization or become unavailable due to their mobility within the organization. As a result, various approaches to collection and codification of knowledge have emerged. One of the most important approaches to emerge is knowledge management.

Even though KEPSNet contribution demonstrates how knowledge and competencies can be managed, acknowledgement of expertise and referral of the expert for knowledge sharing.

Recent advancements which include the use of intelligent agent (Roda *et al.*, 2003), are some of the future study and possibilities that can be investigated in the improvement and enhancement into KEPSNet decision making capabilities.

**Andrea Prencipe , Fredrik Tell [6]** , in their literature on knowledge codification , they were overly concerned with the economic properties of its outcomes, neglecting the importance of its underlying learning processes. Following Zollo and Winter [Organization Science, 2001, in press], the paper distinguishes three learning processes: experience

accumulation, knowledge articulation and knowledge codification and suggests a framework to analyze the learning abilities of project-based firms.

We have identified that the main gap in this work is that the delimitation of this study relates to their explicit interest in the process, rather than the outcome, of knowledge codification. Hence, we, at least at this stage, have little to say about the efficiency properties of codification strategies for knowledge transfer between projects. Moreover, as pointed out by Eisenhardt and Santos (2001), from a strategic perspective the relationship between learning effectiveness and overall firm performance has yet to be established empirically.

**Malgorzata Bugajska [7]** in his paper makes a detailed study on Successful transfer of knowledge between two organizations which is of particular importance for outsourcing relationships and even more so for relationships within IT/IS domain where the relationship often needs to be rapidly redefined or terminated. Transferring knowledge in IT/IS outsourcing relationships requires empowering of both teams of outsourcer and service provider towards achieving knowledge transfer goals set by outsourcing organization. He focus on the Transfer Team which consists of knowledge keepers (service provider) and receivers (outsourcer) and propose a framework for piloting knowledge transfer initiative in IT outsourcing set-up. To empower the outsourcing Transfer Team, we propose two tools to support the process: Transfer Profiler and Transfer Instruments Catalogue.

From the study there are some areas that we believe needs further research and hence lead to **certain** degree of automation: this may bring additional value to the Catalogue and the

Knowledge Transfer Profiler. Additionally, describing a Transfer Instrument in the form of patterns could reveal additional qualities of such an Instrument and offer a more reusable approach which can be furthered applied by organizations in their future outsourcing initiatives.

**Keith Goffi n, Ursula Koners, David Baxter, and Chris van der Hoven [8]** study how every new product development (NPD) team learns a unique set of lessons in solving the many problems that arise in a typical project, and it is importance to ensure that these lessons are shared. Since much of the learning is tacit in nature, it is difficult to articulate, to capture, and to disseminate. Therefore, managers face a challenge in trying to stimulate project-to-project learning. Many companies hold post-project reviews (PPRs) meetings at the end of projects to determine the lessons learned and document them for the future. Their research at five leading German companies shows that written reports fail to convey much of the key learning from NPD teams and so managers need to focus on stimulating individual learning and running PPRs in specific ways to generate and transfer tacit knowledge.

In analyzing the paper, we find that **the** new product development involves solving complex technical problems encountered during a project, the know-how generated by teams is significant. The technical solutions are often original and it is appropriate to consider whether these solutions can be codified to make them easier to share. As the interaction between the plastic and the environment is complex and not clearly understood, a new way of codifying this is required.

**Ruben Prieto-Diaz [9]** in his paper explores the experience on the development, implementation and deployment of reuse library technology.

The focus is on organizing software collections for reuse using faceted classification. Briefly described are the successful GTE Data Services' Asset Management program and the steps taken at Contel for furthering reuse of technology. The technology developed for reuse libraries is presented first, followed by a description of how it was transferred. The conclusions of the experience are: reuse library technology is available, it is transferable, and it definitely has a positive financial impact on the organization implementing it.

We find that the research and development experience has also pointed to new research directions needed to advance reuse technology. These areas include domain analysis and tools to support domain analysis activities, tool integration for supporting a library centered environment.

**Margaret-Anne Storey [10]** in his paper presents the conceptual design of TagSEA, a collaborative tool to support asynchronous software development. Our goal is to develop a lightweight source code annotation tool that enhances navigation, coordination, and capture of knowledge relevant to a software development team. Our design is inspired by combining "waypoints" from geographical navigation with "social tagging" from social bookmarking software to support coordination and communication among software developers.

We conclude that by using tagging to specify waypoints, we can also investigate how social tagging is used to share and exploit tagging vocabularies and taxonomies, while also increasing awareness of development activities beyond the confines of the IDE.

**Anil Midha [11] dives deep into** our experiences, whether "good" or "not so good" teach us important lessons. He studies whether individually, do we really learn from these lessons? Whether even if we learn some of the lessons, do we always share our key learnings with others? He wanted to study whether even if we share our key lessons with our team members, are they shared with larger entities (projects/organizations)? And even if some of these lessons are shared at larger levels, do most of the projects/organizations really learn from and apply them?

A systematic five-step approach of collecting and translating key lessons into practices is suggested to yield sustained and continuous process improvement: Capture lessons from various activities, Catalog and save lessons in a structured knowledge repository, Communicate and apply lessons, incorporate lessons into process, Rollout and institutionalize enhanced lessons

**Barbara H. Kwansnik [12]** studies the **link** between classification and knowledge is explored. Classification Schemes have properties that enable the representation of entities and relationships in structures that reflect knowledge of the domain being classified. The strengths and limitations of four classificatory approached are described in terms of their ability to reflect, discover, and create new knowledge. These approaches are hierarchies, trees, paradigms, and faceted analysis.

However we find that some classifications enable flexible manipulation of knowledge for the purposes of discovery; some are rigid and brittle, barely able to stand up under the weight of new knowledge. It is useful to understand the properties of various classification structures so we can exploit their



strengths and work around the weaknesses. In the future, classification will be enhanced by new methods of revealing patterns, associations, and structures of knowledge, and by new ways visualizing them.

### **Methodologies of Tacit knowledge codification Existing Methodologies of Tacit knowledge codification**

Knowledge management can be considered the dynamic process of creating new knowledge, identifying sources of this new knowledge and the elicitation and distribution of this knowledge [15]. The identification of tacit knowledge sources and the creation of knowledge through tacit-to-tacit knowledge sharing and tacit to explicit knowledge sharing are fundamental to this process.[16]. When we look into the KM process of an IT company, the key persons who will be using the codified knowledge derived from tacit knowledge could be managers, team members and the main area of expertise they seek guidance are project management processes and tools, technical work and business processes

According to Parsaye, there are three major approaches to the capture of tacit knowledge from groups and individuals. They are:[17] interviewing experts, learning by being told and learning by observation. Interviewing experts can be done in the form of structured interviewing or by recording organizational stories. Structured interviewing of experts in a particular subject is the most used technique to capture pertinent, tacit knowledge, like an exit interview. Learning by being told can be done by interviewing or by task analysis. Either way, an expert teaches the novice the processes of a task. Task analysis is the process of determining the actual task or policy by breaking it down

and analyzing what needs to be done to complete the task. Learning by observation can be done by presenting the expert with a sample problem, scenario, or case study and then observing the process used to solve the problem. Another technique for capturing tacit knowledge is Action learning. All these approaches normally will be recorded to transfer the tacit knowledge into reusable explicit knowledge.

Professor Ikujiro Nonaka has proposed the SECI (Socialization, Externalization, Combination, Internalization) model, one of the most widely cited theories in knowledge management, to present the spiraling knowledge processes of interaction between explicit knowledge and tacit knowledge (Nonaka & Takeuchi 1995).

### **Proposed Methodology for Tacit Knowledge Codification**

A process by which the expert's thoughts and experiences are captured and how a knowledge developer collaborates with an expert to convert expertise into a coded program is an abstract task as we want to "know" how experts know about what they are experts. Much of the Tacit knowledge may be difficult to capture because the individual may be unaware it even exists. It is important for the employee to be a willing participant in the organization's quest to obtain the tacit knowledge. It is also very common that the employees are not willing to share their information [20]. Our main problem definition includes in how to effectively organize software project lessons learnt and devise some methodologies to convert those tacit to explicit knowledge for future software projects.

We have found that the systematic way of gathering tacit knowledge reduces

the challenges in later codification process. We have taken the JIRA reports of only selected participants and concentrated in extracting the opinions using opinion mining techniques using the simple yet effective queries like what was done rightly (positive measures in sentiment analysis), what went wrong (negative measures in sentiment analysis) and the critical bottlenecks where we could improve. We have created a unique lesson-learned questionnaire which mainly covers lesson learnt, root cause for the problem, response for critical issues, selection criteria for proposing such responses, along with keywords. We have tried to extract knowledge about a specific case from these two sources and then consolidate into the Knowledge base. We have used

## 1. Inferences and Results

One of the popular Product Management Tool used by many small-scale IT industries is JIRA. JIRA is a proprietary issue tracking product, developed by Atlassian used for bug tracking, issue tracking and project management. The product name, JIRA, is not an acronym but rather a truncation of "Gojira", the Japanese name for Godzilla. Figure 1 indicates the first screen shot of JIRA. There are two places where information can be extracted; one is Bug Write-up Procedure and second one is step where issues are resolved and closed. In order to "Hasten The Work" it is very important that the bug reporter write up the bug correct. This will allow the person who is reporting the bug, the person that saw it firsthand, to accurately describe the issue in adequate detail. The next person that meets the write up will then be able to follow the proper steps and verify if indeed it is a bug. Correct procedure in bug write-ups will also benefit any employee that is new on the

team, who may not be familiar with the project, to step in to the role and know exactly what to do to reproduce the bug. If procedure is not followed the momentum of the project will be affected. The following steps are followed in writing up a bug: Steps to Reproduce, Actual Results of the application after performing the above steps, expected results in case of absence of the bug, date and platform details and additional debugging Information. The standard method for resolving the issue expects the programmer to specify the code change clearly in the description section of the "Resolve Issue" tab of the JIRA product. Figure 2 explains various parameters captured in JIRA reports. This information can be extracted for the analysis to extract the knowledge. The cause and remedy has been captured in decision trees and stored in the Knowledgebase.

## CONCLUSION

Much research has been conducted regarding Tacit Knowledge management, but little research has been devoted to the extraction of knowledge from an employee's work diary, which is recorded in Product Management Tools. This paper provides a starting point for future studies in such knowledge extraction and codification. The KM implementation from tacit to organization is an important subject for both researchers and practitioners. Though the previous literature has given a partial prescriptive for the success of KM implementation, none have been complete. This paper seeks to include all areas for consideration when trying to implement the codification process using Data mining approach. Usage of Opinion mining and sentiment analysis might throw a deep insight in capturing the hidden tacit knowledge.

