ISSN NO.: 2392-4330

INDUSTRIAL VISION

INNOVATION . INDUSTRY . PROSPERITY

VOL 8.0 | 2022

13
Industrial Engineering
Importance in Context of Nepal

32
Energy Efficiency in Industry
A Tool for Improving Competitiveness and Productivity

53
Artificial Intelligence for Medical Diagnosis, Prognosis, and Treatment

67
Project Garuda
Nepal's First Sounding Rocket

85
Public Enterprises



28
Interview with **Prof. Dr. Govind Raj Pokharel**



35
Green Hydrogen
Economy for Nepal

Hero

NEW XPULSE 200, NOW WITH OIL COOLING TECHNOLOGY

XPULSE 200

Born for the toughest terrains





LED HEADLAMP



ALL-NEW 4V ENGINE



LCD DISPLAY WITH BLUETOOTH & NAVIGATION



DUAL PURPOSE TYRES



HISTORIC SALES MILESTONE



1ST INDIAN TEAM WITH STAGE WIN AT DAKAR



PRESENT IN 42 COUNTRIES

INTRODUCTORY PRICE*

NPR. 4,50,000/-

BOOK NOW

*Team Hero MotoSports won Stage 3 of Dakar 2022. This is the first-ever stage win at the Dakar – the toughest race in the world – by an Indian Team and an Indian manufacturer.

Accessories and features shown may not be a part of standard fitment.

JYOTI NGM

CUSTOMER CARE
Toll Free No.: NTC: 16600122033 Ncell: 9801571023
customercare@ngmhero.com
www.facebook.com/ngmheromotocorp

फ्री हेल्मेट

NGM connect GET IT ON Google play

*शर्तहरू अनुसार

Corporate 9801902885 • **Kathmandu Valley** Balaju 4961786 • Balkumari 5186184 • Bhaktapur 6613112 • Buddhabari 4104540, 4104541 • Gatthaghar 6638444 • Gyaneshwor 4428970 • Kantipath 5325377, 5366517 Kumaripati 5408781 • Mitra Park 5241224, 5241033 • Ravibhavan 4670812

Outside of Valley Attaria 551244 • Baglung 520174 • Bardaghat 580727 • Bardibas 550552 • Bharatpur 526697 • Bhairahawa 523930 • Bhairahawa 524290 • Biratchowk 545227 • Biratnagar 463754 • Biratnagar 503095 • Birgunj 529667 • Birtamod 590195 • Butwal 542725 • Butwal 437909 • Chandranigahapur 540739 • Damak 580690 • Damauli 560477 • Dang 563442 • Dhading 9860306631• Dhangadi 417115 Dhanushadham 414063 • Dharan 526522 • Gaidakot 502399 • Gaur 521109 • Gaushala, Mahottari 556186 • Golbazar 540327 • Gulariya 420099 • Gulmi 520142 • Hetauda 525386 • Inaruwa 566498 • Itahari 587580 Jaleshwor 521095 • Janakpur 523644 • Janakpur 527426 • Kalaiya 551526 • Kapilbastu 550160 • Kawasoti 541001 • Kohalpur 540280 • Lahan 562202 • Lalbandi 501628 • Lamahi 540863 • Malangawa 521711 Mahendranagar 520745 • Mirchaya 550803 • Narayanghat 532255 • Nepalgunj 551598 • Palpa 400639 • Parsa 582862 • Parsa 561825 • Pokhara 589389 • Pokhara 522905 • Pyuthan 460464 • Rajbiraj 523542 Simara 521520 • Siraha 520442 • Surkhet 525196 • Surunga 551010 • Taulihawa 561330 • Tikapur 560426 • Trisuli 9851105677 • Tulsipur 522050 • Urlabari 540074 • Waling 440610

ISSN No.: 2392-4330

INDUSTRIAL VISION

VOL 7.0 | 2020

INNOVATION. INDUSTRY. PROSPERITY



21 SIX SIGMA: It's Not Just about the Error Rates

36 A Talk with Nation's Hero Kulman Ghising

53 Ethics Concerning Colonization of the Moon and Mars

93 The Case for Less-Intrusive Biometrics: In a Post Pandemic World

19 Startup Scene | 82 Sneak Peek

Tribhuvan University
Institute of Engineering
Thapathali Campus
Department of Industrial Engineering

Society of Industrial Engineering Students Nepal

ISSN NO.: 2392-4330

INDUSTRIAL VISION

INNOVATION . INDUSTRY . PROSPERITY

VOL 8.0 | 2022

Team Industrial Vision 8.0

COORDINATOR



Shishir Gyawali

EDITOR IN CHIEF



Bikram Panthee

FINANCIAL COORDINATORS



Deepa Poudel



Jigyasha Regmi

EDITORS



Monica Parajuli



Prajita Ghimire



Shistata Thapaliya

PRINCIPAL CORRESPONDENTS

Anjana Chaulagain	Balkrishna Kharal	Dipesh Dahal	Girbana Gyawali
Nabin Bhandari	Rojit Shrestha	Sadikshya Gautam	Sanjit Kumar Singh
Shreeya Shrestha	Sonali Chhetri	Swastika Bardewa	

Industrial Vision is an ISSN 2392-4330 certified annual industrial magazine published by Society of Industrial Engineering Students (SOIES) Nepal. The magazine shares research works, various interesting, timely and significant contents to address the broad spectrum of engineering and management solutions in all industries. This aims to help the manufacturing and service industries to improve productivity, develop long-term business goals, execute and lead new techno-commercial methods and principles; and ultimately help in the creation of wealth.

Publication Supported by GIZ

as part of Renewable Energy and Energy Efficiency Programme (REEEP)

जर्मन सहयोग DEUTSCHE ZUSAMMENARBEIT

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

A note to readers

The views expressed in articles are the authors' and not necessarily those of Industrial Vision. Authors may have consulting or other business relationships with the companies they discuss.
All enquires should be sent to mail@soiesnepal.org.np

© Copyright 2022. All rights reserved.

OUR EXECUTIVE COMMITTEE

President	**Shishir Gyawali**
Vice-President	**Sonali Chhetri**
Secretary	**Nabin Bhandari**
Joint-Secretary	**Anjana Chaulagain**
Treasurer	**Prajita Ghimire**
Member	**Sanjit Kumar Singh**
Member	**Deepa Poudel**
Member	**Shistata Thapaliya**
Member	**Rojit Shrestha**

Board of Advisors

Prof. Dr. Shashidhar Ram Joshi
Dean, Institute of Engineering

Er. Janardan Bhatta
Campus Chief, IOE, Thapathali Campus

Er. Bishworam Parajuli
HOD, Department of Industrial Engineering IOE
Thapathali Campus

Regd. No.: **239/063/064**
PAN No.: **600379230**

ABOUT US

Society of Industrial Engineering Students - Nepal is a studentdriven dynamic society dedicated solely to the support of the Industrial Engineering scholars, to bring meaningful collaborations with the industrial stakeholders, professions and individuals involved with improving quality, productivity, technology, industrial success and prosperity, thereby making a fundamental contribution to the creation of wealth. We incubate leadership, explore collaborative possibilities, and lead Innovative vision through industrial engineering discipline to be followed in mainstream of sustainable development.

HOW WE WORK?

COLLABORATION

We collaborate with industrial stakeholders, experts, and various industrious professionals to bring significant programs, discussions, seminars and many more events of great deal of education, development and economic importance.

FORUM

We are organized to support the scholars in the industrial engineering discipline through regularly scheduled programs on fields of industrial engineering. 'Society of Industrial Engineering Students- Nepal' serves as a forum for development, networking, information sharing, idea exchange and problem solving for the industrial engineering community.

PROMOTION

We are dedicated to support the profession of industrial engineering and promote an increased awareness of the value of industrial engineers and lead the nation towards remarkable development.

INDUSTRIAL PROSPERITY

We explore momentous sources of productivity improvement information via the Internet, publications, seminars, interviews and discussions including an annual magazine -'INDUSTRIAL VISION' to find optimal and practical solutions, which contribute to the success and prosperity of an industrial undertaking, thereby making a fundamental contribution to the creation of wealth.



SOCIETY OF INDUSTRIAL ENGINEERING STUDENTS (SOIES) NEPAL

Institute of Engineering, Thapathali Campus
Thapathali, Kathmandu, Nepal

+977-9840257131

mail@soiesnepal.org.np, info.soiesnepal@gmail.com

www.soiesnepal.org.np

SOCIETY OF INDUSTRIAL ENGINEERING STUDENTS NEPAL



RETHINKING INDUSTRIES. INVENTING STRATEGIES. PERCEIVING OPTIMIZATION.

"RESEARCH . INNOVATION . INDUSTRY . PROSPERITY"

www.soiesnepal.org.np

We are Grateful to our **Well-wishers!**



I am overjoyed to learn that Industrial Vision Volume-8.0, the next gift from SOIES Nepal, will astound once more. I would want to congratulate the entire SOIES Nepal team and other individuals who contributed to this magazine, despite the fact that the effort students put into creating it cannot be expressed in words. Every stakeholder has always found "Industrial Vision" to be a gold mine of information, concepts, and data. I anticipate the team demonstrating a similar level of focus and dedication in the future. I wish the best for the entire team.

Prof. Dr. Shashidhar Ram Joshi
Dean, Institute of Engineering | Tribhuvan University

I'm elated that SOIES Nepal is releasing the eighth volume of their magazine 'Industrial Vision.' The Thapathali Campus and the Industrial Engineering department have always been proud of SOIES Nepal's ongoing organizational efforts. Former editions of the magazine have proven to be an invaluable resource for students, industries, and other stakeholders as they provided platforms for students to carve their research ability and have various innovative ideas and industrial references decoded into it, and I hope that this volume, too, will be a priceless resource for that country's continued industrial growth and development. I congratulate SOIES Nepal on another milestone in their magazine's journey and express my heartfelt appreciation for their endeavor.



Er. Janardan Bhatta
Campus Chief | IOE, Thapathali Campus



I am delighted to know that the Society Of Industrial Engineering Students (SOIES) Nepal is publishing the annual magazine "Industrial Vision" Volume 8. I hope the magazine will be helpful for all the readers who are interested in technologies and innovations of industries and industrial development. Hope the magazine will also make good collaboration between industries and academicians. I want to congratulate the entire team of SOIES Nepal and the Magazine publication committee for the effort they made and also extend my best wishes for continuing more creative activities in the future too.

Er. Bishworam Parajuli
Head of Department | Department of Indusrial Engineering
Thapathali Campus, IOE, TU

The SOIES Nepal team has worked hard to publish the 8th edition of "Industrial Vision." I'd like to congratulate the entire team on the successful publication of a magazine with useful information and novel concepts. I'm hoping for more fresh ideas and efforts from the team in the future. I'd like to thank all the article authors and supporting organizations for their contributions to the SOIES Nepal initiative.



Er. Sudan Neupane
Deputy Chief | Examination Control Division
IOE, TU



I'd like to thank the entire Magazine team for their continued efforts in publishing the eighth edition of Industrial Vision with resourceful content and innovative ideas. I'm hoping for more innovative ideas and efforts from the team in the future. Best wishes from everyone at Hitco Pvt. Ltd.

Mr. Pradeepman Pradhan
Executive Director
Hitco Pvt. Ltd.

I would like to congratulate SOIES Nepal and the entire magazine team on the successful publication of the 8th Edition of the annual magazine "Industrial Vision." In the future, I hope to see similar efforts from SOIES Nepal. All the very best!!



Anup Gautam
Deputy Manager
Nepal Electricity Authority



President's Message

It is an utter honor for me, as President of the Society of Industrial Engineering Students (SOIES) Nepal, to present the Eighth Edition of the annual Publication "INDUSTRIAL VISION," which has been a remarkable accomplishment from the release of its first volume back in 2014 AD.

SOIES Nepal's unwavering efforts can be seen in all editions of Industrial Vision, where knowledge, facts, and information on the most recent industrial and technological breakthroughs/trends, as well as managerial aspects are decoded so that readers can easily get the gist. I hope that, like previous editions, this Eighth Volume will serve as a medium for its valued readers to broaden their knowledge, develop their skill set, improve their research ability, become acquainted with the latest industry trends, and assist them in their academic and professional development.

SOIES Nepal has always been committed to the promotion of industrial engineering through various skill and knowledge enrichment programs, trainings, and seminars, and has always served as a platform for industrial engineering students to carve their academic, personal, and professional capabilities. It has been so reassuring to see this society reach new milestones as a result of its efforts. This would not have been possible without the assistance of students, seniors, and faculty members from the Department of Industrial Engineering.

I'd want to use this opportunity to extend my sincere gratitude on behalf of Team Industrial Vision to the contributors, technical supporters, our kind sponsors, and all the hands that directly and indirectly helped and encouraged SOIES Nepal to achieve INDUSTRIAL VISION 8.0 and made it possible.



Shishir Gyawali
President

Editor's Note



Subjects like: how Industrial Engineering was started and its importance in the present perspective of Nepal, global logistics after pandemics, energy efficient industries, intellectual properties, Artificial Neural Networks and their use in medical treatment, creation of the first Nepali rocket "Garuda", effect in petroleum consumption after imposing two days holiday, and many more issues concerning industry, energy, and artificial intelligence have struck with you?

If so, you are in the right magazine. In the eighth volume of "Industrial Vision", you can find the answers to the above questions. In the eighth volume of "Industrial Vision", articles, research papers, and other content are solicited in five categories: For Industry, Energy, Dataverse, Creation, and Management. Starting with the magazine's cover page, the cover theme, a wind turbine standing alone and delivering clean energy to humanity, conveys a subliminal message. As the year 2020/2021 was severely struck by Covid-19, many sectors were damaged by the lockdown, and after a few months of starting the year 2022, the Russia-Ukraine war caused a massive worldwide economic crisis. The wind turbine alone is providing hope of energy to humankind similarly, the industrial development of any country, especially a country like Nepal helps to stabilize the country's economy.