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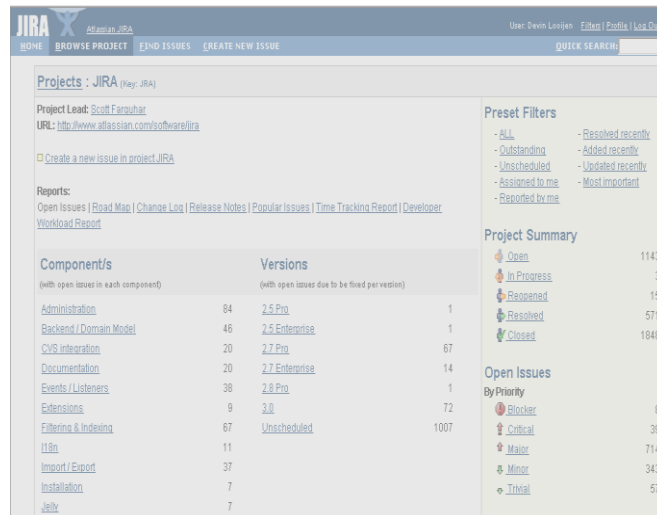


Fig 1: JIRA -Product Management Tool



Fig 2: Parameters Captured in JIRA reports

## Systematic Knowledge Management of Lessons Learnt in Mitigating Project Overruns

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### Abstract

The Healthcare sector has the compulsive need to be socially responsible by promoting both curative and preventive measures for the welfare and general well-being of society. Hence, it is imperative to make sure that the controllable elements of projects minimize and, if possible, eliminate inordinate delays in completing the same should become a top priority. To achieve this, it could be very desirable to look at documented knowledge even before conceiving and designing a project. The social security system and health care system in advanced countries are the envy of developing countries and the poor African nations that face a lot of problems caused by inadequate medical infrastructure and support systems. Against this backdrop, the provision of knowledge created by historical data and effective methods of retrieval of such data in time may well be the answer to ailing populations all over the world. Hence an inquiry into the causes and the remedy for software project delays in the health care sector may well address this problem and provide the necessary solution. The study is about identifying the critical factors that affect the creation of knowledge and use of the same to overcome hurdles in project management through a process of systematic documentation and codification of knowledge with an inbuilt conveyance of knowledge extraction to achieve higher levels of management knowledge. Amos used as the tool and established a model of the relationship of variables. The model has been interpreted by the variables have been categorized as independent, moderating, and dependent this has led to the formulation and testing of the hypothesis

### INTRODUCTION

The Healthcare sector has the compulsive need to be socially responsible by promoting both curative and preventive measures for the welfare and general well-being of society. Hence, it is imperative to make sure that the controllable elements of projects minimize and, if possible, eliminate inordinate delays in completing the same should become a top priority. To achieve this, it could be very desirable to look at documented knowledge even before conceiving and designing a project.

The social security system and health care system in advanced countries are the envy of developing countries and the poor African nations that face a lot of problems caused by inadequate medical infrastructure and support systems. Against this backdrop, the provision of knowledge created by historical data and effective methods of retrieval of such data in time may well be the answer to ailing populations all over the world. Hence an

inquiry into the causes and the remedy for software project delays in the health care sector may well address this problem and provide the necessary solution.

The integration of information technology with healthcare is another important milestone that rendered availability of data on a large scale for not only treatment but also for research and development in this field of study. The advent of software products for healthcare management has taken Medicare to the next level with online solutions and diagnosis through advanced means of testing, a welcome reality. Under these circumstances, it would be desirable to promote innovation in system and application development of medical software that would provide a quick

solution to long-drawn health issues. The time gap between testing, diagnosis, and treatment can be ideally minimized through effective use of medical knowledge that has already been stored in

databases rendering retrieval of such critical information by the click of the button. Hence such highly sophisticated software projects mustn't get choked at some bottlenecks causing undue delays and denial of the benefits to the ever-increasing sick population. In that direction, identification of factors that cause project overruns and mitigating the same through effective codification and extraction of knowledge can never be overemphasized. This study attempts to fill the gap in the literature that currently exists for the health care sector in terms of the creation and dissemination of knowledge through a well-structured process of codification and knowledge extraction.

Can a systematic Record of software projects from the time of planning to the ultimate execution be the solution to create a relevant project management database?

Would it be possible to facilitate mitigation of project overruns through systematic documentation and effective retrieval through codification and extraction of such knowledge?

### **STUDY VARIABLES**

A careful scrutiny of the above factors brings to light the importance of codification and extraction of knowledge to mitigate and subsequently eliminate the causes of project overruns, particularly in terms of time. Having considered these factors, this study has identified some important variables that may provide the base for a proper framework to achieve systematic documentation of knowledge and the extraction of the same through a process of scientific codification. Each one of these factors covered in this study is described briefly and form part of the survey questionnaire that is circulated among the respondents.

#### **Planning inadequacy**

Planning Inadequacy has been the story of undue delays and even failures of

many projects in many sectors, including healthcare. The lack of Scientific applications of past experience in planning future projects always leads to inappropriate and unimaginative time schedules that are neither standardized nor verified based on the experience from the previous project. This is particularly relevant for projects in the healthcare industry where timely decisions need to be made based on credible data.

#### **Organizing Inadequacy**

A systematic process of planning becomes entirely irrelevant if it is not effectively implemented at every stage through proper organization. It is essential to bear in mind that employees at the ground level are the ones who take care of the execution and implementation of projects, particularly in software. The project managers and team leaders are responsible for ensuring that time schedules are scrupulously and adhered to and any deviation is sufficiently justified, and appropriate measures are taken for eliminating such deviations. In that sense, organizing a project throughout its life cycle is very critical to mitigate overruns and achieve efficiency and standardization.

#### **Control Inadequacy**

Control is a mechanism that routinely checks the implementation of the project at every stage by comparing the planned activity with the actual output. In software projects, this is highly relevant because there is likely to be cascading effect caused by delay at stage 1, leading to a domino effect in terms of delays in another stage as well. Since Management information system reports are a feature of the present-day control mechanism, it is easier to monitor the projects through a careful comparison of the plans with actual implementation. This is particularly applicable to areas that result in undue variance between the standards and actuals that need to be explored and explained so that such variances can be

avoided in the future. In this context, activity reports become a critical part of knowledge documentation as well as the establishment of a suitable control mechanism.

### **Falling back on Project manuals**

As has been repeatedly emphasized in the early part of this chapter, recording the activity and creation of reports for non-variant and variant activities forms an essential element of the project manual. This not only helps in the documentation of the project after implementation but also aids in providing the basis for comparison when it comes to other projects. By falling back on past experiences, project managers would be in a position to access the similarities and dissimilarities of the present and past occurrence of events and record the deviations appropriately and highlight the same as a critical aspect of every stage. This would help in easy troubleshooting in the future by falling back on documented knowledge.

### **MIS reports as a tool for knowledge management**

As stated earlier, a continuous check on the project implementation is imperative for timely completion of the same. Since MIS reports form the basis for a systematic record of actual performance, it becomes easier to compare the same with planned activity to identify pockets of delay and suitable measures taken for the timely corrections of the same. The final activity reports also form a part of subsequent MIS reports and help troubleshoot for future projects on account of a systematic database created from these reports. In that sense, MIS reports can be considered as an important tool for knowledge extraction and use the same to minimize routine delays caused by foreseeable bottlenecks to a project.

### **Knowledge Documentation**

It is a logical culmination of all the factors mentioned above that would result in an accurate and systematic record of transactions in all their details. This document would help in storing project knowledge with a particular focus on variances and steps taken to correct the same. MIS reports Activity reports, Project Manual, and Project Document would all together comprise valuable data that can be stored in the project database. After this, codification and extraction of knowledge is only a matter of intelligent choice of the right tools to gather information relevant to a particular issue on hand. Hence there is no necessity to overemphasize the value of documentation and its utility as a record of historical data.

### **Benefits of Codification**

The vast data, which is popularly known as big data today, is created by a systematic record of project data, is useless unless there are effective methods and tools for retrieval of appropriate facts for relevant conditions. This aspect of software project management is sought to be achieved by the codification of project knowledge through the use of the right language. Codification is a process that helps in the easy retrieval of information from a database to eliminate time consuming and tedious searching process.

### **Ease of Extraction**

Systematic documentation of project knowledge and an effective method of codification would enable easy access to critical data that may do away with frequent reference to voluminous records or databases. In effect, knowledge extraction is simplified by the effective use of codification and collection of relevant details that are necessary to handle a particular issue that has been threatening to get out of control in terms of an immediate solution. The ease of extraction of data would help in minimizing the time

lag between the identification of an issue and the resolution of the same effectively.

### **Creation and Dissemination of Project Knowledge**

The very objective of the whole exercise, starting from the recording of details in a project manual to the ultimate goal of ease of extraction, is to minimize possible time delays, to begin with, and achieve a fool-proof system of creation and dissemination of knowledge. This is particularly relevant to the health sector, where the need for addressing complicated medical issues cannot be compromised by undue delays that can be well avoided by leveraging technology that is seamlessly integrated with people and processes. It is also relevant to point out at the stage that the resulting cost advantage may prove crucial in achieving a competitive advantage for players in the sector.

### **PRIMARY DATA COLLECTION**

Choice of things, from writing survey, which might cause challenges of Indian producing SMEs in carrying out TQM. Planning of fundamental review poll also, leading pilot test, Settling the overview, poll for literature review research in light of the pilot test Choosing the objective Indian SMEs by accommodation testing and snowball examining strategy, Sending the review survey to the objective Indian SMEs for their reactions, Follow up to assist their reaction, furthermore, take on meet based review for the respondents confronting hardships in reacting or deferring Gathering, organizing and recording of the essential information from the reactions of the study.

The 'content legitimacy' is a non-factual legitimacy deciding if the study content covers an agent test of the conducted space to be estimated. The substance-related legitimacy can be founded on assessing educated authorities thinking about the overview things in contrast to the study determinations (Anastasi and Urbina, 1997). Any study

would have content legitimacy assuming the Items are chosen cautiously, so they follow the study mainly. The substance legitimacy of the overview can be improved by utilizing a board of specialists in the subject area to audit and remark on the study poll and the determination of things (Foxcroft, Paterson, le Roux and Herbst, 2004).