An interview with Mr. Ramchandra Tiwari, General Director at the Department of Industry, advises industrial engineers and entrepreneurs about the Department of Industry, the Ministry of Industry, Commerce, and Supply. Ramchandra sir thoroughly explains the industry registration process, intellectual property registration, and verification method. Interviews with professor Dr. Govind Raj Pokharel and Er. Bishowram Parajuli provides us with a better understanding of the academic areas of industrial engineering in Nepal.

Finally, I would also like to extend a sincere word of gratitude on behalf of the editorial team to our readers, contributors, authors, editors, and anonymous reviewers who have all volunteered their time to support the magazine's success as well as its goal of raising the standard of research in the field of industrial engineering through publication.

Enjoy Reading!



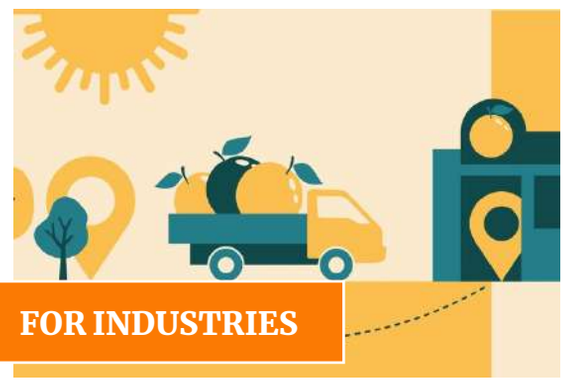
Bikram Panthee
Editor in Chief

CONTENTS

INDUSTRIAL VISION 8.0



15
Automobile Global Supply Chain



13
Industrial Engineering
Importance in Context of Nepal

19
Fresh Chain

24
Botnet Detection
Using Graph - Based Clustering

25
CAM-Into the Point Cloud



32
Energy Efficiency in Industry
A Tool for Improving Competitiveness and Productivity

35
Green Hydrogen Economy for Nepal
Opportunities for Industrial Development

44
Water Boiling Test (WBT) for Cook Stoves



45
Energy Management and Indoor Air Quality Improvement with Energy Recovery Ventilation (ERV) System



65
Data Analytics
Prominent Tool for Future Technology

53
Artificial Intelligence for Medical Diagnosis, Prognosis, and Treatment

55
Neural Networks

59
Technical Advancement in External Beam Radiation Therapy

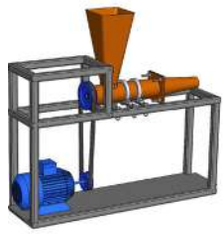




CREATION

67
Project Garuda
Nepal's First Sounding Rocket

75
Design, Analysis and Optimization of Diffuser of the Diffuser Augmented Wind Turbine



78
Projects Retrospective 2021



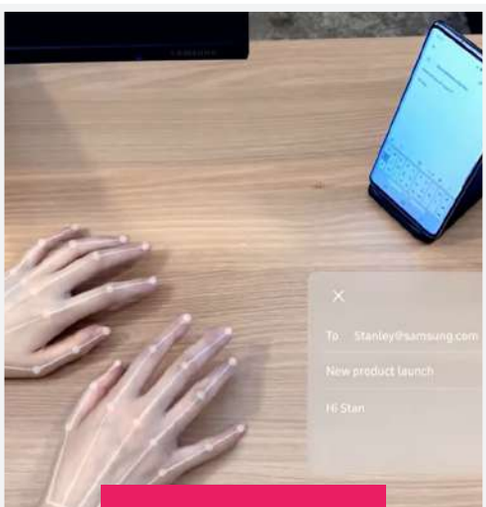
48
Mr.
Ramchandra Tiwari

28
Prof. Dr.
Govind Raj Pokharel

80
Er.
Bishworam Parajuli



INTERVIEW



NOT TO MISS

22
Top Business Process Simulation Softwares

42
Top Open - Access Journals

62
Top Productivity Apps for Students

72
Smart Gadgets



82
IE Spotlight

90
Alumni News

MANAGEMENT FRONT

85
Public Enterprises

91
Hypothesis Study on the Effect of Two-Day Public Holiday on Petrol Consumption

96
Circular Economy
A New System for Sustainable Economy



IISE Body of Knowledge

INSTITUTE OF INDUSTRIAL & SYSTEMS ENGINEERS





Industrial Engineering

Importance in Current Context of Nepal

- Dr. Sushil Raj Poudel

If I had asked high school graduates during the early 2000s "What do you want to be?", it was unlikely to hear "I am planning to be an Industrial Engineer." I would have been surprised if somebody in their teenage years even had known there is a field in engineering called Industrial Engineering. At least I was not aware and none in my close circle ever talked about it. Thanks to the internet and the plethora of information at our fingertips; many of us are aware of the term but still do have limited knowledge or even inaccurate information about what it is and what exactly Industrial Engineers are supposed to be doing. I always get sympathy from my close ones that there are no big industries in Nepal, so I don't have any scope to come back and work there. This article is a small effort on making clear on a few facts about Industrial Engineering and why it is a domain that needs to be leveraged in the present context of Nepal.

History

The engineering concept took birth with the invention of the first tools for humankind's subsistence, it grew alongside the growth of humankind's ability. Engineering is a broad area; it covers many different types of activity. Engineers make things, make things work, and make things work better. They also use their creativity to design solutions to the world's problems and help build the future. Engineering has previously been defined by the Royal Academy of Engineering as the 'creative application of scientific principles, principles that are put in practice to invent, design, build, maintain and improve structures, machines, devices, systems, materials, and processes.'

Industrial engineering is one of the younger domains in the field of engineering. Federico Winslow Taylor (1856-1915) studied the human factor, the mechanics, and the materials inside the production process and proposed the study of times to optimize the process and later recognized as the father of industrial engineering.

> ***"Given the education, experience, and training of the Industrial Engineers, IE's can be leveraged to do and play a pivotal role in the sustainable development of Nepal."***

Why is industrial Engineering Important?

Understanding a little more depth of the field will itself make a case for its importance. Industrial engineering is a branch of engineering that deals with improving processes. This is a field where hard science blends with soft science to solve a wide variety of problems. This is a bridge between technical and managerial expertise. IE does have the core of interdisciplinary within itself. It has been defined by the American Institute of Industrial Engineers as 'the branch of engineering concerned with the design, improvement, and installation of integrated systems of people, material, information, equipment, and energy.'

There are fourteen knowledge areas of the industrial engineering discipline (refer to the previous page). This classification can be further classified into smaller buckets, Operations Research alone can be dissected into several small categories when it comes to the field of expertise, keeping it elevated level for now to give the bird's eye view, this classification depicts and covers most of the IE's scope area. Industrial engineers are trained to understand and do the technical stuff and to talk the talk of business stakeholders. They are the force that can transform an invention into an industry.

What do Industrial Engineers (IE's) do?

Industrial engineers by nature of their education and experience are ideally equipped to initiate and achieve sustainable results in promoting growth, development, and employment which are vital for most developing countries, and by implication, for the stability of the world.

Industrial engineers look to reduce production costs, improve efficiency, and improve the quality of services and products while ensuring the safety of workers and environmental protection. They defined the best way to perform given things for higher returns while meeting all the business and governmental requirements and regulations. They make sure the business/project gets the best ROI while workers are safe and happy. They are the ones who contribute how to make comfortable car seats, design ergonomic keyboards, and ensure the safety and quality of highchairs. It seems simple, but it is essential.



Dr. Sushil Raj Poudel, PhD
Senior OR Scientist/ Manager | United Parcel Service (UPS)
Adjunct Faculty, Westcliff University
sushilpoudel1989@gmail.com

How can Industrial Engineers contribute to Nepal's current context?

Given the education, experience, and training of the Industrial Engineers, IE's can be leveraged to do and play a pivotal role in the sustainable development of Nepal. IE's can take a seat on stronger leadership roles, and more entrepreneurial activity. They are the force to be mobilized to start from the basics to identify the needs of the society and define the best process with given resources to meet the need on a priority basis.

We can come up with a never-ending list of the problems that can be solved by industrial engineering.

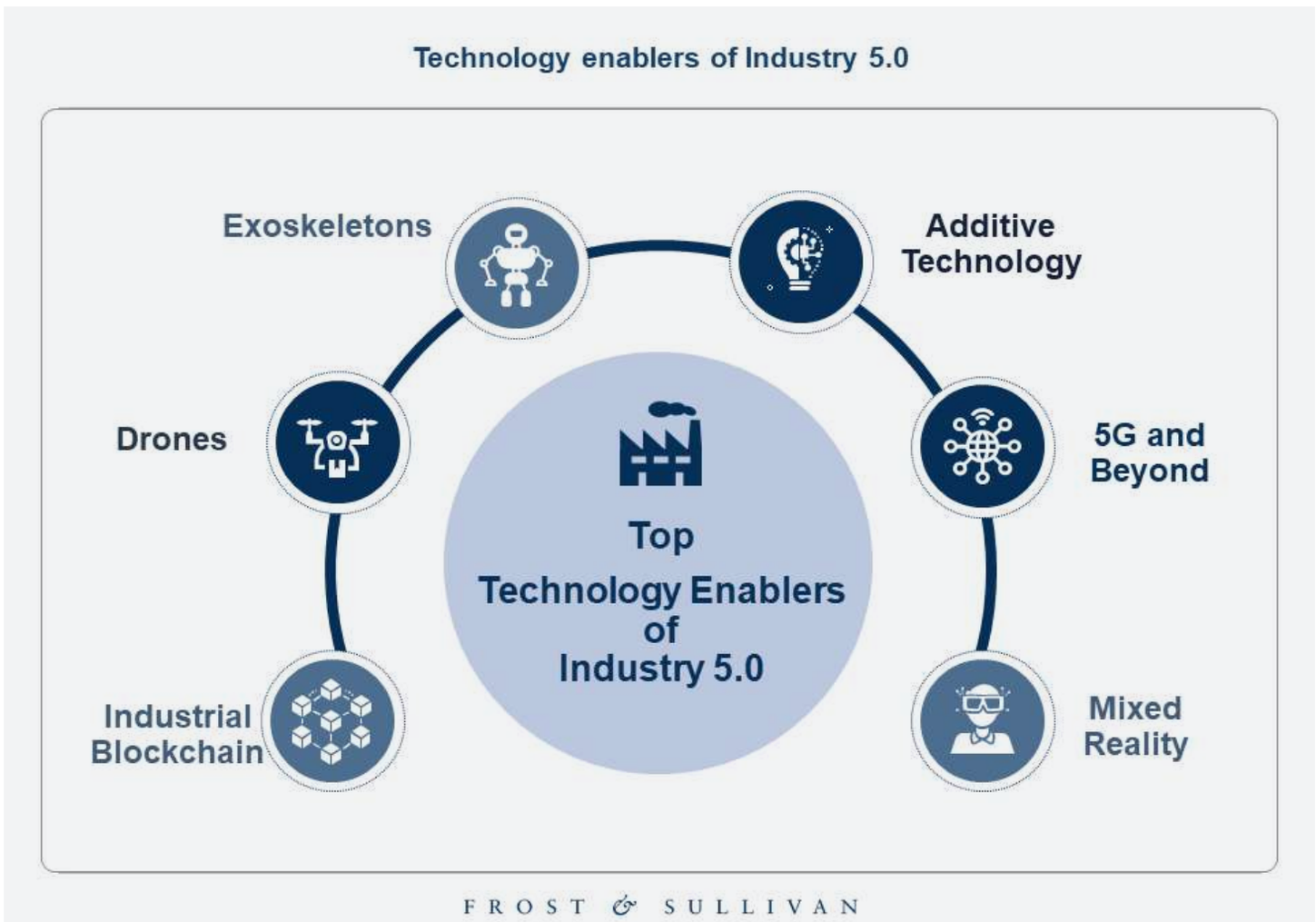
Here is a brief note at a very high level:

- IEs determine the ideal locations for different establishments. They can suggest where to locate the dumping trailer to the optimal locations of fire stations, schools, hospitals, and ambulances to maximize the coverage for every citizen.
- IEs can help hospitals, airports, and bus stations with how to schedule patients, flight timing with overnight parking locations for planes, and dispatch schedules for buses.
- IEs can define the optimal route of different school buses to minimize congestion and make sure the students are picked
- IEs can develop management systems to ensure products are manufactured free of defects reducing returns.
- IEs can help retail stores with how to display the items and which items to put together by learning from the purchasing habits of customers.
- IEs can train government officials on how to think and work like IEs so they can see the real problem and understand the objective of the projects
- IEs can propose a plan on how to remain better prepared for a natural disaster if something like the 2015 earthquake happens again.
- IEs can support basic things like where to allow street vendors to sell stuff and how newspaper vendors can deliver newspapers to every house within fewer miles to big multi-year projects of national infrastructure development.

Conclusion:

Discussing why, what, and how of Industrial Engineering and Industrial Engineers we can conclude that IE is not an Imaginary Engineering neither it is something/someone to only work in big manufacturing industries. Bringing together specialist knowledge and skills to analyze and evaluate processes and systems, industrial engineering crosses into areas including business administration, production and manufacturing, operations, systems and supply chains, ergonomics, logistics, and more. It doesn't matter whether you have a university degree with IE title or not, you can always have an Industrial Engineering mindset of continuous improvement and optimize the process. You can use the fundamentals of IE starting from your kitchen to your executive round table.

8.0





Automobile Global Supply Chain

Influence of Covid- 19 and its Countermeasures

- Er. Prem Lal Tamang

The spread of COVID-19 has impacted global economics haphazardly. Different industries like tourism, airlines, automobiles and manufacturing industries have suffered throughout the pandemic period. Low-cost country sourcing, globalization, and minimal inventory management are the key parts of supply chain management for industries like automobiles, electronics, etc. To cope with COVID-19, actions like flight stops, import lowdown, city lockdown, and outside activities restrictions have been implemented in many countries. For manufacturing industries, risks have risen including supply chain interruption due to production stops for raw materials and spare parts, various setbacks in logistics, and the unknown timeline for recovery.

With the continuous escalation of the pandemic, the condition has changed from supply and demand recession to global supply shortage due to which supply chain interruption has already happened in the automobile industry. The coronavirus has mostly affected industrial manufacturing countries like China, The US, South Korea, India, etc. Particular industries like electronics, machinery, and automobiles have been noted as prime industries of impact. Due to necessary quarantine measures taken in place, the negative impact on countries that are regional industry chain centers will gradually spread to other countries and cause supply chain interruption.

The volume and structure of demand have changed and the supply chain planning for the manufacturing industry has been disturbed. Hence, analyzing the measures to cope with the pandemic and recovery afterward from a supply chain perspective is quite necessary.

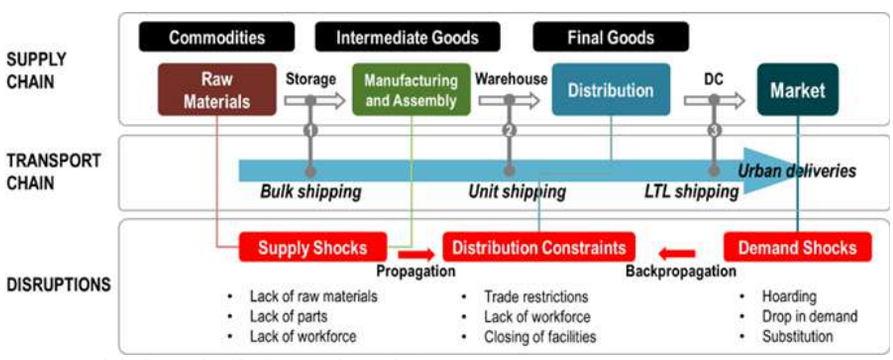


Figure 1: Global Supply Chain Paradigm Shift

> ***"Technologies like the cloud and big data have already played an important role in the supply chain operation for many industries to anticipate customer's needs, mitigate uncertainty and resume operations quickly during the crisis."***

Spare Parts Production Paradigm Shift

Figure. 1, indicates the paradigm shift of the global supply chain with reference to the effect of COVID-19. The major automobile manufacturers do the supply chain management of spare parts from the initial raw material requirement to production, warehousing, shipping, and distribution. Due to the decision of flight stop, import lowdown, city lockdown, and outside activities restriction in different nations, the demand, and supply recession has been magnificently distorted. Most of the international air transportation has been severely affected and hence massive congestion has taken place in ship transport. Most of the sea transportation ports and ship containers are prior booked and used for consignment delivery.

Pandemic has created three different disruptions in the supply chain system, visually- the supply shock, distribution constraints, and demand shock. The supply system shocks are noted as a lack of raw materials in the manufacturing plant along with the lack of parts and workforce. It has resulted in the untimely supply of required parts by the vendor and suppliers.

Under the distribution constraints, there is trade restriction between two or more countries which has a direct impact on the supply chain system. With the limited workforce, the distribution system has a severe impact on handling the spare parts system. It has ultimately forced the supply chain system to close the spare parts system of certain facilities. The sea shipping demand has dropped sharply since many international trade contracts have been canceled or new ones could not be signed in time. This could lead to the shipping route change, which certainly causes a longer lead-time for international logistics.

Another big impact of the pandemic is demand shock in the market which is causing a significant drop in demand and customers are searching for substitutes for the products which are unavailable in the market. This is making the market uncertain and partially disturbed. Due to the halt of airports, massive congestion has risen in all seaports and most of them are out of stockyards. In this situation, the number of delivery trucks for delivery of spare parts has decreased. For a country like Nepal, which is completely



Er. Prem Lal Tamang
Service Manager, (Hyundai Service)
Visiting Faculty: Institute of Engineering, Thapathali Campus
premlama546@gmail.com



Figure 2: Ship Consignment Supply

landlocked- there is no option other than surface transport. The spare parts received from the third country come via the route of Calcutta, the seaport, and are then delivered via the shipping truck to the distribution channels.

1. COVID-19's Initial Impact on Manufacturing Supply Chain

There were two phases of the initial impact caused by the outbreak and the spread of the coronavirus. In Phase 1, production was forced to pause in the manufacturing countries and the global supply of raw materials and spare parts was shrunk with the delay and decrease of export orders mainly in February and March. In Phase 2, the supply and demand in the manufacturing supply chain were severely impacted by the continuous spread of COVID-19 globally. COVID- 19 has caused plant shutdowns in major manufacturing countries due to the actions like lockdown, flight stops, outside activities restrictions, etc. The manufacturing supply chain has been or is about to be interrupted for some products in industries like auto, electronics, and pharmaceutical industries.

1.1 Production Interruption of Raw Material and Spare Parts

The Global supply chain has been formed for many manufacturing industries with enterprises closely connected with each other. China, India, South Korea, Japan, The US, Germany, etc. have become regional manufacturing centers for Asia, North America, and Europe. In a short time, a certain number of manufacturing enterprises that are deeply involved in the global supply chain have been forced to shut down because of the lack of raw materials and spare parts supply. In the context of automobile spare parts production, China is the prime country that supplies the raw material and finished goods to most countries at a competitive price. But due to the lack of raw materials, there is a halt in the production of spare parts before the automotive industry and international supply chains.

An industrial country generally processes the import of raw materials from different countries to make final products. Production may stop for key components like engines, integrated circuits, and chips in semiconductor industries due to the deteriorated situation in different countries. China, as a center of global manufacturing and the biggest manufacturing site for raw material and spare parts for many industries, holds critical value to industries like automobile, machinery, telecommunication, etc. The decrease in China's export has gradually affected downstream enterprises in other regions and lead time to supply.

1.2 Unsatisfied Demand Due to Setbacks in Logistics

Logistics has become the weak spot for the manufacturing industry after the breakout of COVID-19. As for domestic logistics, long-distance road transportation is mostly affected because of highway control. The demand for logistics services has dropped severely in a short time because of the pandemic. More importantly, the quarantine policy has led to a decrease in the supply of drivers and trucks.

Starting from 2020, lockdown action has been seen in some major manufacturing countries as well as countries that are international logistics hubs due to the global outbreak of COVID-19. Measures including air flight control, import and export restriction, and stricter commodity inspection have caused four challenges for international logistics which are demand recession due to order cancellation or requirement of delayed shipment; cost increase for air freight, haulage, and distribution; supply shortage due to air flight cancellation; lower efficiency due to longer time needed for commodity check and road transportation. Hence, a large portion of market consumption of electronic products, cars, spare parts, and fast-moving consumer goods cannot be satisfied.

1.2.1 Freight Cost accumulation due to Ship Congestion

Due to the reason of COVID-19, most of the containers have been pre-booked and there is a queue of consignments for logistic handling. Very few air flights have been scheduled for logistics delivery and hence, the freight cost has increased by 150%, which has resulted in highly expensive material costs.

Similarly, due to the higher cost of air freight, most of the consignment has been routed via sea transport and land transport. This has created a series of effects in queue management of logistics in different land and seaports, which has, in long run, increased the cost of freight. Due to the large containers and big sipping sizes, the cost of freight has been proportionally increased. Thus, land and sea transport has also been recognized as a congested area for logistics handling.

1.2.2 Industries' adaption for optimum inventory level management.

Different industries that are manufacturing



Figure 3: Optimized Shipping Containers

the goods have adapted to the method of parts management via optimization of the shipping container and lead time management. Instead of multiple shipping containers of low volume, the parts delivery has been adapted via the one shipping container of high volume which can give good space for optimum level of spare parts storage. With reference to the demand pattern, industries are accumulating the minimum 6 months of stock and placing the order in a monthly time frame with an optimal order pattern.

All the Suppliers, importers, and shippers have optimized the number of stocks, along with the proper level of spare parts and optimal size of containers. They have shifted to the sea consignment instead of the air order and delivery system. The logistics system has been directly affected by the consequences of COVID-19, but they are implementing the optimized inventory system via sea and land transport systems.

2. Pandemic- Aftershock on Supply Chain System

a. Change in Globalization to Regionalization

Nowadays, the supply chain has been globally designed and optimized to identify proper lead time with the lowest operation cost for many manufacturing industries. However, the risk of delivery delays has been observed due to the dependency on remote sources and more complex logistics networks caused by globalization.

With the rise of protection, coupled with increasing costs in less-developed countries and new financial barriers, the reshoring increases. With the continuous spread of the coronavirus, regionalization can be the new normal of the manufacturing supply chain after the crisis.

b. Increase in Supply Chain Digitalization

Digital technology and analytics can assist companies to navigate the crisis and be better prepared to serve the market. Cloud-based software to maintain a digital map for its supply chain to capture real-time information and mitigate the disruptions cost-effectively during the pandemic could be effective.

Now, business is operating in a new context in a dynamically changing external environment due to the pandemic. Technologies like the cloud and big data have already played an important role in the supply chain operation for many industries to anticipate customer's needs, mitigate uncertainty and resume operations quickly during a crisis.

3. Countermeasures for Recovery of Manufacturing Supply Chain

Although production has been gradually resumed, the situation may not be that promising in some particular companies, industries, or regions. Many enterprises have faced the second wave of impact due to a shortage of key materials and the decrease in export orders from overseas caused by the continuous spread of COVID-19. Also, there are profound changes in the economy and social life after the pandemic. Hence, the two-point corresponding action is needed including an immediate response to address the most pressing impact to maintain smooth supply chain operation and enhance the resilience of the manufacturing supply chain to recover and thrive in the post-crisis world.

3.1 Responding to Crisis and Business Continuity

Companies must address the most immediate and pressing challenges caused by COVID-19 and ensure continuous business operation among all supply chain members. By ensuring employees' safety, supporting their supply chain partners, and maximizing the usage of favorable policies implemented within the period, the supply chain operation is expected to be gradually recovered to some extent.

3.1.1 Making Supply Chain Flexibility in Post-pandemic World

Even though manufacturing companies are busy dealing with immediate shocks currently, they also need to think beyond the firefighting plan and start to prepare for the post-crisis world to recover and thrive afterward. COVID-19 has amplified the drawbacks of a complex and closely collaborated global manufacturing supply chain and indicated its lack of flexibility. Supply chain flexibility is to be enhanced to improve its responsiveness to unforeseen shocks.

3.1.2 Providing Aid to Supply Chain Partners

It is essential to secure the production recovery for companies that are critical to the global supply chain for manufacturing countries to minimize the total impact. Taking an example of Toyota, the spare parts for Toyota vehicles come from vendors in different countries. The Toyota vehicle cannot be manufactured in the Thailand plant if any of these components are not made or shipped to Thailand in time. Hence, core companies need to be aware of the recovery status of other supply chain members and help them when necessary.

By providing financial and non-financial assistance to supply chain members, the core companies can facilitate smooth supply chain recovery instead of individual resurrection. For the manufacturing-related work as well as logistics operations where staff is required to be on the scene of the manufacturing site, strict protective measures can be taken to help to create a safe working environment during the pandemic.

3.1.3 Maximizing the Benefits of Government Policies to Resume Operation

Policies to cope with the impact have been taken in almost all affected countries to stimulate the economy in some developed countries already.

More and more stimulus plans and policies can be expected from country to country in the following months. There are three types (supply type, environment type, and demand type) of policy tools that have been implemented to cope with COVID-19.

Enterprises, especially SMEs, should closely monitor the announcement of these policies and maximize their usage.

3.2 Enhancing Supply Chain Resilience in Post-COVID-19 World

Even though manufacturing companies are busy dealing with immediate shocks currently, they also need to think beyond the firefighting plan and start to prepare for the post-crisis world to recover and thrive afterward.

COVID-19 has amplified the drawbacks of a complex and closely collaborated global manufacturing supply chain and indicated its lack of resilience. Supply chain resilience is to be enhanced to improve its responsiveness to unforeseen shocks.

a. Improving supply chain visibility.

The supply chain disruption caused by the coronavirus has underscored the necessity of end-to-end visibility of the entire manufacturing supply chain. However, nowadays, most companies are having difficulties possessing end-to-end visibility when managing a multi-tiered supply chain. With the acceleration of the digital supply chain stimulated by COVID-19, technologies such as radio frequency identification and blockchain can be implemented to enhance information sharing and improve visibility in the supply chain. With a better bridge between the physical and the digital information, real-time visibility can be achieved in the network and help to build a more robust