The study survey was outlined dependent on the chosen things, looked into by a specialist board. The amendment of the poll was taken up through the pilot test, considering the ideas given by the respondents of the pilot test and the assessment of the master board for the improvement of the 'content legitimacy' of the study. The overview survey was settled, having content approval endorsed by the master board. The master board was comprised comprising of five individuals having information and ability in the accompanying fields,

### **OUTCOME OF THE STUDY**

Through reliability analysis the researcher is enabled to examine the properties of estimation scales and items that comprises of this scale. The reliability Analysis method enumerate various ordinarily utilised measures of scale, by not deviating the quality and furthermore gives data about the connections between individual items in the scale. Over and above to it, the intra class correlation coefficients can be used to calculate between interrelated quality appraisals.

### **CONCLUSION**

The Healthcare sector has the compulsive need to be socially responsible by promoting both curative and preventive measures for the welfare and general well-being of society. Hence, it is imperative to make sure that the controllable elements of projects minimize and, if possible, eliminate inordinate delays in completing the same should become a top priority. To achieve this,



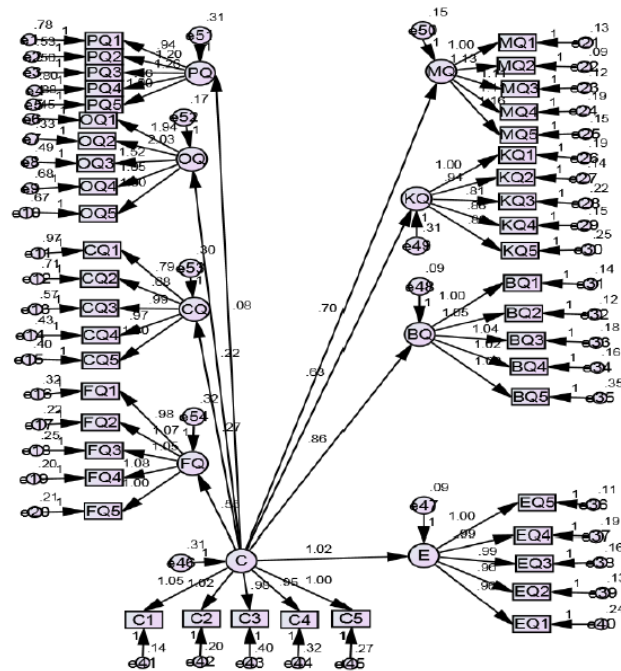
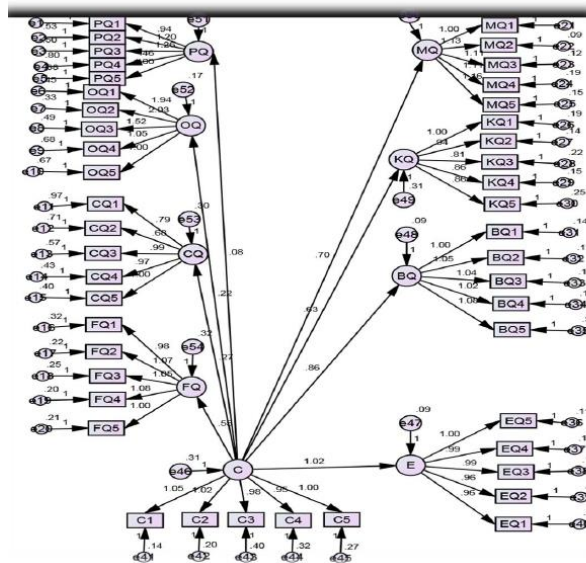
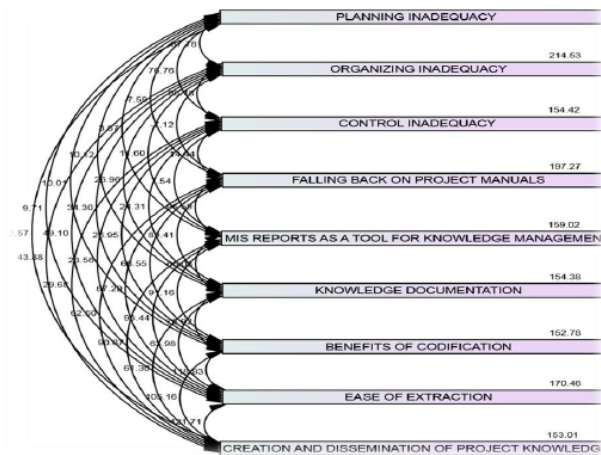
it could be very desirable to look at documented knowledge even before conceiving and designing a project.

The social security system and health care system in advanced countries are the envy of developing countries and the poor African nations that face a lot of problems caused by inadequate medical infrastructure and support systems. Against this backdrop, the provision of knowledge created by historical data and effective methods of retrieval of such data in time may well be the answer to ailing populations all over the world. Hence an inquiry into the causes and the remedy for software project delays in the health care sector may well address this problem and provide the necessary solution.

We find that the senior members with several years of experience in executing the projects do help in mitigating project overruns through systematic knowledge extraction of lessons learned from software projects in the healthcare sector. The senior team members are also in a more accountable and responsible role in the project and they help significantly in using the lessons learned and making a solid execution plan for the projects. The study found that it is highly beneficial to consult the project manuals that have been organized systematically, to have projects executed and completed on time. The study found that it is important to spend time in creating and disseminating project incidents and events, mitigation strategies. It is important to document this knowledge for the use of future project teams. It is very critical to make it easy for the teams to access the project lessons learned data from the previous projects. It should be easy to locate for new and existing team's members. The knowledge items should be categorized and stored. We should have a tool that will make it is easy to search and locate the information needed. This needs an MIS tool like Confluence.

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# Changing Role of Artificial Intelligence in the Growth of Entrepreneurship Development

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## Abstract

Innovation is also an important part of a business start-up process. Many new ventures grow around a creative idea or a decision to put to the market a new company model. Spontaneously, some revolutionary innovations arise, but most commonly, they emerge out of a deliberately designed and organized phase of invention. They will need a detailed strategic strategy to bring ones designs to fruition, as well as funding to help users design, test and sell the inventions. To minimize operating costs, improve performance, increase sales and enhance customer service, many organizations use artificial intelligence (AI) technologies. Businesses should consider putting the entire range of smart technology into their systems and goods, including artificial learning, natural language processing and more, for the maximum gain. Also companies that are new to AI, though, will reap big reward.

**Keywords:** Artificial Intelligence, AI, Innovation, Startup, Smart Entrepreneurship, SMART, Business.

## INTRODUCTION

Innovation is also an important part of a business start-up process. Many new ventures grow around a creative idea or a decision to put to the market a new company model. Spontaneously, some revolutionary innovations arise, but most commonly, they emerge out of a deliberately designed and organized phase of invention. They will need a detailed planned strategy to bring ones designs to completion, as well as funding to help users design, test and sell the inventions. To try to minimize operating costs, improve performance, increase sales and enhance customer service, many organizations use artificial intelligence (AI) technologies. Businesses should consider putting the entire range of smart technology into their systems and goods, including artificial learning, natural language processing and more, for the maximum gain. Also companies that are new to AI, though, will reap big rewards.

## The market effect of artificial intelligence

By introducing the right AI technologies, the organization will acquire the opportunity to: Save time and resources by automating and optimizing repetitive procedures and activities to improve productivity and efficiency of operations. Making quicker business decisions based on cognitive technology outputs prevent mistakes and 'human error,' provided that AI programs are correctly set up to use intuition to anticipate consumer desires and provide them with improved, customized experience mine vast quantities of knowledge to produce quality leads and maximize revenue by detecting and optimizing market opportunities. The key driving force for the use of AI in industry was strategic advantage, according to a recent report. An executive-led decision needs an unlikely solution to a challenge and offshoot of another initiative from a specific group, organizational or technological problem and internal experiment client.

## **Benefits of working together AI and humans**

AI cannot always do well on its own, literature shows. AI systems are excellent at driving or even eliminating lower-level, routine activities, but when people and computers operate together, organizations also produces the greatest efficiency enhancements.

- Save time and money by automating and optimizing routine tasks and procedures
- Increase productivity and efficiency in operations
- Based on outputs from cognitive technologies, make faster business decisions
- Prevent mistakes and 'human error' if AI systems are properly configured
- To predict customer preferences and offer them a better, personalized experience, use insight
- To generate quality leads and grow your customer base, mine vast amounts of data
- Increasing revenue through the identification and maximization of sales opportunities
- By enabling analysis and providing intelligent advice and support to develop expertise.

### **The Smart Entrepreneurship:**

To achieve precise targets, an effective organization has specifically set and expressed goals. Yet, many organisations miss a concentrated target in the field of small business. "Get more business" is a common reaction when asked about potential plans by small

business owners. To complete a cryptic response, any self-respecting CEO will be thrown out of a shareholder meeting. Organisation's achievement relies on owner's ability to set and attain targets, whether they have a corporation of 50 workers or a domain of one. Put the enterprise on the fast-track by applying the SMART target setting rules.

### **Specific**

Great targets are well-defined and concentrated. It is more important to mobilize their squad than "Get more business" to gain two new billion dollar corporate clients in the Boston property insurance industry." Ryan Blair, the Goal powerfully states, "Energy generates a strong force: target strength. The goal becomes a magnet the moment they focus on a goal, dragging them and their money into it. The more concentrated their efforts that the more power they are using to achieve their goals.

### **Measurable**

A target without a visible consequence, without a clock or scorekeeper, is like a sporting game. Numbers are an important component of industry. To know if they're on target, bring tangible figures into their targets. As a daily reminder, a target white board placed in their office will help to keep themselves and their team focused on the desired goals they want to produce.

### **Attainable**

Small companies will, all too many, set targets beyond their reach. No one has ever developed a company worth a billion dollars overnight. Invest capitalists and angel partners discard endless investment proposals with outlandish targets by businesses. Dream big and shoot for the stars, but in fact, keep one foot firmly fixed. In order to set wise expectations, consult

with the business organization and get a handle on achievable growth in their industry.

### **Relevant**

Achievable market strategies are based on the business climate's existing circumstances and realities. Entrepreneurs may choose to have the best sales year or raise sales by 50 percent, but if a recession is looming and three new entrants have opened up in their sector, the targets are not applicable to the market's realities.