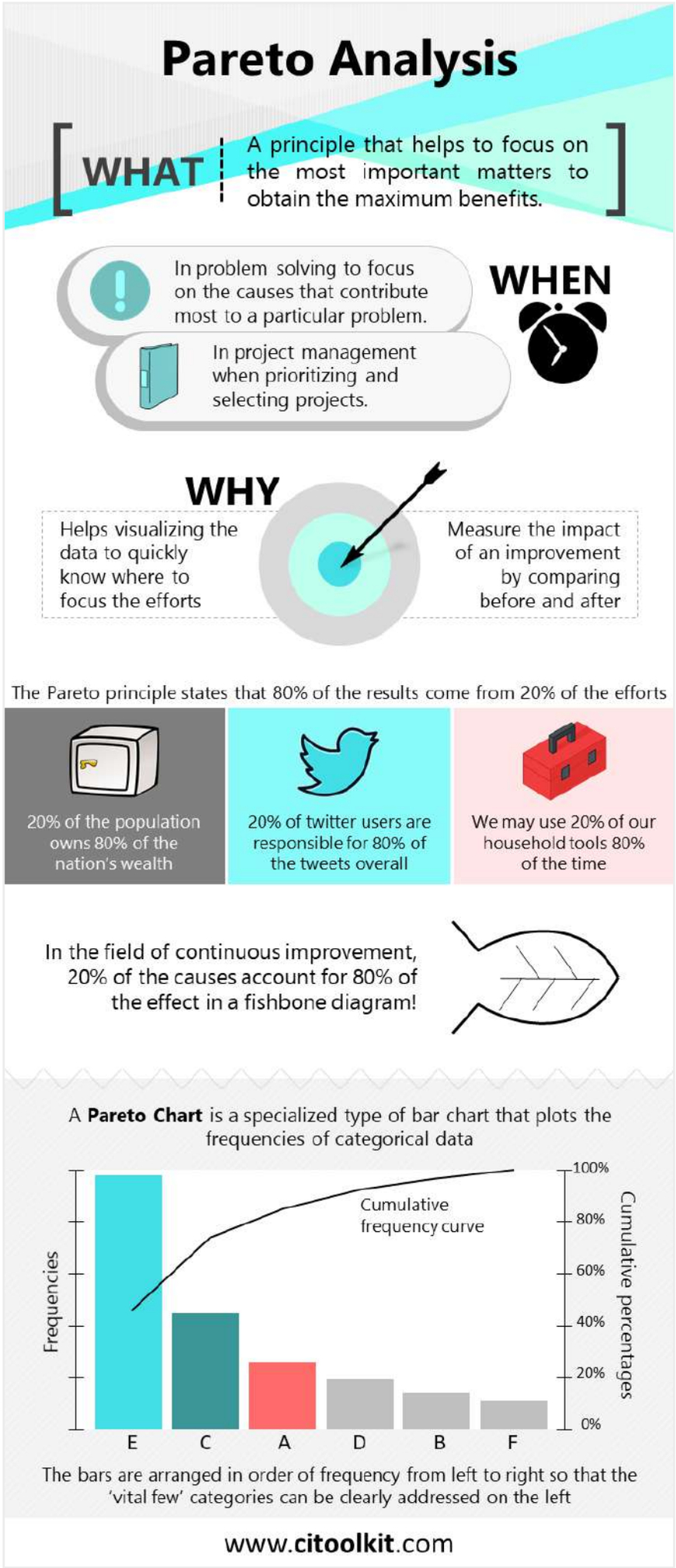
supply chain. Thus, it can be a better tool for supply chain visibility.

b. Handling supply chain planning with intelligent analysis and simulation tools. For enterprises, it may be critical to do the supply chain planning, but with economic stimuli announced in many countries, there are strong needs for infrastructure, automobiles, and electronics, which can help the rebound of many manufacturing industries. In the era of big data, recalibrating and optimizing supply chain planning with extensive data digging and analysis is critical for business success. However, planners do not have enough time or skill set to do their job better by considering all the massive variables instead of their own experience.

To overcome this, intelligent analytical and simulation tools can be beneficial. Firstly, planners can quickly collaborate and understand the impact of stimulants from both internal and external with the help of a data-sharing platform in the digitized supply chain. Secondly, scenario planning can be done with the leverage of the predictive power of artificial intelligence and help to anticipate the uncertainties better. The sourcing strategy is to be re-evaluated and the supply network should be redesigned accordingly with the aid of dynamic programming to create a more resilient supply chain. Thus, this model can make robust use of intelligent analysis and simulations.

4. Conclusion

Reviewing the pandemic impacts from a supply chain perspective and exploring countermeasures for the manufacturing industry, Interruption in the supply of raw material and spare parts, setbacks in logistics, and demand fluctuation are gradually intensified within the period. Also, the manufacturing supply chain is likely to become regionalized and digitalized in the post-crisis world. Thus, countermeasures to this situation can be adopted for ensuring the continuous supply chain operation as well as enhancing supply chain resilience for better preparation to recover and thrive afterward.





Fresh Chain

-Bipin Pandey, Tamar Sanadze, George Janjghava.

Fresh Chain refers to the online shopping of everything (that includes groceries to pharmaceuticals and many more) which are being delivered to the respective customers through various standard networks like cold-chain networks. In recent years, we have seen that there has been huge growth in online shopping methods. People find it a more relaxing, easier, and effective method of shopping and a reliable source of fresh products. The fresh chain has played a huge role in making people's lives easier. If this growth continues, it is believed that by the end of 2025, online shopping will be a 170-billion-dollar company. (Yu, 2017) It holds a huge share in the ongoing market value. In this report, we will discuss the key developments and implications of fresh chain logistics, the challenges that arise, and the opportunities that lie in fresh chain logistics. Similarly, we are going to present a case study and a trend assessment.

1. Key Developments and Implications

While before the pandemic the fast delivery of fresh produce seemed like a creation of convenience for the customer, the Covid-19 pandemic has shown us that it is, in fact, a necessity during times of lockdowns and social interaction restrictions. For years, the main goal of the fresh chain was to make it appealing to as many potential customers as possible, while still keeping the logistics under control. Fresh chain focused on creating stable and reliable relationships with the customer *(Fresh Chain: DHL 2020)*. As of today, the companies are fully focused on not just customer satisfaction but managing to satisfy the evermore increasing demand for online shopping and fresh produce.

On-demand Delivery of Fresh Goods

As many have suspected, there is a significant increase in online shopping since the initial lockdown. Even before the lockdowns, forecasts showed an online grocery shopping increase of up to 15% in 2019 in the US (Fresh Chain: DHL 2020). Naturally, these forecasts did not consider the pandemic. In the past years, the demand for Meal kits, the service of delivering recipes and necessary fresh ingredients instead of the finished meal products, has increased drastically, to a point where big grocery store chains have started offering their Meal kits, as a means to participate in this relatively untapped market.

> ***"In-transit monitoring helps cut down waste by identifying spoiled products in time and thermal-packaging is more convenient and cheaper than using refrigerated trucks."***

Additionally, we see increasing interest in home delivery services. Giant supermarket chain Walmart, which rarely used to focus on the online shopping experience, is now implementing the Buy Online, Pickup in Store (BOPIS) model, which has proven to be a success in the U.S., especially during the times of the pandemic (Grill-Goodman, 2020)

End-to-end Cold-chain Networks

The unexpected situation has sped up the global cold-chain implementation process radically. The main reason for this is of course not just the constant delivery of fresh products, but a far more delicate medicine. Even now, logistics companies are working on creating and modifying a global network with high bandwidth, for example, vaccines. Unlike food products, medicine has a lot less variable conditions resistance and can easily alter into something ineffective and even harmful to the human body (Fresh Chain: DHL 2020). It is highly important to set up proper equipment not only during the transportation cycle of the medicine but in storing units that contain medicine as well.

Temperature-controlled Packaging Innovations and In-transit Monitoring

Thermal packaging is designed for products that require a specific temperature to be maintained during transportation. This type of packaging enables the transportation of goods without using refrigerated trucks and containers which makes the reduction of costs possible. There are different temperature-controlled packaging innovations. For example, reusable thermos boxes. Moreover, constant monitoring of these packages enables cutting down waste by identifying spoiled produce on time. In-transit monitoring can be of different types: data loggers that transmit temperature, and location wirelessly, Internet of Things (IoT) sensors, single-use, reusable and more.

2. Key Challenges

The main goal of the fresh chain is to deliver fruit, vegetables, and other perishable produce to retailers or consumers in a fast way and more importantly in good condition. While the fresh chain has relatively clear steps and goals, many challenges are encountered on the way.

Minimizing Costs

First of all, in the fresh chain, it is important to use specialized, expensive technology to maintain the freshness of products. Because of this, it can be challenging to minimize costs, which is one of the main goals of supply chain management. Specifically, the use of Thermal packaging and in-transit monitoring increase expenses. (Fresh Chain: DHL 2020) However, this equipment and technology are extremely important for the fresh chain. In-transit monitoring helps cut down waste by identifying spoiled products in time and



Bipin Pandey | Co-authors: Tamar Sanadze, George Janjghava.
Undergraduate Student | Industrial Engineering and Management
Jacobs University, Bremen
bipinexpert18@gmail.com

thermal packaging is more convenient and cheaper than using refrigerated trucks. (Gilman, 1957)

Dependable Cold-chain Partners

Time and distance are the main sources of problems in the fresh chain. Delivering fresh produce despite distance and time is only possible by the cold chain. Because of this, it is crucial to find dependable and trustworthy cold-chain partners to ensure efficient collaboration. Since an end-to-end cold chain network is a major part of the Fresh chain, the cold-chain partners need to guarantee the successful execution of their part. So, finding a dependable partner may present a challenge. (Kaipia, Dukovska-Popovska, & Loikkanen, 2013)

Waste Management

Other than this, following the right sanitary practices or seasonal issues can be an obstacle in certain cases. Following the right sanitary practices decreases waste which is why it is significant. If not executed correctly, it can result in increased waste along the supply chain which remains to be one of the biggest problems in the fresh chain. (Kaipia, Dukovska-Popovska, & Loikkanen, 2013)

To conclude, time and distance are big enemies to a successful fresh chain, but to overcome the difficulties a fresh chain must be especially fast, efficient, careful, and focused on quality compared to other supply chains.

3. Key Opportunities

Fresh Chain logistics creates huge opportunities for many individuals, and companies to learn and grow progressively. These opportunities help to maintain stability in the fresh chain logistics and achieve its main target (i.e., to provide groceries to the customers as quickly as possible in the best condition possible.)

New Business and Job Opportunities

New business and job opportunities can be created for the temperature-controlled last-mile delivery (e.g.- cargo driver) For the delivery of fresh goods, different modes of transportation will be used. It will help to provide job opportunities for many individuals and overall, many companies involved with it get a chance to grow their business.

Increase collaboration across the entire Supply Chain

There will be an increase in collaboration across the entire supply chain to develop end-to-end cold chain networks (the uninterrupted series of storage and distribution activities that maintain a given temperature range.) Different companies will be involved at different ends of the supply chain to make sure that the cold chain is maintained properly which becomes a handful in the overall growth of the company.

Higher Product Security

Products can be highly secured through packaging innovation and real-time monitoring. Different technologies are being used to make sure that the product will reach its destination with full safety. Similarly, different individuals are working regularly to make sure that every system is in check and balanced and there is no breach in security.

4. Case Study

For our Fresh Chain case study, we analyze the delivery logistics of HelloFresh, a Berlin-based startup that quite quickly became the largest Meal kit provider across the globe (Li, 2015). We are going to look at 2 parts of the company's Fresh Chain, order logistics and last-mile delivery.

The HelloFresh system is following customers subscribe to their service and each week select 3 meals for the upcoming week. Afterward, the customers receive thermal packages, during time slots of their choosing, containing recipes and necessary fresh ingredients for their meal (Rajamanickam, 2019).

This system is specifically designed to make the company's Fresh Chain possible. HelloFresh has its direct product suppliers that they contact each week. The subscription model in addition to the weekly plan removes any uncertainty from the company's weekly demand, therefore they can contact suppliers in advance and receive the exact amount of product necessary (Rajamanickam, 2019). Customers select one of the time slots provided by HelloFresh. This allows the company to bundle all purchases to a standard delivery time (Li, 2015). Not only does this model create an efficient transportation system, but drastically decreases food wastage as well, since the company knows in advance the exact amount of fresh produce it is going to sell (HelloFresh, 2019).

HelloFresh is acting as a middleman between the customer and the supplier, but unlike other companies, such as amazon, they offer more than just the delivery service. They assist the customers in understanding what they require and take it upon themselves to negotiate with suppliers and ensure the freshness of the product.

For their last-mile delivery system HelloFresh uses connected fleets, this means that they receive precise vehicle data. With this system, customers are also able to track their package and thanks to specialized algorithms receive precise time estimation for their package. In addition to this, HelloFresh closely monitors the temperature inside their trucks to avoid spoilage. The packages are thermal and ensure the freshness of the products (Rajamanickam, 2019).

After going global, especially after penetrating the US market, HelloFresh has slowly dominated the fresh produce home delivery market. In fact, the United States is now HelloFresh's biggest Market, with more customers in the US compared to all their other markets combined (HelloFresh, 2019). We believe that it is the combination of customer experience, the Fresh Supply Chain model, and data monitoring that allowed HelloFresh to succeed in this market in such a short time. The Covid-19 related lockdowns have caused a spike in the company's demand in recent months, amounting to a 22% increase in the number of customers worldwide just in 2020 (Pasquini, 2020). Considering the steady pre-Covid trend and boost the company got from worldwide lockdowns, HelloFresh will most likely not be slowing down any time soon.

5. Trend Assessment

Fresh Chain logistics has been on the uprise for years now, alongside the rapid development in the transportation industry. Internet accessibility in every household ensures the future development of home delivery services. Additionally, the Covid-19 pandemic has so far played a major role in accelerating the process that had already been set in motion. People across the globe were suddenly required to stay home and shop mostly online (Grill-Goodman, 2020). These circumstances have forced a lot of customers to try out online shopping, whether they were initially interested or not. As the customers have grown accustomed to the delivery services and online fresh shopping in the past years, as seen from our case study, The trend and popularity of the industry will only increase in the future. Naturally, the companies involved in the Fresh Produce home delivery industry has been decreased in numbers after lockdowns and restrictions

lifted, but in the long run, they should be able to maintain the upward trend and see a continuous increase in customers once the post-quarantine craze has passed and people return to slightly changed normal daily lives.

6. Conclusion

The constant increase in customer satisfaction and shopping convenience inevitably leads to the development of the Fresh Chain industry. Over the years the Fresh Chain logistics have become increasingly efficient and advanced. With the constant technological advancements Fresh Chain products are now accessible to most of the people of developed nations. There lies a lot of opportunities with the fresh chain logistics if it is carried out in a settled and systematic manner with proper planning and execution. The fresh chain is evolving with its new technologies, competition in the industry, and other innovations connected to the cold chain and its operations. These developments help detect and overcome challenges in the fresh chain and as a result, optimize freshness throughout the supply chain.

References:

The Future of Fresh Food. (2020, October 15). Retrieved on November 20, 2020, from https://www2.deloitte.com/us/en/pages/consumer-business/articles/future-of-fresh-food.html

Kaipia, R., Dukovska-Popovska, I., & Loikkanen, L. (2013, April 12). Creating sustainable fresh food supply chains through waste reduction. Retrieved November 20, 2020, from https://www.emerald.com/insight/content/doi/10.1108/IJPDLM-11-2011-0200/full/html

Gilman, M. (1957, October 1). US2808093A - Frozen food shipping containers. Retrieved on November 20, 2020, from https://patents.google.com/patent/US2808093A/en

Pasquini, L. (2020, November 03). HelloFresh sees U.S. growth opportunities as pandemic triggers eating at home boom. Retrieved December 01, 2020, from https://www.reuters.com/article/us-hellofresh-results-idUSKBN27J0KO

Fresh Chain: DHL. (2020). Retrieved December 01, 2020, from https://www.dhl.com/pl-en/home/insights-and-innovation/thought-leadership/trend-reports/freshchain.html

Yu, J. (2017). Global e-commerce grocery market grows 30%. Retrieved November 20, 2020, from https://www.kantarworldpanel.com/cn-en/news/Globa--e-commerce-grocery-market-grows-30

Li, C. (2015, August 27). Why Berlin meal delivery startup HelloFresh just raised $50m. Retrieved December 01, 2020, from https://tech.eu/features/2356/hellofresh-funding-profile/

"HelloFresh Annual Report 2018" (PDF) (2019, March 6). Retrieved December 01, 2020, from https://ir.hellofreshgroup.com/download/companies/hellofresh/Annual%20Reports/DE000A1614 08-JA-2018-EQ-E-00.pdf

Rajamanickam, V. (2019, October 21). HelloFresh pushes towards leaner and more centralized last-mile meal-kit delivery. Retrieved December 01, 2020, from https://www.freightwaves.com/news/hellofresh-pushes-towards-leaner-and-more-centralize d-last-mile-meal-kit-delivery



Top **Business Process Simulation** Softwares

1

Arena Simulation

Arena business process simulation software enables us to create these business process models, providing the information we need to reduce costs, measure performance, and optimize our business operations. Its simplicity, flexibility, and scalability will allow us to model any aspect of our business. Active dashboard reporting tools improve presentations and assist us in making the best decisions without requiring additional time, resources, or capital investments—all before our decisions have an impact on your bottom line.

2

Simcad Pro

Simcad Pro provides a user-friendly and interactive 2D/3D simulation modeling environment for improving, optimizing, and visualizing process flow systems. Simcad Pro allows to plan, optimize, and rearrange processes and procedures, as well as optimize layouts, facility improvement, automation, and schedules. Simcad Pro integrates with real-time and historical data to provide the most powerful and interactive simulation system available today. Manufacturing, automation, logistics, distribution warehouse, food and beverage, services, and other industries all have applications.

3

ProModel Optimization Suite

ProModel Improves processes more quickly While Reducing Risk Planning, designing, and improving new or existing manufacturing, logistics, and other operational systems are done using the discrete-event simulation technology known as ProModel. It enables to conduct predictive analysis on potential changes by precisely representing real-world processes, including their innate variability and interdependencies and system is optimized based on key performance indicators.

4

aPriori Digital Manufacturing Simulation Software

aPriori is a digital manufacturing simulation software. By leveraging the digital twin with digital factories, aPriori automatically generates Design for Manufacturability (DFM) & Design to Cost (DTC) insights, helping manufacturers collaborate across the product development process to make better design, sourcing, and manufacturing decisions and create higher value products in less time.

5

AnyLogic

When it comes to multimethod modeling technology, AnyLogic is the industry standard and offers more efficiency and less risk. Users can capture the complexity of almost any system, at any level of detail, because of AnyLogic's unmatched versatility, which also gives them a greater understanding of the interdependent activities taking place both inside and outside of an organization.

6

Simio

Simio is an intelligent object-based simulation modeling framework. Modelers create intelligent objects, which can then be reused in multiple modeling projects. Although the Simio framework is primarily concerned with object-based modeling, it also allows for the seamless integration of other modeling paradigms such as event, process, object, and agent-based modeling.

7

FlexSim

Flexsim is a powerful and user-friendly modeling and simulation software tool that allows the user to create a three-dimensional computer simulation model of a real-world system and run experiments on it. Flexsim is a discrete-event simulation software tool that provides realistic graphical animation and comprehensive performance reports, allowing the user to quickly identify problems and evaluate alternative solutions.

8

NetLogo

Netlogo is a platform for agent-based modeling and simulation. It also enables the development of system dynamics models and participatory simulations. It is appropriate for research as well as various educational purposes. Netlogo can be used to teach programming, computational thinking, simulation and model building, and model-based understanding of complex phenomena in a variety of domains.

9

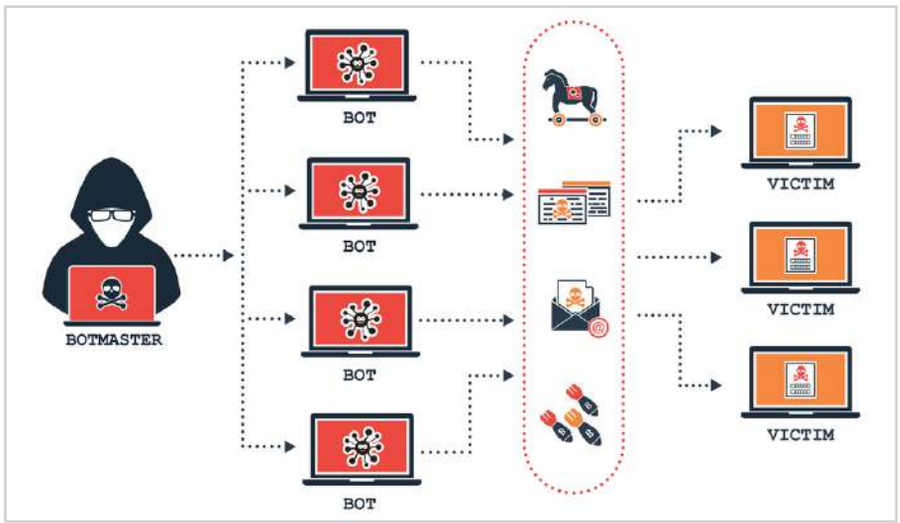
Simul8

SIMUL8 is a software that models, simulates, analyzes, and optimizes the system-level performance of manufacturing systems during the design, reconfiguration, and production planning phases. The simulation building blocks enable the creation of precise system models of complex system architectures such as manufacturing lines, job shops, robotics cells, assembly systems, and complex product flows.

10

Tecnomatix

Tecnomatix is a comprehensive portfolio of digital manufacturing solutions that can assist you in digitizing manufacturing and the process of transforming innovative ideas into transformative products. To maximize efficiency, use Tecnomatix software to achieve synchronization between product engineering, manufacturing engineering, production, and service operations.



Botnet Detection Using Graph-Based Clustering

- Er. Bimal Banjade

A botnet is a gathering of web-associated gadgets, which may incorporate PCs, servers, cell phones, and web of things gadgets that are contaminated and controlled by a typical kind of malware. Botnets are becoming more sophisticated and dangerous day by day. Therefore, there are various methods of Botnet detection. In this research, I will approach to detection of botnets in a system by graph-based methods, flow-based methods, and the network-based method. The network-based detection method is one of the important methods in detecting botnets because they involve the use of very large, coordinated groups of hosts for both brute-force and subtle attacks which are detected by monitoring network traffic. In flow-based methods, I will use classification and clustering techniques which will be more efficient to detect bots. In graph-based features, anomalies are used to detect static graphs and dynamic graphs. Determining the source of a botnet-based attack is a challenge because there is a distinction between the attack and the attack mechanism. Clustering is a popular approach to detecting botnets using flow-based features as well as communication traffic is another way of approach to graph-based detection. The expected contribution to this field from this project is to improve the efficiency of bot detection, and filtering algorithms by removing the single-degree nodes before clustering and ensuring cyber network integrity, and protecting it from future botnet attacks.

Applying the SOM-based botnet detection algorithm to the extracted seven graph-based features. Fig. 1.1 demonstrates the results of SOM clustering based on the CTU dataset. There is a total number of 25 cells, each representing a possible cluster of graph-based features. We choose the total number of cells to be 25 so that the SOM algorithm can capture various types of node behaviors while not significantly increasing computation costs.

> *"Determining the source of a botnet-based attack is a challenge because there is a distinction between the attack and the attack mechanism."*

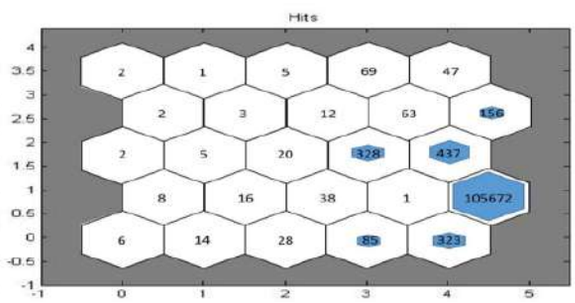


Fig: 1.1 SOM hits on CTU dataset

From Figure 1.1, the numbers in each cell represent the total number of nodes that belong to the corresponding cluster. These nodes share similar behaviors in terms of the identified graph-based features. For example, there exist 105,672 nodes in the biggest cluster (in blue), which accounts for over 99% of nodes in Dataset 6. Note that malicious behaviors i.e., the botnet flows are typically a small proportion of the entire dataset and when compared to normal flows, botnet flows possess a high range of feature values because they are very active in the network. So, we delete the clusters that have the highest number of nodes that don't possess the usual characteristics that a bot might have. This helps to narrow down the identification of bots to the remaining few nodes, which account for less than 1% of the total nodes.

Conclusion

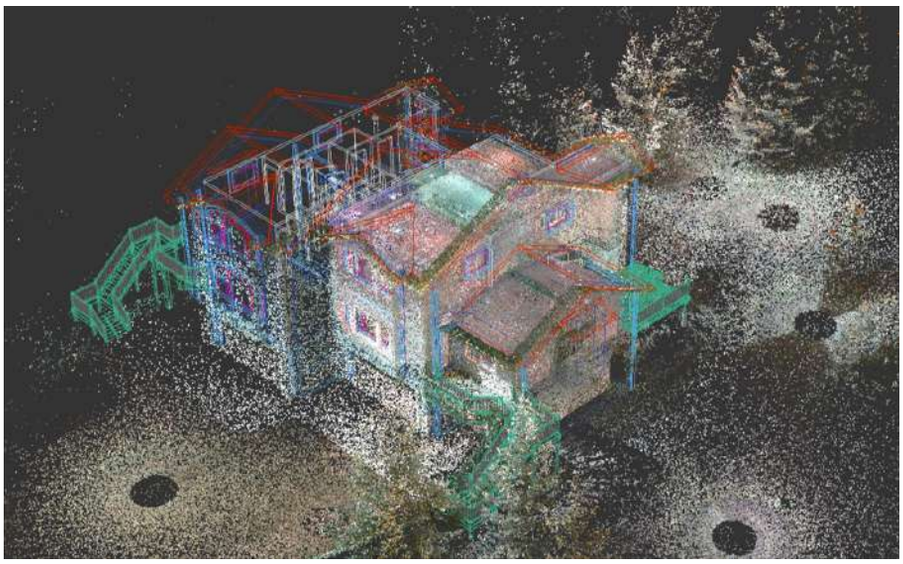
In this work, a graph-based botnet detection approach can detect changing behaviors of bots. SOM is applied to establish the clusters of nodes based on these graphed features. Our approach is capable of isolating bots in clusters with very small sizes (less than 100 nodes), which enables fast detection of bot nodes. The proposed algorithm is further enhanced by filtering out inactive nodes, which are unlikely to be bots. We verify the proposed methods using CTU-13 and ISCX Botnet datasets. Numerical results show that our proposed procedure can detect the bots by searching a limited number of nodes.



Er. Bimal Banjade
Continuous Improvement Engineer
Milwaukee Tool, USA
bimal.banjade@milwaukeetool.com

References

1. Strayer, W. T., Lapsely, D., Walsh, R., & Livadas, C. (2008). Botnet detection is based on network behavior. In Botnet Detection (pp. 1-24). Springer US.
2. Gu, G., Zhang, J., & Lee, W. (2008). BotSniffer: Detecting botnet command and control channels in network traffic.
3. Barford, P., & Yegneswaran. V. (2006). An Inside Look at Botnets. Special Workshop on Malware Detection: Advances in Information Security 2006.



Computer-Aided Manufacturing

Into the Point Cloud

- Er. Sandeep Tripathi

Introduction

With the ongoing development in the area of smart, automated, and digitized manufacturing systems, it has become vital to digitize the manufacturing process using recent technologies. Among these, point cloud technology or point cloud data structure is an emerging technology in this area. In the past, objects were dominantly represented in the field of manufacturing and design using Winged-Edge data structure to capture information about polygon meshes. However, there is a new trend where other data structures are being brought under the microscope and used for manufacturing and design-related analysis and programming. This article focuses on a brief overview of point cloud data, its acquisition, processing, and applications in the field of Manufacturing.

Definition

What is a point cloud? A point cloud is a set of data points in space that represents a 3D shape or object [1]. If we consider the data structure of a point cloud, primarily it contains information about position (X, Y, Z). In addition to positional information about the geometry of an object, information such as color, surface normal, and intensity can be included in the point cloud data depending upon the application.

Generation of Point Cloud data

How are these point clouds generated? Point clouds are generally produced by stereo cameras, 3D scanners, time-of-flight cameras, using photogrammetry software, or synthetically using computer programs.

> ***"Positional information about the geometry of an object, information such as color, surface normal, and intensity can be included in the point cloud "***

which measure many points on the external surfaces of objects around them.

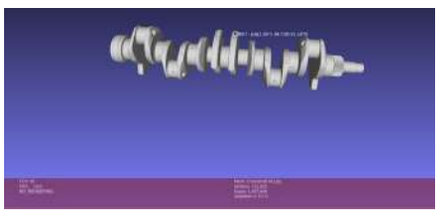
Processing of Point Cloud data

After the Point Cloud of an object is generated from scanning or alternative processes, these scans need to be stitched together to get the complete point cloud object.