### **Time-based**

Business goals and goals just don't get accomplished because there is no time limit related to the method of setting goals. If the business aim is to raise sales by 20% or find 5 new buyers, pick a time-frame to reach the target. Once the company objectives are SMART, to meet the targets, break down each aim into a specific series of tasks and activities. It's important to revisit the priorities regularly and make changes if necessary. The setting of targets for the small company is an important instrument for growth. Remember to be clever in the end.

### **10 rules that entrepreneurs should know before adopting AI**

Although the company's implementation of artificial intelligence (AI) and machine learning (ML) is still in its early days, the technology has evolved enough for entrepreneurs to begin collecting inspiration and assessing future applications opportunities. Every day, neural network processing capacities are growing, as is the accessibility of large-tech and academic standard APIs in the institutions which help to accelerate innovation. Instead of attempting to offer generic toolkits to business users or get bogged down in custom software consulting engagements that address non-

repeatable use cases, entrepreneurs have now mastered the knowledge of targeting AI applications against real, well-defined business problems.

Today, developers have more chances to work on addressing vertical issues than developing horizontal solutions. Building generic products for consumers across industries is within the ethos of existing tech companies. But for competitors, the more they can concentrate on solving key business challenges, the more they will be successful. They can thoroughly understand business demands and consumer requirements. Based on the unique pain points of their customer, configure product functionality. As a consequence, in the approach, the client will see more market value and be more likely to turn to a paying client. (An additional start-up bonus: lower customer-acquisition costs. Nevertheless, it has been proved difficult for entrepreneurs to write effective AI strategies. After all, technology is a moving target, potential customers are wary of costs and complexities of implementation, and use cases are still missing in many areas.

For entrepreneurs ready to make their mark at the beginning of the digital business age, all this confusion is a fertile breeding ground. Here are 10 rules of thumb to follow as they build an AI strategy as an AI-first venture in an existing business or sinking roots.

It is at least as important to consider the business challenge they are solving as the algorithms. While what makes these applications different from traditional apps is the technology and data processing behind AI, their company clients are not looking for technology per se. To fix challenges, they want answers. It is not nearly precise enough to put the service or product as "AI for health care" or "AI for

sales". Although we can market AI tools to data science teams or IT agencies, company executives like to ensure that you are intimately aware of their challenges and prospects, and that their approach is customized to their case. Artificial intelligence should provide a safer solution.

In order to fund the approach, is the market ready? When more of the planet gets digitized, "data collection" begins to accelerate (their ability to gather data from multiple facets of the world has never been quantified before). The problem: Much of the data is not digital and unstructured, especially in traditional industries such as health care, manufacturing, and agriculture, vastly increasing the effort needed to extract, disinfect, normalize, and wrangle. Determine the industry's digital sophistication in terms of embracing AI prior to starting an AI strategy. Is the market advanced, with data collection and ready-to-implement technology already in place?

From day one, build the data plan. Experience-based training machine-learning models also need vast volumes of high-quality data to evolve, so it is incredibly necessary to set out the data plan from day one, including how it can manage topics such as data sourcing, length, diversity, privacy and protection. In a variety of ways, data can be acquired, including crawling public data, seeking data-rich collaborators, extracting it from clients, or producing it internally. It has its own pros and cons, and at various points, their application could be better suited. Data strategy is a rational business decision that must be established from the outset by entrepreneurs.

The product also needs better user interface (UX), the best workflow, and detailed documentation, even though the AI is fantastic. It is not because the AI is superior that they might win, but because

the end-to-end product is stronger. Concentrating on representing the end customers of the clients should be baked into the DNA of the team. They are creating more than the ML product in most situations, so teamwork and cooperation is required across functions and between software engineers and UX designers, both frontend and backend.

AI may be magical, but it still gains sales. Venture capitalist and influential author Fred Wilson argues that "marketing is for businesses that have sucky products." Likewise, many AI founders believe it can sell itself if the product is amazing. That is not the truth of the world of enterprise, however by default, large businesses are unable to adapt until they are persuaded that the option is worth their market planning work and the legal-finance team's time to sign negotiations and turn to a new seller. In the sales and marketing team, respect experience, particularly if they come from the sector or companies on the target list. Functional leaders today have more leverage to determine which technologies to use than in the past, so entrepreneurs need to find out an entrance point for the venture.

"In ads, be cautious about "AI-first" messaging. An AI-forward positioning might be a successful tactic to get a first meeting considering the buzz surrounding AI that has raised everyone's interest. However, consumers don't really care whether it has AI inside or not when it comes to actual purchasing decisions. In fact, some startups have deleted AI from their marketing and sales messages. Although leading with AI does not make sense, there is value in weaving it into the introduction of the product, particularly when it comes to simplicity and the underlying machine-learning algorithms are clarified.

Stop the trap of "science project." What is the Minimum Viable Algorithm (MVA)? As the saying goes, "perfect" is always the "good" enemy. Business management has come to accept the power of efficiently injecting and iterating a minimally viable commodity into the market based on real-world reviews. Similarly, AI ventures should aim to create a minimum viable algorithm and sell it rapidly. The DNA of the founding scientific teams is mostly about solving technical problems and increasing precision from 90 percent to 95 percent. This strategy can require some persuasion. The distinction will not be noticed by many consumers, but they will note how the product progresses from release to release.

Manage the over and under-expectations of clients. Half of the fight is over control of standards and coordination when it comes to effectively deploying AI in the real world. Customers always overestimate the influence of their AI, thinking of it as superhuman, especially if AI solves difficult issues such as 100% accuracy in self-driving cars and medical diagnosis. They have to make them realize that with time the efficiency of ML goods increases (after all, it is machine learning) and that at the beginning it is impossible to produce flawless results. If AI is addressing a restricted problem such as back-office automation or insurance premiums, underestimates may also occur. It is essential to help customers understand which AI issues can and cannot be solved, just as an Insurance company, which uses AI and other technologies to determine coverage and set premium rates, very clearly explained to potential customers how their product worked and what was and was not covered. AI is still a technology that is very imperfect and often fails. On that score, there should not be any surprises for clients.

Recruit industry specialists as well as domain experts. Both ML engineers (often PhD level) and top software engineers who can produce and deploy AI are needed by their team. (Ideally, they want talent that can do both, but find them with good luck!) There is a limited supply of ML engineers and big tech companies are going to pay dearly for a brand new deep learning PhD. For startups, it's difficult to attract top AI talent, but even harder for Fortune 1000 businesses. It is even more significant, however, to attract domain experts from the traditional industries they are trying to disrupt. In order to trust AI's judgments and validate outcomes, they are critical in assisting target clients, deploying technology, and understanding the input needed and the internal workflow used by companies.

Organizational change: Toward a culture that is more open and experimental. In the world of business, ML/AI engineers are still a novelty. Managing an AI-first startup requires fundamental changes in the organization: an experimental culture, a mindset driven by data analytics, and more openness to uncertainties. As a founder, cross-functional teams should be helped to understand how ML products differ from conventional software products, address potential conflicts, and promote a culture that is more open and experimental.

### **Top applications of artificial intelligence in business:**

While John McCarthy invented the word "Artificial Intelligence" back in 1955, Alan Turing proposed the first notion of a computer simulating human reasoning and intelligence years ago. In short, the intelligence displayed by computers and software is Artificial Intelligence (AI for short or the art of making intelligent software and hardware). There are two main branches of Artificial Intelligence, including general AI (its purpose is to learn

how many things function, such as a language) and narrow AI (building smart computers and applications that solve real-world and usually business-related problems).

### **AI has many specialty areas:**

**Gaming sports:** Back in 2011, Watson of IBM defeated two of Jeopardy's key teams. While the machine has developed over the years into a complex system of healthcare analytics, it was originally programmed to simply answer natural language questions;

**Networks of Experts:** The AI-powered computer can ingest and interpret data even faster than humans, and that's why Watson diagnoses cancer with 90% specificity (while in 50 percent of all cases, well-trained human doctors are mistaken);

**Recognition for voice:** People can ask Siri to order pizza or find the closest flower shop thanks to Apple's AI efforts, and they don't have to type something in anymore.

**Learning by machine:** Google search is now improved with machine learning algorithms that deliver meaningful content to consumers, and that's one of the reasons why traditional SEO is dying slowly;

**Robotics:** Spread, a Japanese lettuce processing firm, has revealed plans to equip its farms with robots to harvest 30,000 lettuce heads daily. Robots can also monitor storage equipment, navigate in-store customers and take care of baggage for guests at hotels and train stations.

Artificial Intelligence has the ability to streamline business operations, optimize customer services and exploit marketing and advertisement sensor-driven data. The global demand for information analytics, exploration and

cognitive systems will be worth \$ 9.2 billion by 2019.

### **Use of Artificial Intelligence in Business**

Enhanced services for customers. Companies have definitely encountered some improvements in consumer behaviour in the case of running an online shop. 30 per cent of all internet purchases are now mobile-based. While smartphone owners spend 85 percent of their mobile time on multiple applications, their focus is paid to just five apps (including messengers and social media). The world's leading retailers such as Macy's and Target add beacons and turn to gamification in order to promote smartphone app acceptance. Kik and Facebook went even better, introducing chatbot platforms.

While among the first businesses to hop on the chatbot bandwagon were H&M, Sephora and Tesco, the promise of bots reaches well beyond the e-commerce realm. A Facebook bot was created by Royal Dutch Airlines to assist travelers with check-in documentation and submit flight status updates. A virtual assistant software was created by Taco Bell that handles orders via the Slack messaging app. HP's Print Bot allows users to transfer files straight from Facebook Messenger to the printer. 33,000 businesses have now installed Facebook bots, according to David Marcus, VP of Facebook messaging goods, and now they are "starting to see good experiences on Messenger".

### **Automation of workloads and predictive maintenance:**

Work automation will cause a net loss of 9.1 million US jobs by 2025. The next employment crisis will not, however, be caused by Artificial Intelligence; instead, smart programs will allow businesses to use their resources more effectively. To monitor its infrastructure, Engine, an electrical company from France, uses



drones and an AI-powered image processing application. The National Free Hospital in London has partnered with DeepMind (a Google-owned AI startup) to develop algorithms that detect acute kidney injuries and vision conditions with little or no human interference. Through gathering and processing input from smart sensors mounted on its devices, General Electric battles computer downtime. Businesses will decrease running costs, improve efficiency and ultimately build a knowledge-based economy through the Internet of Things and AI solutions. Through gathering and processing input from smart sensors mounted on its devices, General Electric encounters computer downtime. Businesses will decrease running costs, improve efficiency and ultimately build a knowledge-based economy through the Internet of Things and AI solutions.

**Efficient monitoring and analytics for data:** Worldwide, there will be 6.4 billion wired gadgets by the end of this year. If more businesses continue to use IoT technologies for business purposes, the volume of data produced by intelligent sensors is growing (and will reach 400 zettabytes by 2018). We will boil this knowledge down to something concrete thanks to Artificial Intelligence and have a deeper perspective into the handling of funds and employees. In his "Can Artificial Intelligence Usage Make Hiring Less Biased?" Sean Captain's article talks about Fama's social media presence assessment service for career applicants.

**Marketing and advertising growth:** The way advertisers have been operating for decades has been transformed by emerging technology. Researcher can have a news article written (or generated!) in mere seconds using the AI Wordsmith platform. To support the Muppet Show movie, the smart Miss Piggy

bot talks together with fans. To detect user behaviour and optimize ad targeting, Facebook uses machine learning algorithms. In order to maximize accommodation costs, Airbnb has developed a smart app to take into account the location of accommodation, seasonal demand and common activities held nearby. Marketers can automate a substantial share of repetitive activities with Artificial Intelligence, gain considerable data, and devote more time to their core obligations, i.e. increasing sales and customer loyalty.

### **Artificial Intelligence Technology in Business**

#### **AI technologies can be used for:**

- Improving customer services - for example, using virtual assistant systems to provide customers with real-time assistance (for example, with billing and other tasks).
- Automate workloads - e.g. capturing and processing smart sensor data, or using machine learning (ML) algorithms to categorize jobs, route service requests automatically, etc.
- Logistics optimization - for example, the use of AI-powered image recognition software to track and optimize your networks, schedule transport routes, etc.
- Increase manufacturing quality and productivity - such as automating the production line by incorporating industrial robots into the workflow and training them to execute labor-intensive or mundane tasks.
- Prevent outages - such as using anomaly detection techniques to recognise trends, such as an IT outage, that are likely to interrupt the business. You can also be supported by

specialized AI applications to identify and prevent security intrusions.

- Predict results - Use AI applications, for example, to assess when performance targets can be reached, such as response time to support desk calls.
- Predict behavior - For example, use ML algorithms to evaluate online behavior patterns to serve customized product offerings, detect credit card fraud or target relevant advertising, for example.
- Manage and analyze your data - for example, AI will help you more accurately view and mine your data than ever before and offer valuable insight into your finances, your brand, employees or clients.
- Develop the advertisement and promotions - for example, track consumer behavior efficiently and automate certain repetitive marketing activities.

## CONCLUSION

Artificial intelligence continues to evolve at a breakneck pace, creating plenty of ground-floor opportunities for entrepreneurs who are disciplined in their approach, identifying the best vertical solution markets, recruiting talented and experienced teams, and who are successful in selling AI not as a technology but as a means to the best solutions. Whatever the justification for choosing AI, there is the ability for it to modify the way the organization runs. An open-minded attitude and a desire to pursue new challenges everywhere and wherever possible is what it takes to start a new business.

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## Factors Influencing the Policyholders Satisfaction Towards Mediclaim Policy

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### Abstract

The average consumption of mediclaim policy holders was studied to determine policyholders satisfaction. Mediclaim is a type of coverage that pays for some or all of the cost of medical care. It safeguards those who are covered by insurance against a variety of risks, including paying high treatment costs in the event of sickness. The purpose of the study was to identify policyholders satisfaction in HIPHs. The level of awareness and satisfaction of existing mediclaim policy holders is the set objective. The sample of 260 respondents was selected from Madurai City using a convenience sampling method. A standardised questionnaire based on a thorough literature review was used to analyse the data. Data was analysed using statistical techniques. A demographic profile of the respondents, KMO and Bartlett's Test, and factor analysis were employed on the data using SPSS. The results indicated the exploratory analysis since mediclaim policy holders have a total of four factors. Policyholder's satisfaction, out of pocket spending, medical insurance, and a comprehensive health plan are the four categories. Moreover, demographic variables were also policyholder's satisfaction HIPHs. The studies contributed by identifying the policyholder's satisfaction of mediclaim policyholders. The findings of the study may be useful for customer awareness and satisfaction, which are valuable resources to mediclaim policyholders. More benefits for mediclaim policyholders and increased customer awareness and satisfaction.

**Keywords:** *Customer, mediclaim policy, data, awareness, satisfaction.*

### INTRODUCTION

The rising expense of health care has prompted many people to purchase health insurance. People's perceptions of mediclaim have shifted from a protection tool to an investment instrument—a provision from which future health bills can be covered for medical objectives. People also like to have a regular health checkup and spend money on their health. Aside from these factors, rising income levels, price liberalization, less bureaucracy, and the introduction of private healthcare have all contributed to a growth in the popularity of health insurance. Mediclaim is provided by four public sector insurers, 18 private-sector insurers, six stand-alone insurers, and two specialist insurers. Many new products, such as critical sickness plans,

family floater policies, and top-up policies, were introduced by private sector general insurers. Despite the growth of the mediclaim industry, there remains a disparity in understanding among people based on their socioeconomic status and where they live. Due to out-of-pocket payments associated with hospitalization, many middle and lower socioeconomic class families are trapped in debt. Lack of mediclaim coverage can be attributed to a lack of financial resources to purchase the policy or a misunderstanding of the importance of having adequate insurance coverage. This paper investigates people's perceptions of mediclaim plans and the extent to which knowledge of mediclaim products contributes to customer satisfaction.

## REVIEW OF LITERATURE

**K. Nisha & S. Abirami (2020)** In their article "A Study on the Level of Customer Satisfaction Towards Medici-claim Insurance Policy in Madurai City," they explain that mediclaim provides an affordable way for the insured and his family to stay healthy and get medical care when an emergency health issue arises. The purpose of purchasing Medici-claim for the insured is to avail themselves of quality health treatment without the burden of medical bills. A facility like cashless hospitalization entitles the insured to avail of the treatment on a cashless basis. The insured's perception depends on the quality of service and products offered by the insurer according to their needs. Research has been carried out to understand the cost of insured dissatisfaction and to determine the areas where the insurer needs to focus and strengthen its customer relationship. **Nga Le, Wim Groot (2019)** In this article, "Medici-claim and patient satisfaction," Evidence from Vietnam's poorest districts shows that it's not so much the Medici-claim coverage as it is the financial coverage that matters when it comes to improving patient satisfaction with medical care. Patient satisfaction depends on the depth of insurance coverage and the ability to use Medici-claim to reduce medical costs via the co-payment mechanism. We find that it is not Medici-claim coverage per se, but the financial coverage when seeking healthcare that matters to improve patient satisfaction. In other words, patient satisfaction depends on the depth of coverage (services and medicines covered, copayment rate) and the ability to use Medici-claim to reduce medical costs via the co-payment mechanism.

**Rambabu Lavuri, Maloth Naresh Naik (2019)** "Medici-claim Policy: Policy Holder Awareness" and Satisfaction In the

article The purpose of the present study was to find out the awareness level of policy holders, followed by the influence of Medici-claim policy factors, satisfaction levels of holders and problems faced by the policy holders due to the Medici-claim policies in a selected area, i.e., Hyderabad city. The study reported responses from 183 policy holders from Hyderabad city. The convenience sampling method was adopted in the collection of data from individual health policy holder responses and tested by the ANOVA test used with the help of the SPSS 20.0 Version. The results indicated that there was a strong impact of HIP on demographic factors, followed by HIP factors' influence having a greater influence on policyholders and finally policyholders' satisfaction with HIP, even if they faced a little bit of problems with HIP. Accordingly, through policyholder opinions, HIP companies should concentrate on the problems of the HIP, and they should also create the highest levels of satisfaction for policyholders to give the best competition to competitors in the market. **Monica Bhatia & Alok Bansal (2018)** According to the analysis "Factors Influencing Customer Satisfaction in Medici-claim Services in India," trustworthiness is the most important factor in customer satisfaction in Medici-claim services, and policyholders are most concerned with proper and timely claim settlement. The study is useful for managers and policymakers of Medici-claim companies. The same study can be undertaken in other non-life insurance and life insurance sectors, as well as banking, travel and tourism. As a result, the study is extremely beneficial and serves as a foundation for future customer satisfaction research.

## OBJECTIVE OF THE STUDY

The primary goal of this study is to assess policyholder satisfaction with Mediclaim policies in Madurai District.

## RESEARCH METHODOLOGY

The present study is focused on measuring the policyholder's satisfaction of existing mediclaim policy holders in Madurai District. The study employed primary and secondary data. The primary data is collected from the customers of mediclaim policyholders in Madurai District. The responses are gathered from the policyholders through the well-designed questionnaire. The purpose of the secondary data is to familiarize the research area. The secondary information is collected from research articles, magazines, the Insurance Regulatory Development Authority, and daily newspapers.

## SAMPLE

The convenience sampling method is used to identify sample respondents. 260 mediclaim policy holders in Madurai District have been identified for collecting primary data. The sample size is 150 policy holders.

## STATISTICAL TOOLS

The collected data went through descriptive analysis and factor analysis to arrive at the findings.

## FINDINGS AND DISCUSSION

Table 1 displays descriptive statistics for demographic variables such as gender, age, merited status, educational qualification, occupation, monthly family income, insurance company, and policy types of respondents. It indicates that 58.1% belong to men and the remaining 41.9% of the respondents are female. Hence, a majority of 58.1% of respondents are male. 50.8% of them belong to the

below 30 year age group, 21.5% belong to the 31–40 year age group of respondents, 14.2% belong to the 41–50 year age group of respondents, and the other 13.5% belong to the age group of above 50 years. Hence, a majority of the respondents are the higher proportion of respondents contacted to be below 30 years. 28.5% of the respondents are post-graduate, 23.5% of the respondents are graduates, 18.5% of the respondents have professional degrees, 16.9% of the respondents are school-level, and another 12.7% of the respondents are uneducated. 28.5% of respondents had postgraduate degrees. Businesses account for 53.5% of respondents, government officials account for 25%, private employees account for 16.9%, and retired people account for 4.6%. Hence, a majority of 53.5% of respondents are businesses. 58.8% of the respondents are from the public sector and 41.2% of the respondents are from the private sector. Hence, a majority of 58.8% of the respondents are from the public sector. 50.4% of the respondents are individuals, 39.2% of the respondents are family floater health policy and another 10.4% of the respondents are group health policy. The individual policy of 50.4% of respondents is the majority.