Firstly, to get the correspondence between the same points in different point cloud scans, the scans undergo a registration process. The next step is to align different point clouds obtained from different fields of view of scanner or camera data into one object. The final result of all of these processes is a complete object in the desired file format like PLY or OBJ. For processing Point Cloud Data, tools like Meshlab and CloudCompare can be used.

Visualization and rendering

How do I visualize the data? For visualization and rendering of point cloud data, software and libraries such as Meshlab, CloudCompare, and Point Cloud Library (PCL) can be used.



[Figure 1: Point cloud of crankshaft rendered in Meshlab]

Data Formats and Structure

The file formats like .ply, .obj, and .xyz are common for Point Cloud data. One of the commonly used file formats for working with point cloud data is Polygon File Format (PLY), which stores the positional data along with information like surface normal, color, and face of the object. Each row of the PLY file is data with positional information also known as Vertex. When these vertices are grouped by lines, they form faces or surfaces. The PLY file format is a simple description file format and is designed for research in the area of polygonal models. There are two types of PLY files: text and binary [2]. The PLY file format contains a header and data of points (Figure 2 from line 16,) in rows representing the actual data.

```
ply
format ascii 1.0
element vertex 498934
property double x
property double y
property double z
property double nx
property double ny
property double nz
property uchar red
property uchar green
property uchar blue
element face 996584
property list uchar int vertex_indices
end_header
0.132887 4.491608 -7.736926 0.037160 0.950864 0.309834 163 149 42
0.129068 4.488378 -7.732786 -0.449202 0.777404 0.440296 166 152 43
0.128100 4.490841 -7.740711 -0.471330 0.880491 0.050824 163 149 42
0.119868 4.484759 -7.743535 -0.438040 0.858337 0.267169 165 151 43
0.148265 4.488491 -7.739566 0.192531 0.958103 -0.212064 163 150 43
0.132757 4.491601 -7.743460 0.141230 0.968116 -0.206894 162 148 41
0.147001 4.486496 -7.729104 0.052671 0.767770 0.638557 174 160 49
0.092079 4.480801 -7.743455 -0.498480 0.865151 0.055061 177 163 48
0.083695 4.476719 -7.732069 -0.523997 0.848414 0.074981 180 166 49
```

[Figure 2: Data structure of .ply file format]

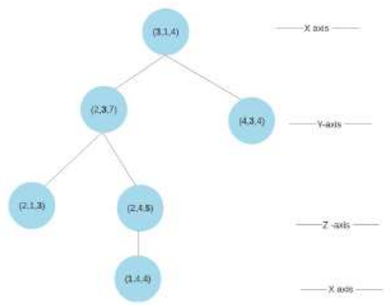
In terms of data structure, point cloud data can be represented by graphs such as the k-d tree and Octree. Let us briefly look into one of these data structures, namely: the k-d tree (short for k-dimensional tree). K-d tree is a space-partitioning data structure for organizing points in a k-dimensional space[3]. The idea behind the k-d tree is to



Er. Sandeep Tripathi
Industrial Engineer
sandeepp.tripathi@gmail.com

divide the space into n halves by generating splitting hyperplanes in each axis for each level of the tree.

Once the tree is grown to form a k-d tree, operations such as adding or removing a point cloud and finding the nearest neighbor of any particular point cloud can be easily achieved. Once the k-d tree has been grown, querying from the tree is efficient in terms of computational time.



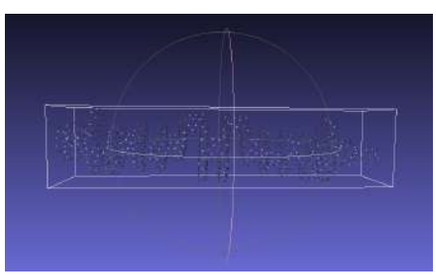
[Figure 3: K-d Tree example]

Conversion to other formats

Easy conversion to formats such as STereoLithography(STL) file format for use in CAD programs for Computer-Aided Manufacturing(CAM) is possible with the Point Cloud Data.

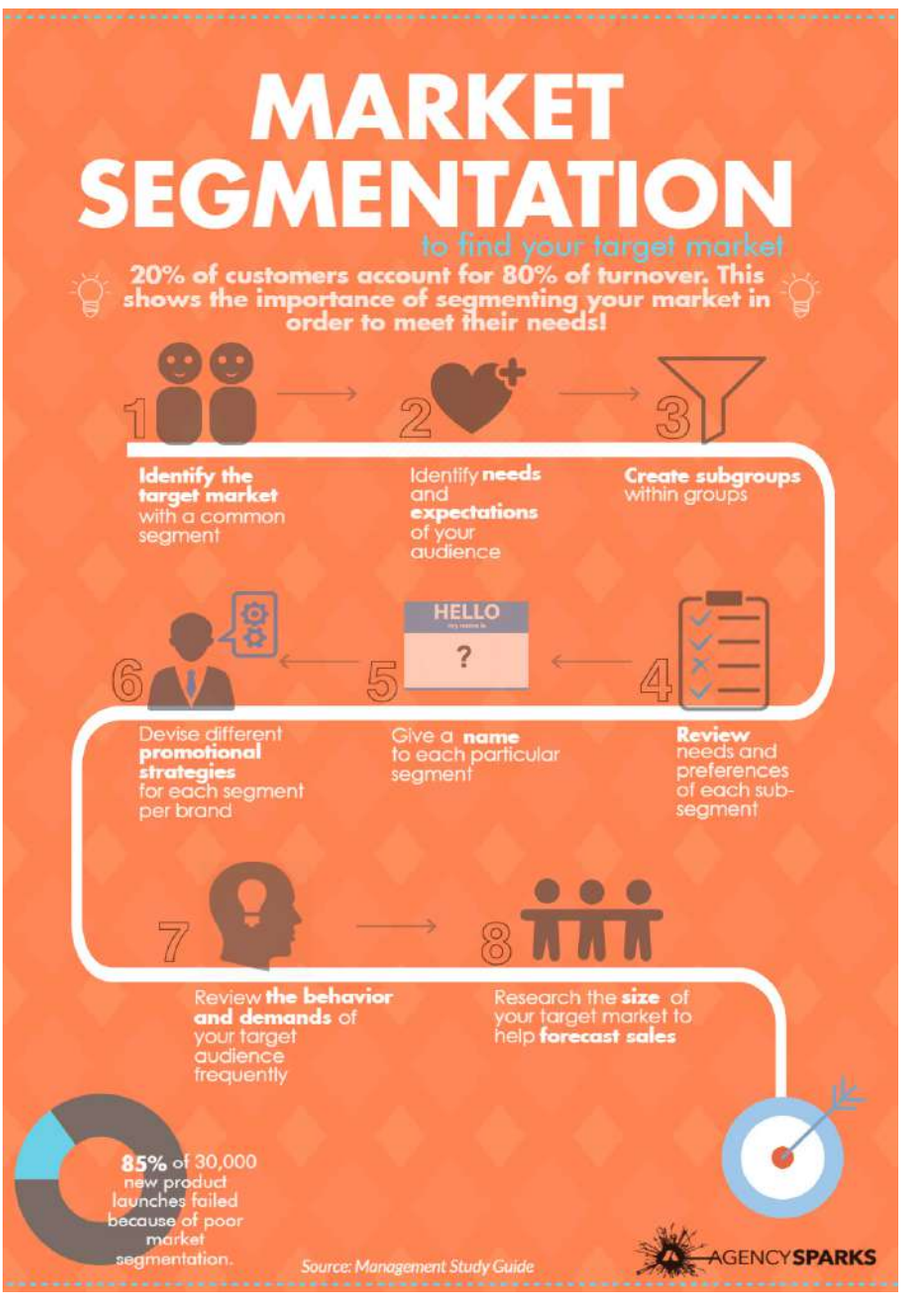
Applications in Manufacturing

The application of point clouds in the manufacturing context is wide, for example, creating 3D CAD models for manufactured parts, Automated Path Planning of robots, Facility design for manufacturing plants, Metrology and Quality Inspection of manufactured parts, Computer Vision, Reverse Engineering, and development of Digital Twins. One of the use cases that I am currently working on with the point cloud data is the path planning of the robot using Computer Numerical Control (CNC) code generated using colored point cloud data as its input.



[Figure 4: Downsampled point cloud of crankshaft]

References:
1. R. B. Rusu and S. Cousins, "3D is here: Point Cloud Library (PCL)," 2011 IEEE International Conference on Robotics and Automation, 2011, pp. 1-4, doi: 10.1109/ICRA.2011.5980567.
2. Turk, G. and Mullins, B., 2021. About File Formats & Downloading. Available at: <https://www.cc.gatech.edu/projects/large_models/about.html> [Accessed 1 June 2021].
3. Panhalkar, Neeraj & Paul, Ratnadeep & Anand, Sam. (2014). Increasing Part Accuracy in Additive Manufacturing Processes Using a k-d Tree Based Clustered Adaptive Layering. Journal of Manufacturing Science and Engineering. 136. 061017. 10.1115/1.4028586.



How to Be the Best Logistics Manager 10 SECRETS for SUCCESS

1 Get the Right Transportation Management Technology

A transportation management system (TMS) that meets your specific needs can yield major visibility — and savings. TMS software can help you monitor shipments, assess carrier performance, optimize routing and essentially provide end-to-end visibility.

2 Find Other Ways to Automate

In addition to managing transportation, software can also help you automate your workflow and manage things like incoming goods, retrieval of goods, dispatch processing and repackaging.

3 Start a Vendor Compliance Program

A vendor compliance program allows you to set expectations for your vendors, track their performance, and ensure they are meeting the goals you've set for them. The better your vendors are operating, the more fluid your supply chain will be.

4 Establish Alliances with Key Suppliers

Creating strong alliances with your suppliers will encourage them to be loyal, bring problems to the forefront, identify ways to improve and find opportunities for mutual growth.

5 Make Metrics Meaningful

Make careful choices about the metrics you report on. To be meaningful, metrics should help you measure performance, tell a story to your intended audience and follow consistent standards.

6 View Your Supply Chain as Circular, Not Linear

In a circular supply chain, discarded materials are recycled and reused, in part replacing some of the natural resources consumed and thereby closing the supply chain loop. Take into account what happens after your products are consumed and how you can reclaim raw materials from existing goods.

7 Keep Up on Industry Trends

Look beyond your supply chain by benchmarking other companies, following industry trends or joining a professional organization.

8 Ensure Logistics is a Key Piece of the S&OP

When your company develops a yearly operating plan that aligns all of the functional areas of your organization, like sales, manufacturing and procurement, make sure you have a seat at the table and logistics is part of the discussion.

9 Make a Solid Backup Plan

Consider what you would do if your supply chain were to break down due to a strike, a natural disaster or another major disruption and make a contingency plan to keep things moving.

10 Leverage Social Responsibility as a Differentiator

Think beyond cost when sourcing and selling products and services and consider factors like the environment, impacts to the local community, ethical business practices, human rights and safety.

Track Record by UPS

"Consumption without production is evident in today's date which should be reversed as 'consumption of our production'."

Prof. Dr. Govind Raj Pokharel

Chairman at Baliyo Nepal Nutrition Initiatives
Visiting Prof, Thapathali Campus, IOE/TU
Former VC, National Planning Commission
Former CEO, National Reconstruction Authority



INTERVIEW

We, as soon-to-be Industrial Engineers, could only be here because of you, as you were the one who introduced Industrial Engineering to Nepal. We'd like to know with what objective you introduced this course and what are your views on the present scenario of Industrial Engineering?

The country was recovering from violent and destructive conflict. The economy of the country was in a total mess. Industry, a robust, long-lasting, and sustainable investment sector are what we desperately need to make an economy a stable one. It is not like many other investments which are comparatively not robust and long-lasting in nature but a long-term project that creates sustainable and reliable decent jobs. So, after our continued interactions and open discussions with different industries, we decided to introduce a course that can at least fill some of the gaps to promote the industrial sector for a healthy and resilient national economy.

What are the aspects of industrial engineering that you find unique, based on your extensive experience as a faculty member?

Well, it's a very comprehensive course. You see, it's a mixture of an industrial engineering and MBA-level management syllabus. The uniqueness I say is an opportunity of exposure to students in real-life practice in the field. Via all the OJT experiences, presentation skills, and industrial visits that are the additional focus of the course which enable our students to emerge themselves as interactive individuals, equipped with first-hand knowledge of leadership quality.

There is widespread criticism that our academic studies are incapable of bridging the theoretical and practical gaps. What are your stands and recommendations on these issues?

It's not the syllabus of industrial engineering to blame. In fact, industrial engineering places itself in a better example in this regard. But the problem remains in the development of an industry. Investors are skeptical to invest in the sector at the very firsthand. Only if industries were massive and mega, investors would seek the relevant and qualified personnel, and all the knowledge gained by industrial engineers during all the years could be fully utilized. But yes, the syllabus needs to be revised regularly as modern technologies, and management theories are being developed rapidly and with the modification of the syllabus, these problems will certainly be addressed.

What are the various obstacles to Nepal's development that you have encountered through your varied experiences working for different government agencies and (I)NGOs? What roles can we play as technical personnel to mitigate these obstacles?

The first obstacle I say is suitable skilled and educated human resources. We, for this very reason, try to compensate from the engineering sector. Others are the overall political environment, policy gap to create a cohesive environment, the attitude of society towards investors and private investment, the certainty of return on investment, and the capacity of human resources as well government and private institutions. The main I would say is the lack of investment ecosystem in the sector.

The year 2072 not only shook the tectonic plates but also the hearts of the Nepalese as a result of the massive infrastructural destruction caused by the earthquake. The entire world was watching us and our comeback procedure. In these circumstances, the national reconstruction authority had a higher responsibility to bear, and you were the one in charge. What were your bitter and sweet experiences during the reconstruction process?

It was a sad loss indeed. But as a matter of fact, that was an opportunity to rebuild and move forward differently. We had planned to reconstruct not only infrastructures but the economy as well which sadly happened to be only partially fulfilled. However, our rebuilt infrastructures are more resilient than before.