## FACTOR ANALYSIS

The KMO (Kaiser-Meyer-Olkin) measure of sampling has been computed to conclude the suitability of using factor analysis. The values between 0.5 and 1.0 indicate that factor analysis is suitable or appropriate. The KMO test is presented in Table 2. Table 2 indicates that the calculated value of KMO is .917, which shows that sample is adequate to conduct Exploratory Factor Analysis. Bartlett's Test of Sphericity also shows a significance of factor analysis on the data. The scale has also been tested for reliability and the value of Cronbach's Alpha is .967. The reliability

test is given in table 4.53(Hair et. Al 2010) suggested that variables with loading greater than 0.45 are practically significant and support acceptable levels of explanation. Hence, criteria of 0.45 have been considered for selecting the variables.

**From the Table 3.** Shows that Communalities have been examined to determine to determine the suitability of data for analysis. Hair et.al (2010) suggested that variables with loadings greater than 0.45 are practically significant and support acceptable levels of explanation. Hence, criteria of 0.51 have been considered for selecting the variables. Communalities of 32 statements.

**From the Table 4.** Shows that indicates that the extracted communalities are highly acceptable for all the variables. It can be seen that Exploratory Factor Analysis revealed six underlying dimensions for online shopping. These four factors explain 49.675% of the total variance. Based on the rotated component matrix the statements are categorized under respective factors as shown in table 4. Eigen values for Factor1, and Factor2, Factor3 and Factor 4 are 15.896, 1.509, 1.263 are 1.161 respectively.

### ROTATED COMPONENT MATRIX

The Rotated Component Matrix assists in determining the component's meaning. It includes correlation estimates for each of the variables as well as the estimated components. The researcher divided the rotated components matrix into six categories based on the greatest value ( $> 0.50$ ) obtained from the rotated components matrix analysis.

### NAMING OF THE FACTORS

The naming of the factor done on the basis of variable represented in each

case. The sixteen variables were extracted out of total twenty considered variable under the level of satisfaction of mediclaim policyholders. The naming of factor identified based on the mediclaim policyholders is as follows:

**From the table. 6** - Indicated that factor influencing mediclaim policy holders had four statements. Namely: Services, Financial, Claim Statement, Treatment. The KMO measure the sampling adequacy of 0.917 which is a satisfactory value nearing 1 with Bartlett's test of Sphericity indicated that emerged factor were related at significance level 0.000. Factor one labeled "Services" and the Second factor labeled as "Financial" and the third factor labeled as "Claim Statement" and final factor labeled as "Treatment" Result of the individual loadings, Cronbach alpha variance explained with factor labels for HIP preference were summarized in Table.6.

### CONCLUSION

It has been established that the knowledge and satisfaction of mediclaim policyholders are influenced by the type of policy and the type of insurance firm. Compared to individuals who bought insurance from private limited companies, policyholders who bought mediclaim from public limited companies are more satisfied with their coverage. When it comes to insurance types, there is a big effect on policyholder satisfaction. Individual policyholders are better off with their mediclaim when compared to family floater policies and group policies. Insurance businesses will need to put a strong emphasis on policyholder awareness and satisfaction because they are essential factors in policy renewal and company selection.

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**Table-1. Descriptive Statistics of Respondents**

S. No	Explanatory Variables	Coding	Frequency	%
1	Gender	Male	151	58.1
		Female	109	41.9
2	Age	Below 30	132	50.8
		31-40	56	21.5
		41-50	37	14.2
		Above 50	35	13.5
3	Educational Qualification	Uneducated	33	12.7
		School Level	44	16.9
		Graduate	61	23.5
		Post Graduate	74	28.5
		Professional Degree	48	18.5
4	Occupation	Business	139	53.5
		Private Employee	44	16.9
		Government Official	65	25
		Retired Persons	12	4.6
5	Insurance Company	Public Sector	153	58.8
		Private Sector	107	41.2
6	Types of Policy	Individual	131	50.4
		Family Floater Health Policy	102	39.2
		Group Health policy	27	10.4

*Source: Primary Data***Table: 2- KMO and Bartlett's Test**

KMO and Bartlett's Test			Reliability Statistics	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		<b>.917</b>		
Bartlett's Test of Sphericity	Approx. Chi-Square	1732.329	<b>Cronbach's Alpha</b>	<b>No. of Items</b>
	df	120		
	Sig.	.000		

*Source: Computed from Primary Data***Table: 3 Communalities**

Communalities		
	Initial	Extraction
Right services in first instance	1.000	.641
Services are provided quickly & effectively	1.000	.577
Use of latest technology in providing services	1.000	.613
Efficient grievances handling machinery	1.000	.577
The mediclaim makes it possible to perform the emergency services	1.000	.645
All the necessary medicines are available with health insurance	1.000	.565

Pre existing disease cover	1.000	.483
Reminders for policy renewals	1.000	.520
Employees behavior	1.000	.576
Flexible premium payment schedule	1.000	.565
Transparency in conducting different transactions	1.000	.518
Daily hospital cash allowance	1.000	.615
Tax benefit of mediclaim plan	1.000	.561
Restoration	1.000	.560
Coverage	1.000	.631
Processing time for loan	1.000	.537
Premium payment period	1.000	.605
Premium amount and sum assured	1.000	.515
Interest on loan	1.000	.606
Workflow solutions	1.000	.680
Business intelligence	1.000	.600
Documentation required for claim settlement	1.000	.553
Claim processing time	1.000	.634
Claim settlement procedure of the company	1.000	.679
Ambulance fee	1.000	.560
Customer friendly procedures	1.000	.821
Well defined terms and conditions of the policy	1.000	.810
Timely issue of policy document	1.000	.689
It is easy for obtaining an appointment on convenient day and hour	1.000	.639
Free health check- up	1.000	.623
Medical check- up facility	1.000	.821
Free health checkup	1.000	.810
Extraction Method: Principal Component Analysis.		

*Source: Computed from Primary Data*

**Table: 4 Total Variance Explained**

Total Variance Explained									
Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	15.896	49.675	49.675	15.896	49.675	49.675	5.635	17.611	17.611
2	1.509	4.715	54.391	1.509	4.715	54.391	5.217	16.305	33.915
3	1.263	3.946	58.337	1.263	3.946	58.337	4.795	14.983	48.898
4	1.161	3.627	61.964	1.161	3.627	61.964	4.181	13.065	61.964
Extraction Method: Principal Component Analysis.									

*Source: Computed from Primary Data*

**Table: 5 Rotated Component Matrix**

Rotated Component Matrix <sup>a</sup>					Eigen Value	Variance Explained	Cronbach's Alpha
	Component						
	1	2	3	4			
Right services in first instance				.566	15.896	49.675	.874
Services are provided quickly & effectively		.642					
Use of latest technology in providing services	.595						
Efficient grievances handling machinery			.512				
The mediclaim makes it possible to perform the emergency services	.704						
All the necessary medicines are available with health insurance			.536				
Employees behavior	.522						
Flexible premium payment schedule	.581				1.509	4.715	.917
Daily hospital cash allowance		.626					
Tax benefit of mediclaim plan				.514			
Restoration		.540					
Coverage	.566						
Premium payment period		.660					
Premium amount and sum assured			.509				
Workflow solutions	.586				1.263	3.946	.884
Business intelligence				.522			
Documentation required for claim settlement		.528					
Claim processing time		.604					
Claim settlement procedure of the company	.619						
Ambulance fee	.504						
Customer friendly procedures				.700			
Well defined terms and conditions of the policy			.802		1.161	3.627	.771
Timely issue of policy document	.669						
It is easy for obtaining an appointment on convenient day and hour	.671						
Medical check- up facility				.700			
Free health checkup			.802				
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 25 iterations.							

**Source:** Computed from Primary Data

**Table 6 Naming of the Factors**

sS.No	Identified Variables	Factor Name	Dimension Explains
1	Right services in first instance	Factor 1 Services	A government mediclaim scheme is a mediclaim policy sponsored by a state or the central government. The aim of such schemes is to offer affordable mediclaim to the common man and improve healthcare facilities in different strata of society.
2	Services are provided quickly & effectively		
3	Use of latest technology in providing services		
4	Efficient grievances handling machinery		
5	The mediclaim makes it possible to perform the emergency services		
6	All the necessary medicines are available with health insurance		
7	Employees behavior		
8	Flexible premium payment schedule	Factor 2 Financial	Mediclaim is a type of insurance that covers medical expenses that arise due to an illness. These expenses could be related to hospitalization costs, cost of medicines or doctor consultation fees. Ayushman Bharat is a universal mediclaim scheme of the Ministry of Health and Family Welfare, Government of India. PMJAY was launched to provide free healthcare services to more than 40% population of the country. The scheme offers a health cover of Rs 5 Lakh.
9	Daily hospital cash allowance		
10	Tax benefit of mediclaim plan		
11	Restoration		
12	Coverage		
13	Premium payment period		
14	Premium amount and sum assured		
15	Workflow solutions		
16	Business intelligence		
17	Documentation required for claim settlement	Factor 3 Claim Statement	A mediclaim claim is a request that a mediclaim policyholder submits to the Insurance Company in order to obtain the services that are covered in their mediclaim policy.
18	Claim processing time		
19	Claim settlement procedure of the company		
20	Ambulance fee		
21	Customer friendly procedures		
22	Well defined terms and conditions of the policy		
23	Timely issue of policy document		
24	It is easy for obtaining an appointment on convenient day and hour	Factor 4 Treatment	Mediclaim is a type of insurance that covers medical expenses that arise due to an illness. These expenses could be related to hospitalization costs, cost of medicines or doctor consultation fees.
25	Medical check- up facility		
26	Free health checkup		

## Strategic Management Practices in Indian Higher Education

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### Abstract

This article aims to assess the impact of attributes of strategic management practices on employee's performance in the higher education in India. The current study proposes a model of the impact of attributes of strategic management practices on employee performance. The research found that environmental scanning, strategy formulation, strategy implementation, and evaluation leading to control employee performance. The confirmatory factor analysis (CFA), and Multiple Linear Regression was carried out for the study. The sample of 385 respondents drawn from the higher education institutions in India and condenses a set of 15 items of strategic management practices converted into four attributes. Therefore, higher education institutions should focus on the environmental scanning, strategy formulation, strategy implementation, and evaluation leading factors to increase employee performance. The study investigated the impact of attributes of strategic management practices on the employee performance retention in higher education and concluded that strategy implementation had the highest.

**Key words:** Environmental Scanning, Strategy Formulation, Implementation, Evaluation, Employee Performance.

### INTRODUCTION

The term strategy began from the Greek word "strategos", meaning armed force direction from the place of Commander General. The utilization of this idea dates to somewhere around 400 years (Ježak 1990). "Strategy" gains acknowledgment in different fields of human action, especially in governmental issues and, perceptibly later, in the economy. In days of speed of thought and fast-paced information technology innovations, strategy making is not enough for achieving goals but strategy containing competitiveness energizes its nature and without a strategy, a country or firm will have very meager chances to survive and sustain. Strategic management is the youngest discipline, and its footsteps can be witnessed in seminal publications by (Chandler, 1962) Ansoff (1965), and Andrews (1971)). It evolved significantly coming out with more catalytic, ripped, and

establishes spectra of management stream. These strata pave step by step progress toward development has been associated with many elements. First, there has been a noted rise in the level of subjects speak to (Haskisson et al., 1999). Continuation to this, about "best practices", in 1960 has led to analysis of such varied topics as hold between nations, mutuality between firms, tactics and contesting in the markets for improving shareholding, global leadership and the bond between a company long term plan and its sustainability to quote some of them. Secondly, most pivotally huge rise in the range of research methods used, roused constantly advanced (Hoskisson et al., 1999; Ketchen et al., 2008). Rigorous case studies have been extensively swapped by the usage of various tools of duodecimal based on regression models and techniques, multilevel analysis, and more recently advanced methodologies whereby a single study combines decimal and

observatory techniques, with each being adapted to the nature of the problems to be analyzed (Molina – Azorin, 2012).

Over the last few decades, it has been realized by the world that for a country the element “Education” is most critical, plays zenith significance, and potential instrument to build a nation vibrantly as a knowledge-based society. The overall vision is very keen to understand human resource strength to an extent in Higher Education with equity and inclusion. More importantly and the well-known fact is the Indian Higher Education system where more than 14.6 million students are enrolled in 31000 institutions or universities and even according to CAGR quantity of institutions raised to 11% witnessing the realization of the prominence of education and its relation to the growth of prosperity of both country and living place. Most fundamental substantial reforms in Higher Education System will eventually bring quality and enrichment of standards in undergraduate education. Speaking like this it also includes many other things like reconfiguring programs, giving scope to teach as a lecturer by creating centers at last help them to become instructors or associates. From a scholar’s point of view pragmatically they were held up only to teaching rather than to research where they are expected to pursue research primarily. Here Higher Education institutes can be catalyzed with methods to have excellence in institutional governance and empowered leadership (Sengupta and Halder, 2014). Some reports compel academic leadership is an ‘area of deficiency’ means a bottleneck in the system of Higher Education (RUSA, report 2013).

The present paradigm of academia in India during a covid pandemic and after had drastic evolution structurally competing for international education scenario exploring knowledge and tech

bite in all disciplines. Now education becomes a critical factor in Human capital development as well as bringing up individual accountability in contributing to the prosperity of the country (UGC, 2003; Sharma 2020; Kumar and Shekhar, 2017). Survey observations and reports reveal economic developed regions and developing regions differ in resources expanded, and if we observe economically developing countries concerned with value addition resulting in country enrichment and motivates aspirants to analyze and make self-sufficient in sculpting career choices. Reports throw the light on initiatives of the higher education system like adult education, courses at the secondary level, and occupational preparation (OECD, 2008).

During the days of the knowledge economy obviously, the arguments raised regarding its contribution towards economic enrichment and dwelling intellectual capital become a pivot of national interest. In a country trending upward, intellectual capital send signals to competitors or developed countries that the majority of citizens are creative, innovative, and imaginative. The citizens excelled in information and knowledge catalyzing force to pace fully economic pitch and development. The role of higher education institutions is much potential for the economic endeavor. The parties of higher education and their roles like teaching, research, and service contribute a lot. This is the only sector more critical and left alone to the academic community to have a better intervention of state assuring which can stabilize and fulfill its potential with national development strategic initiatives (Brown, Lauder & Ashton 2011; Wilda sky, 2010).

## REVIEW OF LITERATURE

## Strategic planning

A scheme in action is just like a game among players in which their jobs are discussed, inclusion levels differ from what was planned, and means are organized through several level of talks. (McCuney, 1986). The well-renowned work of Mintzberg (Mintzberg 1987), design strategy is apprehended as being either purposeful or a nascent process, if intentional it is called rational planning (Idenburg 1993). The sculpting process of the strategy includes an earlier analysis, prediction, and interpretation which brings out strengths and weaknesses to assess, along with these upcoming problems and scope to growth aspects in the market also revealed. When a diagnosis of an organization and its external entities is done more possibility of factor recognition is viable which can impact firm strategy. The role of managers in getting strategic plan is to action is vital and they should be aware of parties present in and out of organization (Nanjan 2010). The next plan is to action need coordinate agents and their networks (Loniodo et al., 2009). Stake holders impact the organization in achieving organization goals with their interests vice-versa relation of stake holders impacts selection of strategic implementation (Vos 2003). Strategy architecture and implementation are inseparable, their estrangement affords "futility" (Hambrick and cannella, 1989; Bertero et al., 2003; Mintzberg, 2004; Martin, 2010). The interdependence nature of formulation and implementation is inextricable otherwise leads to pitfalls for a firm (Hrebiniak, 2008; Prieto et al., 2009). The sustainable competitive achievement of companies and Higher education institutes can be with creative successive strategies, mutual sharing, and establishing communications among parties who build and implement it (Gandellini et al. (2013), cock, 2010).

## Strategy formulation

Obviously on the agenda of academicians and practitioners when formulation and implementing policies, programs, and courses the strategic management is considered a pivot driving the needs of existing society. (Mabougunje, 2015). In modern tech-based times, contemporary organizations function in a tumultuous ecosystem. Development of tech bites, globalization, hostile competition, omnipresent change, varieties of data provided from the environment and operations performed at speed of thought by computers, increasing intricacies developing absurdities in the organization is throwing challenges to the modern organization on an everyday basis (Tetenbaum, 1998). Anarchy is the definition of new ideas of the organizations, where the threshold is to manage turmoil. However, it should be stressed, that the anarchy, omnipresent in the workplace of organizations, paves for emergency situations for firms with the conventional frames while keeping side risk factors – and higher education is one of them (Tetenbaum, 1998). Only a well-formulated mission can recognize factors, which concern the development or degrading of a higher education institution (Ratajczak, 1997). It should be highlighted, that the flow of making a mission is as important as its content (kozminski, 1999). Research studies emphasize and pinpoints that firm with good market share, pragmatical obstacles are concerned to each strata of the model, which result in action hurdles as well as bottleneck in strategy (wolczek, 2017).

The formulation of a strategy and its communication by the management is not synonymous with its implementation (Beer, Eisenstat, 2000). More time is to be spend in strategy formulation than implementation (Hrebiniak, 2006). According to study of (T.cater, Pucko

2010) more than average optimistic results shown in the implementation process of a strategy. It is highlighted that more than half of companies had a well-formulated strategy, but unfortunately, only a meager percentage were able to implement them.

### **Strategy implementation**

Many observations and studies have been done on the problem and concern of higher education designing, developing, and organizing institutions of higher education are aware of elements that led to benefit and ruin strategy implementation. Researchers accept that there are inconsistencies between the process of formulation and implementation of the strategy. We need to understand strategy building and its information by the management is not identical (Beer, Eisenstat, 2000). To prepare a strategy and for its timely proceedings, more apparency is to be provided. Simultaneously assessment of contribution and analogies of senior management at the micro-level of deeds of an action strategy in the company (Hrebiniak, 2006).

The studies brought out ample models of NHRD like centralized, transitioning, government initiated, decentralized and a nation which there systematically enriched its personnel is taken as important for appropriate transition from the socialistic to the market-based economy (Mc Lean, et.al., 2004). In growing democratic countries like India, the effective HRD in higher education is liked to be rising when the country cultivates a holistic approach to impacting socio-political and cultural systems on education and labor markets (Alagarja and wang 2012). According to resource scientists' theory, the most pivot resource for higher education institutes to implement, the policy is funding. So it is

crucial and vital to change universities' funding model which will alter the behavior of students and universities focusing on strategic changes (Nienhuser, 2008). Apparent timely resources to be conglomerated while planning to move funding beyond means, always it is neglected even it is well known that sufficient funding is required (Hogwood and Gunn, 1984). Another important constraint is the time necessary for policy implementation need to be apprehended as an organization moves into learning mode as they proceed in implementation (Sabatier, 2005).

For better action of implementation so many external players' support is necessarily like political, interest groups and high level decision makers (Hogwood et.al., 1984). The process of policy implementation needs a dip for sustainability and to witness policy into reality (Fullan 2001), which generally occurs by initiation of organization to change. As the process continues in implementation employees need to be reskilled, interventions should be action for collaborative thinking towards policy realities of action. Overall, a sustainability achieved only by patience, time, and perseverance (Busick and Inos 1992). It is process of resulting the existing framework along with values (Schein 2004).

Many authors and researchers have noted that it is important for organizations to measure what they would like to manage. Investors and managers should make use of strategic management to improve their organizations actual performance at all times. In spite of this overwhelming importance of strategic management foundations to service sectors particularly higher education sector, many institutions in India seems not to appreciate the role strategic management elements plays in



enhancing employee performance. The importance of strategic management in an institution can be answered by analyzing relationship between strategic management and performance. Hence the need to determine the relationship between strategic management practices and employee performance in the higher education in India.

### Research Hypothesis

Ho1: There is no significant relationship between employee opined attributes of strategic management practices on employee performance.

### Research Methodology Sample Size

Sampling size is the targeted number of respondents which had been used for the research. The greater is the sample size, the more accurate the results that can be obtained for the research. Before starting any formal survey, 10 sets of pre-test samples had been distributed for the purpose of pilot test. It is to ensure the validity of the questionnaires and made corrections before conducting the formal survey. A total of 560 questionnaires were distributed randomly to the employees of universities. The questionnaires were distributed in all faculties through email and hard copy. However, only 386 copies of questionnaire were considered for the research. In any exploration, content legitimacy assumes a fundamental part. To make specific the substance legitimacy of the survey, it was ensured that the survey comprised of straightforward, reasonable, and clear language. For the respondents who generally disapproved of the language, the inquiries were orally converted into the local language, and afterward their reactions were recorded. Before the study, respondents were given clear guidelines and instructions to fill the survey. The secrecy of the respondents was guaranteed. The review was led

keeping in view the moral contemplations.