Disasters are inevitable and being ready to deal with them is essential. What suggestions do you have for long-term preparedness against disaster, given your experience leading the reconstruction process?

We all know disasters are unpredictable but with the proper readiness, the risk of the disaster can be minimized. Especially in the industrial engineering field, there are many situations in which one can encounter a disaster that may be intentional or unintentional such as fire, electrical hazards, etc. So, to minimize such risks and provide insights on risks minimization in all such potential disasters and make the industrial sector resilient a new course could be introduced, or this aspect can be included in existing courses. The revision in the syllabus and the addition of a new course on disaster risk management in industrial engineering may address preparedness against the disaster. After the introduction of these courses in the existing syllabus, it will be helpful for those who will be in the field and are first responders of the disaster to cope with rescue, relief, and rebuild.

With your appointment as Vice-Chairperson of the National Planning Commission, your contributions to the country's planning are noteworthy. Everyone talks about improving industrialization in the country, but we can't improve the industrial sector with such voices. What are your forewords and suggestions?

The national planning commission plays a vital role in shaping the policy of our country. Just policy itself is not a complete task, proper implementation can only meet the desired objective. Policy reform, supporting the government in devising policy instruments, planning for capacity building of individuals and institutions, and stakeholder interaction are some of the scopes of the national planning commission. Only policy formulation is not everything for development. Analyzing the present scenario, introduction of new technical knowledge and skills along with the worldwide recognized academic standard that can incorporate the skills to respond to the growing demand and address the gaps. Similarly, revision of policy regarding implementation in various sectors such as human resource development, infrastructure development, progressive taxation system, and foreign direct investment issues should be done to leapfrog.

Recently, turmoil in the world economy is evident as covid-19 hit hard the whole supply chain of the world, war between Russia and Ukraine emerges and the economic breakdown Sri Lanka is facing right now. Could you please provide us with insights on these situations and your analysis?

Nowadays the media and the public discourse are fueled by the speculative news that Nepal would turn to Sri Lanka's economic condition but with deep concern

in this topic I don't see Nepal would be in the condition as Sri Lanka, but it is an alarm for our economy as there is huge pressure on the macroeconomic indicators. There are some national, international, and other causes which may lead us toward Sri Lanka's track., slowly or gradually but not at a rapid pace if we don't improve our fiscal discipline. To bypass this condition, we should emphasize a production-led economy that promotes import substitution and increases exports. Consumption without production is evident in today's date which should be reversed as "consumption of our production". We must focus on import substitution which is possible by giving focus on cheap energy supply, better infrastructure, and technology, and easy access to finance which will create jobs and may lead us to better economic growth. We should not neglect the advantages of foreign direct investment to improve the situation of our economy as it enhances skills, brings hard currency, and can give us access to new export markets. The transfer of new technology and the creation of employment will also be considered the positive side of foreign direct investment. More importantly, for Nepal, the promotion of self-employment is most likely possible only if proper human resource management is done by providing entrepreneurial education and skills that could be useful inside the country as well as abroad.

Sir, the vision with which you started industrial engineering in Nepal, do you find it's going in the same way in the present day? Or maybe even better?

Being involved as a leading faculty member in the initial days of the introduction of industrial engineering, I am happy with the status of industrial engineering in today's date as we are partially able to substitute the foreign manpower with in-house production of skilled manpower, but it is not as expected rate due to various factors and I am optimistic towards the improvement of opportunities for industrial engineering in coming days.

Could you inspire new aspirants in technical fields such as industrial, mechanical, and civil engineering?

To all those young, energetic, and dynamic aspirants who are interested in mechanical automobile and industrial engineering, especially industrial engineering, this is the best stream that would be better for self-employment. The course here is designed in such a way that it is no less than an international standard. The course is also linked with the syllabus of the public service commission of Nepal to provide practical knowledge along with the academic course. The linkage with the various industries through OJT/ internship has been fruitful and would be even better in the future. This course is providing real-world technical skills as well as managerial skills and hence this is an excellent course with a broad horizon. I would like to express my best wishes to all those who are willing to be a part of this Industrial engineering family as well as other engineering courses.

Are there any such things that we missed to ask, and you would like to add?

In developing countries like Nepal, the hurdle to economic development is a lack of adequate investment in the productive and infrastructure sector. Hence the investment environment should be made which can benefit those who are willing to take risks and willing to invest. We must respect those who are trying to earn some money doing hard and innovative work and applying their entrepreneurial skills. Such an investment environment can provide some sorts of employment. Hence a positive narrative must be built to promote such people who are willing to take the risk and invest.

8.0

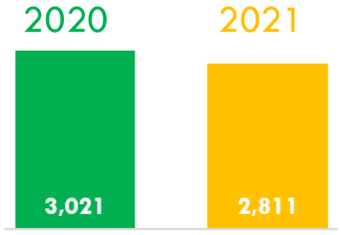


STATUS OF ELECTRICITY IN NEPAL

In Gigawatt hour (GWh)

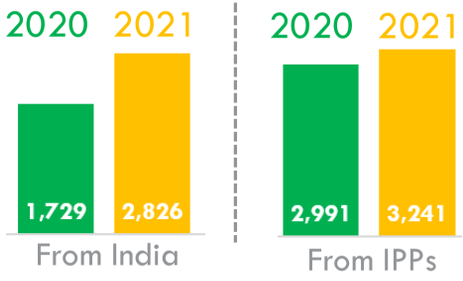
Electricity Generation (NEA)



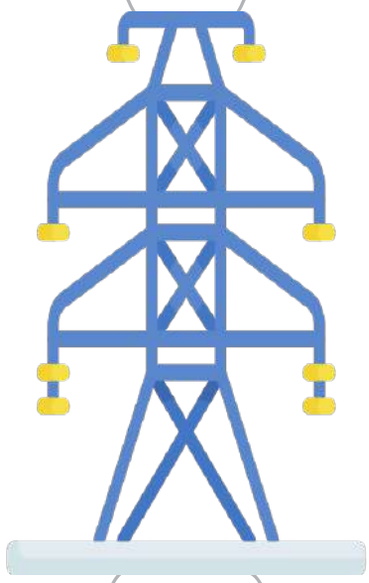


Power Purchase



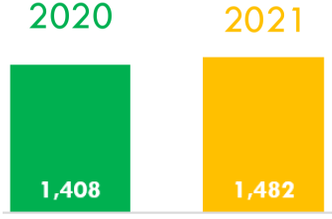


	2020	2021
Total	4,720	6067



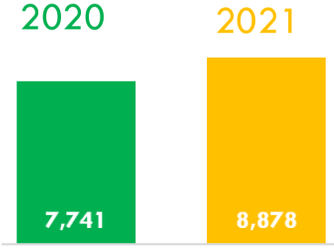
Peak Demand (MW)





Available Energy





Source: A Year in Review FY 2020/21, Nepal Electricity Authority



Energy Efficiency in Industry

A Tool for Improving Competitiveness and Productivity

- Dr. Narayan Chaulagain, Manav K.C

Background

Starting from the industrial revolution of the world that shifted agricultural societies to industrial, the postindustrial societies dominate growth and economic development largely in the developed and developing world. Nepal has been late in this matter with The Company Act coming into existence in 1936 AD. Raghupati Jute Mill was established in 1946 AD and is regarded as the first modern industry in Nepal (Khatri, 2018)Given the state of industrialization in Nepal and the country's overall state of development, much of its industrial growth has yet to come and will likely be developed in the next decade. Ministry of Finance (2022) informed that about 8656 industries were registered in Nepal till mid-March 2022 with a total investment of NRs. 2284 billion. The prevailing practices of energy use in most of the industrial units in Nepal are still inefficient and primitive resulting in higher energy costs, lower productivity, and poorer competitiveness compared with similar industries in neighboring countries. There is a good investment potential and macroeconomic opportunity for Nepal in improving energy efficiency and increasing productivity by realizing the energy-saving potential in Nepalese industries.

Energy Consumption in Industries of Nepal

Manufacturing industries in Nepal consume a relatively large amount of energy to convert raw materials into the finished product. The visible finished product is then brought to market and bought by consumers. Mostly, Nepal's manufacturing industries use electricity and coal as their major sources of energy. Besides, industries also consume petroleum products such as diesel, petrol, kerosene, LPG, furnace oil as well as rice husk, bagasse, and firewood. The industrial sector has been second to the only residential sector in terms of power consumption since FY 2005/06. In FY 2021/22, industries consumed 2816 GWh of electrical energy (Ministry of Energy, 2022).

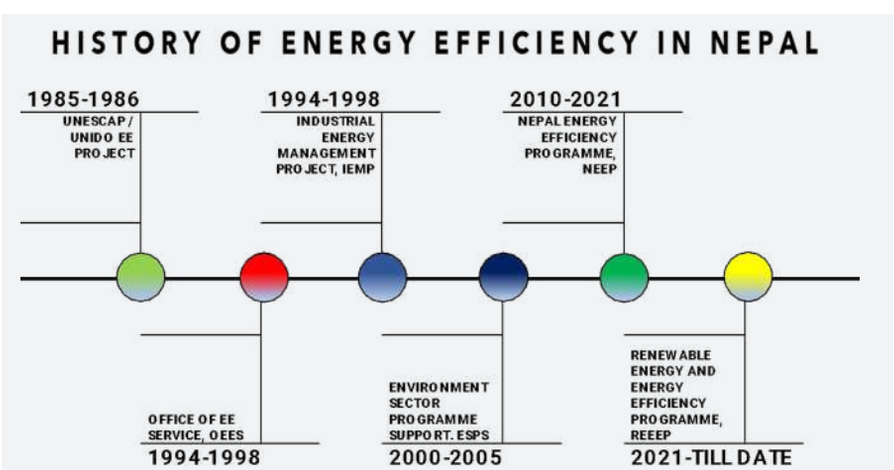
> ***"The prevailing practices of energy use in most of the industrial units in Nepal are still inefficient and primitive resulting in higher energy costs, lower productivity, and poorer competitiveness compared with similar industries in neighboring countries."***

Energy Efficiency in Industries

Energy efficiency is defined as a means of producing more goods and services with less energy consumption or inputs by using efficient tools, appliances, and technologies. In other words, the energy efficiency condition is measured by the amount of energy required to produce per unit of goods or services. Energy efficiency is not just reducing the amount of energy consumption by reducing production or shutting down plants and it is certainly not the goal of energy efficiency. Energy efficiency is not a compromise to comfort, economic growth, or development. Rather, energy efficiency is a means which leads toward sufficiency and prosperity.

Energy Efficiency in Industries – Improving Nepal's economy

From the cost of petroleum utilized in a boiler to electricity used in a compressor, any goods or services' The cost of production of any goods or services heavily depends on the cost of energy used required for the production or manufacturing of such goods or services. Nepal's total electricity consumption has





Dr. Narayan Chaulagain
Senior Energy Specialist
Renewable Energy and Energy Efficiency Programme (REEEP)
narayan.chaulagain@giz.de



Manav K.C
Junior Energy Specialist
Renewable Energy and Energy Efficiency Programme (REEEP)
manav.kc@giz.de

increased by more than double during the last 10 years. In FY 2020/21, Nepal consumed a total of 7318.02 GWh of electricity through domestic generation and import from India, out of which 2826.02 GWh of electricity was imported from India under an exchange agreement (Ministry of Finance, 2022). The amount of electricity consumed by the industries during the same period was about 2816 GWh just a bit less than the amount of electricity imported. This is a clear sign to save electricity consumption in industries and lessen electricity imports. Why do we need to decrease electricity imports? In simple terms, electricity like any other form of energy costs money; particularly foreign currency, which when imported depletes our foreign currency reserve and ultimately hampers Nepal's economy. Not only electricity, as industries use different energy sources, reducing a large amount of energy consumption input to produce the same amount of goods/services output, but energy efficiency can also be regarded as a new energy source for Nepal.

Issues on energy efficiency

Nepal's persistent development challenges result in part from energy poverty, import dependence, and supply vulnerability and are compounded by low levels of embedded energy efficiency. With more than three decades of engagement, energy efficiency (EE) is not new to Nepal. Early efforts in EE focused on demand side management, formation of the office of energy efficiency services, and implementation of some measures, such as case studies around lighting replacement in commercial buildings. These efforts continued during the insurgency and were expanded to look at EE options in the industrial sector. The key issues to EE in Nepal are:

- Absence of a legal, regulatory, and institutional framework providing a statutory basis for the implementation of EE,
- Fiscal, taxation, and pricing policies not generally addressing EE, Access to finance and the high cost of implementation discouraging investors from considering EE investments,
- Limited awareness and information on opportunities from investment in EE,
- Access to technology and technical capacity being absent.

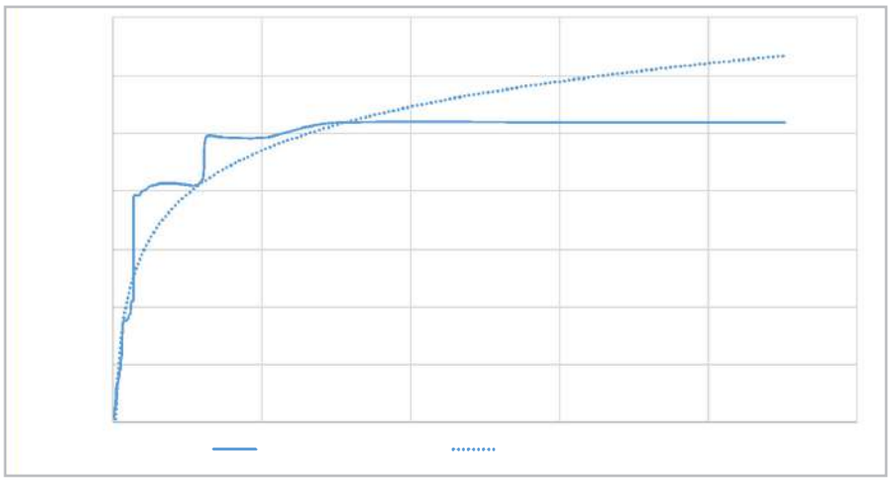


Figure 1: Energy efficiency reductions curve in industries

Opportunities of Energy Efficiency – Improving competitiveness and productivity

Productivity is a measure of the efficiency and effectiveness to which organizational resources (inputs) are utilized for the creation of products and/or services (outputs) (Marsh, 2002). When we talk about the manufacturing industry, good productivity in an industry means the production of the same product with less input in each time frame. Implementation of energy efficiency measures decreases the cost of energy used to produce per unit of goods or services in an industry. In this regard, throughout much of the last decade, many previous energy efficiency initiatives in Nepal have sought to work with industries and large commercial institutions. Detailed energy audits were conducted on approximately 100 industries with the support of the Nepal Energy Efficiency Programme (NEEP), GIZ.