The reliability of the questionnaire was really looked at by working out the Cronbach's coefficient alpha value. The Cronbach's coefficient alpha of the general scale for this study was determined to be 0.913. A Cronbach's coefficient alpha worth of 0.60 is proposed as a threshold for the Cronbach's alpha reliability and acceptability (Pallant, 2013).

### Data Synthesis

Confirmatory Factor Analysis of Strategic Management Practices

The measures adopted to study the strategic management practices have already been validated by other researchers as mentioned earlier. So, we have only conducted a confirmatory factor analysis in order to establish the valid factor structure of strategic management practices. The proposed four- factor model (see Figure 1) was found to fit the research study. The model with a chi-square of 292.380,  $df = 85$  CFI = 0.896, TLI = 0.872, AIC = 392.380, RMSEA = 0.076. Good fit values that are generally acceptable for CFI and TLI should be near to 0.95 and for RMSEA should be less than 0.08 (Hair et al., 2010).

### Selected Variables Expansion

ENV\_SCA (Environmental Scanning), STRA\_FO (Strategy Formulation), STR\_IMP (Strategy Implementation) and EVA\_CON (Evaluation & Control).

Strategic management practices (Environmental Scanning, Strategy Formulation, Strategy Implementation and Evaluation & Control). Figure 1 shows a significant inter-factor correlation between environmental scanning and strategy formulation at a significant level ( $r = 0.67$ ,  $p < 0.05$ ), environmental scanning and strategy implementation ( $r = 0.77$ ,  $p < 0.05$ ), environmental scanning and

evaluation & control ( $r = 0.75$ ,  $p < 0.05$ ); strategy formulation and strategy implementation ( $r = , p < 0.05$ ), strategy formulation and evaluation & control ( $r = 0.88$ ,  $p < 0.05$ ); strategy implementation and evaluation & control ( $r = 0.90$ ,  $p < 0.05$ ). The result of the confirmatory factor analysis of alternative models is displayed in Table 3.

### Multiple Linear Regression

In order to test hypothesis 1, we performed a regression analysis. In the regression analysis technique, we have regressed four strategic management practices attributes on employee performance in higher education sector.

### Structural Model Fit Estimation

Figure 2 indicates the standardized path regression coefficients and the relationship between unobserved and observed variables with respect to the path diagram. Structural model Fit Indices:

The structural model fit is checked based on CMIN/Df, p-value, Goodness of Fit (GFI), Adjusted Goodness of Fit (AGFI), NFI, Comparative Fit Index (CFI), Root Mean square of approximation (RMSEA) and P Close. The Model fit indices for the constructs have been found and the summary of the result is shown in the above table where the obtained Model fit indices are compared with the recommended value. We have not considered the actual chi square value as the chances of model rejection will be high when the sample size increases. Hence we have divided the chi square value with the degrees of freedom so that we can overcome the sample size issue. The result of chi square value divided by the degrees of freedom is shown in the table as 2.163 which is below than the acceptable limit 3. The obtained p-value is 0.00 which is less than the recommended

value. The obtained GFI value is 1.000 which is above the recommended value of 0.90. The obtained AGFI value is 0.902 which is above the recommended value of 0.80. The obtained NFI value is 1.000 which is greater than the recommended value of 0.90. The obtained CFI value is 1.000 which is greater than the recommended value of 0.90. The obtained RMSEA value is 0.067 which is lesser than the recommended value of 0.08. The obtained P-close value is 0.000 which is lesser to the recommended value of 0.05. Hence we can find the overall model fit indices are within the acceptable recommended values as proposed by the researchers, so we can conclude that the hypothesized model fits with the sample data. All the 15 parameters have met all the other recommended value to verify fitness of the Model. Hence we can conclude that the Model is perfectly fit.

Ho1: There is no significant relationship between employee opined attributes of strategic management practices on employee performance in higher education.

The regression weights of strategic management practices on employee performance in higher education sector is presented in Table 2.

### DISCUSSION

Standardized regression coefficients which show the strength of impact and its positive/negative direction. It also comprises of t and significant values to validate the hypothesis framed to measure the significant impact of employee opined attributes of strategic management practices on the employee performance in higher education sector(See Table 2).

The multiple regression equation of this model is:

$$Y = 0.029 \text{ (Environmental Scanning) } +$$

0.61 (Strategy Formulation) + 0.164 (Strategy Implementation) + 0.081 (Evaluation Control) + +1.779 (Constant)

The study investigated the impact of attributes of strategic management practices on employee performance concluded that strategy implementation had the highest impact on the employee performance followed by Environmental Scanning, Strategy Formulation and Evaluation & Control. Implications of the study

The present study proposes a model of the impact of strategic management practices attributes on employee performance in higher education sector. The study found that strategy implementation, environmental scanning strategy formulation and evaluation and control are impacting significantly the employee performance. Hence, the heads of higher educational institutions should focus on the above factors to enhance the strategic management practices.

### SCOPE FOR FURTHER RESEARCH

Further examination might be fundamental, with a more prominent example, to experience whether this outcome hold comparable for the representatives who work in the night swings in IT industry. The review can be mimicked in additional areas where non-attendance and steady loss has turned into a shared issue. BPO industry has close by likenesses with that of IT industry with a correspondingly upsetting recurrence of whittling down. Comparative modification should likewise be possible in additional areas like framework, friendliness, instruction, retail and so on to recognize the worker execution levels.

### CONCLUSION

Strategic Management is turning out to be increasingly more articulate in our contemporary period. Today, we are in an occupied and quick time of progress in all parts of our life. This cycle reliably changes particularly the administration area is driving directors to be prepared to change without warning and is delivering the customary administration rehearses less significant. Strategic management is required is circumstance where customary standards are challenge and re-imagined.

The study investigated the impact of attributes of strategic management practices on employee performance retention in higher education sector concluded that strategy implementation had the highest impact on the employee performance followed by Environmental Scanning, Strategy Formulation and Evaluation and Control.

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Table 3. Confirmatory Factor Analysis of Alternative Models

Model	$\chi^2$	Df	$\chi^2/\text{Df}$	TLI	CFI	RMSEA
Four-Factor Model	292.380	85	3.439	.872	.896	.076

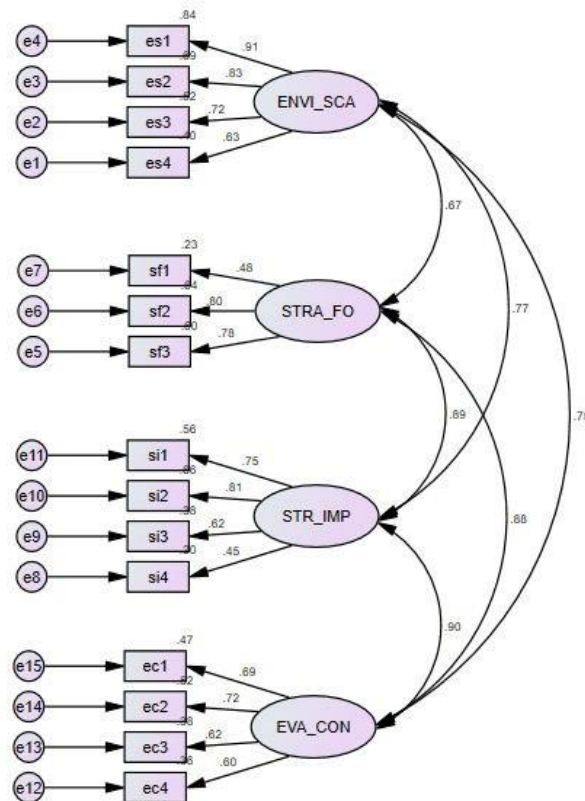
Table: 1. Structural Model Fit Estimation

Indices	Recommended Value	Model Fit Indices
CMIN/Df	< 3	2.163
p-value	$\geq 0.05$	0.000
GFI	$\geq 0.90$	1.000
AGFI	$\geq 0.80$	0.902
NFI	$\geq 0.90$	1.000
CFI	$\geq 0.90$	1.000
RMSEA	$\leq 0.08$	0.067
P Close	$\geq 0.05$	0.000

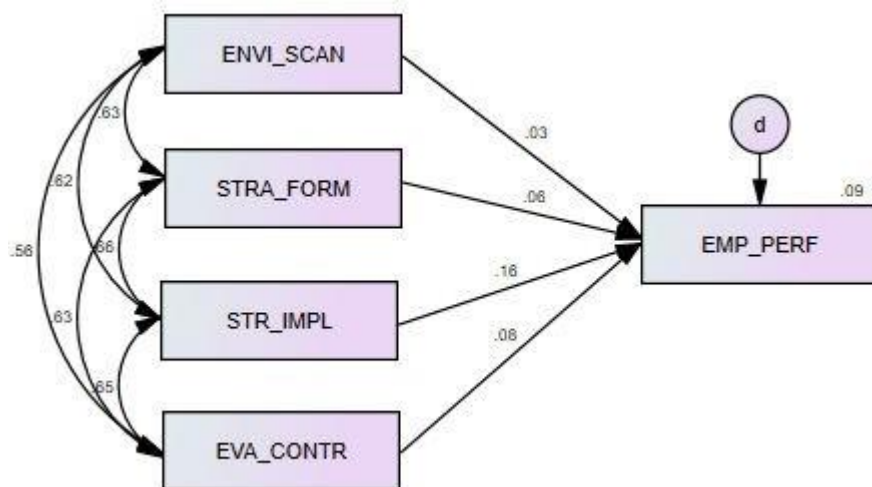
Table: 2. Regression Coefficients of strategic management practices on employee performance.

Model		Unstandardized Coefficients		Standardized Coefficients Beta	T	Sig.
		B	Std. Error			
1	(Constant)	1.779	.300		5.937	.000
	Environmental Scanning	.035	.099	.029	4.356	.001
	Strategy Formulation	.074	.105	.061	3.706	.000
	Strategy Implementation	.206	.110	.164	2.870	.000
	Evaluation Control	.105	.106	.081	3.992	.000

**Dependent Variable:** Employee Performance.



**Figure 1: Measurement Model**



**Figure: 2.** A Structural Equation Model Showing Impact of strategic management practices on employee performance in higher education sector.