As illustrated in Figure 1, there are plenty of opportunities for energy efficiency in industries. The graph represents a summary of 68 different industries and large institutions where detailed energy audits were conducted from 2012 to 2019.

The annual electrical savings directly impacts the financial savings of an industry, which in turn reduces the cost of production. This ultimately reduces the selling cost and creates a competitive market. Working towards having an energy efficient industry should be a priority for any entrepreneur or industrialist. Simple energy efficiency measures such as installing LED lighting providing the same amount of lighting as halogen lamps, and installing smart thermostats to adjust heating and cooling temperature will save thousands of rupees and help optimize the comfort of employees and their productivity. Industries can have sustainable production due to energy efficiency helping to conserve natural resources, save the environment and create a healthy rewarding space for both industrial workers and consumers. The sustainable production approach and obtained environmental benefits can also be used by industries as one of their marketing tools and branding.

A Case Study of Kathmandu Milk Supply Scheme-Dairy Development Corporation (KMSS-DDC)

Energy Audit was performed in KMSS-DDC, covering both electrical and thermal utilization areas in October 2019. During the reference year July/August 2018 to June/July 2019, KMSS-DDC having a capacity of pasteurizer at 15,000 liters/hour processed 20,512,174 liters of milk and consumed 86,751,000 liters of water, 1,534,792 kWh electricity from NEA and 12,342 liters of Diesel (43,197 kWh equivalent) annually. This informs us that the total Electrical Energy per 1000L raw milk processed was 76.929 kWh/kL

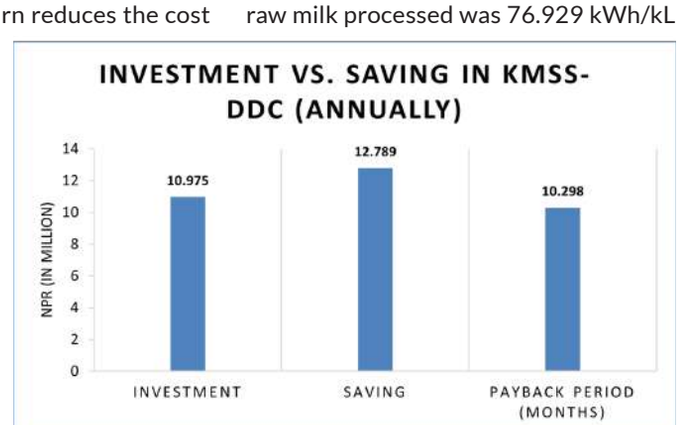


Figure 2: Energy efficiency measures - investment vs saving

(276.544 MJ/kL), total Thermal Energy (High-Speed Diesel) per 1000L raw milk processed @10,200 kcal/kg HSD was 14.69 lit/kL (519.789 MJ/kL) and total water consumption per liter of raw milk processed was 4.229 lit/lit.

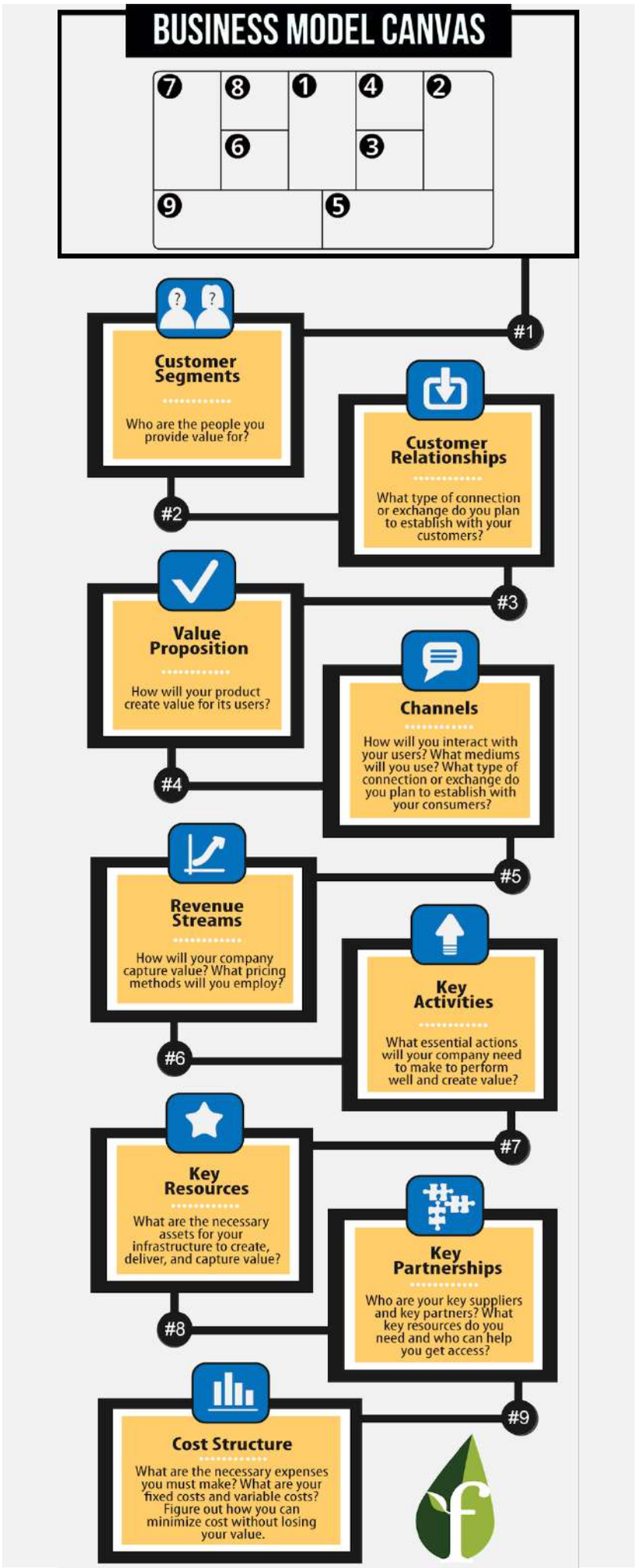
A total of 8 energy saving opportunities were identified and they added up to 138 kVA/month of demand savings and 315,113 kWh (19.97 %) of electrical energy saving per year. Similarly, on the thermal side, potential savings were 102,595 liters (34 %) of HSD per year. The chart in figure 2 speaks for itself as the invested amount can have a payback period of only ≈11 months but have an annual cost saving of NPR 12,789,226 which is compounded yearly. The cost saving due to the application of recommended energy-saving measures will eventually increase the productivity of the industry i.e., production cost per liter of milk (NPR/liter) will decrease. This has a direct impact on the cost paid by consumers as a consumer can pay less for the same product produced with lessened energy cost. Not only the cost, but the direct impact of saving petroleum products and electricity with the production of the same amount of milk will also decrease the import of petroleum products and electricity from India, resulting in an improvement in foreign currency reserve and the national economy.

Conclusion

"Little drops of water, little grains of sand, Make the mighty ocean, and the pleasant land. So the little minutes, humble though they be, Make the mighty ages of eternity." come from Julia Carney's poem 'Little Things'. Energy efficiency initiatives from policy level to ground level help create a big impact through little effort. To conclude, energy efficiency initiatives decrease energy costs, which in turn decrease production costs per unit of service or goods. This increase in productivity creates market competitiveness as most of us tend to choose products based on their cost, given they have the same quality. The chain effect that starts from energy efficiency measures to energy and monetary savings to market competitiveness is a boon for Nepal's economy.

Disclaimer

The views and opinions expressed in the article are the authors' own and not necessarily reflect those of the organization they are associated with.





Green Hydrogen Economy for Nepal

Opportunities for Industrial Development

- Dr. Biraj Singh Thapa, Mr. Bishwash Neupane

Abstract:
The Green Hydrogen-based economy and future are much closer than the perception of the public, politicians, and bureaucrats around the world, as the technology is getting more mature and being developed at a fast pace. When seen internationally, there is strong evidence, the most recent and obvious ones are the proliferation of hydrogen fuel cell vehicles, green hydrogen-based iron, steel industries, and fertilizer industries. For any nation to be energy-independent, it must seek a renewable or green hydrogen future in the near term. This paper discusses the need for research on green hydrogen production and its end uses for which academia and industry collaboration is required. To address the requirement of study on green hydrogen possibilities, Kathmandu University has recently established a Green Hydrogen Lab (GHLab). The lab is currently working on the different thematic areas: Green Fuel, Green Power, Green Processes, and Green Heat. The future green hydrogen developments and national framework can be developed based on these thematic areas. Focusing more on the industrial developments, the paper discusses more on urea production from the green hydrogen in Nepal, one of the potential future industrial sectors, with the challenges, and opportunities.

Keywords: Hydrogen Economy, Research, Green Urea

1. Introduction:

Hydrogen has long been known as the simplest and most abundant element on earth which consists of only one proton and neutron. It does not exist in the free state; rather it is found in complex molecules, such as water or hydrocarbons, and requires extraction to use it in pure form as an energy carrier. Hydrogen is not an energy source but a chemical energy carrier that is used to convert, store and release energy on requirements [1]. Hydrogen can be produced from diverse resources; natural gas, oil, coal, and water using different methods. Based on the resources used, methods followed and carbon emission to extract hydrogen, it has been classified into grey, blue, or green. Hydrogen produced from fossil fuels via carbon-intensive processes like Steam Methane Reforming (SMR) and coal gasification is classified as grey hydrogen. 96% of hydrogen extracted and used today accompanies grey hydrogen. Blue hydrogen is an advanced form of grey hydrogen that is produced by sequestering the emitted CO2 via carbon capture and storage (CCS) [2]. Green hydrogen is produced utilizing clean/renewable energy sources free from carbon footprints which mainly include wind energy, solar energy, and hydropower. Low or zero-emission green hydrogen is produced following the electrolysis method utilizing energy produced from renewable sources. It is expected that by 2030, the cost factor for hydrogen production and application will reduce by half of the present, and with new green hydrogen technologies emerging, hydrogen is going to be the long-term weapon to battle the energy and climate crisis of the next generation. Hydrogen will be an important component of the global energy supply chain to complement and balance renewable energy sources providing flexible electricity balancing the services and need [3].

> ***"For any nation to be energy-independent, it must seek a renewable or green hydrogen future in the near term."***

Green hydrogen derived from clean renewables technologies has been emerging as the most prominent and ultimate clean inexhaustible energy carrier around the globe. The focus has been shifted towards the transition to a green hydrogen economy by integrating the application of green hydrogen in different commercial, industrial, transportation, and utility sectors reducing carbon emissions[4]. Unlike the early 1960s, the hydrogen momentum of the 2020s is going to be the catalyst for the significant leap towards advanced technology development and adaptation of green hydrogen. Nepal with a very high potential for renewable energy from hydropower sectors is in a very prominent position to produce green hydrogen from clean electricity and slowly integrate the green hydrogen application in the different sectors.

The possible end uses of green hydrogen in Nepal can be classified into two categories: existing present end-use areas and future potential end-use areas. The total amount of hydrogen imported into Nepal (2009-2018) is around 14,323 kg which shows there is already an existing hydrogen market. Industries like edible oil processing industries, metalworking industries, and forensic labs have been using hydrogen although the demand is very less and inconsistent[5]. Iron and steel industries, cement industries, food processing



Dr. Biraj Singh Thapa
Asst. Professor
Department of Mechanical Engineering Kathmandu University
Team Leader, Green Hydrogen Lab
Kathmandu University | bst@ku.edu.np



Mr. Bishwash Neupane
Mechanical Engineer
Research Assistant, Green Hydrogen Lab
Dept. of Mechanical Engineering, K.U.
bishwash.neupane@ku.edu.np

industries, independent power and backup electricity generation, and transportation are some of the already existing industries having the possible application of green hydrogen as a clean energy carrier. While collecting some of the hydrogen-based commodities consumption in Nepal, it is found that Urea consumption (2018) was 229,545,715 kg, Ammonia: 102.75 tons (2017), Hydrogen peroxide: 224,131 kg (2019), and Methanol worthen the US $1 million (2017) [5]. A large amount of import of direct hydrogen-based commodities in Nepal indicates green hydrogen potential application in new chemical industries, electricity generation, mining industries, alternative transportation, and so on.

2. Green Hydrogen Research in Nepal - Past works

In the context of Nepal, foreseeing the future energy crisis, and transition towards the green energy system, a study was conducted in 2008 by Dr. B.B. Ale and Dr. S. O Bade Shrestha. The possibilities of generation of hydrogen fuel from existing hydropower plants during off-peak load and utilization of this hydrogen energy to replace the existing fossil fuels used in transportation, cooking, and lighting. Also, the regeneration potential of electricity from hydrogen using fuel cells was studied. Based on the detailed research and analysis, 'National hydrogen Energy- Roadmap of Nepal' was published. Although the study was done a decade ago, the roadmap published at that time is still one of the important documentation and guidelines for conducting a preliminary assessment of hydrogen energy potential in Nepal at the current status and potential application sectors [6].

3. Green Hydrogen Research at KU

The environmental and health challenges induced by emissions are forcing the effects of Nature to lift off the carbon footprints from the energy and economic ecosystem. The Green Hydrogen-based economy is the future of the sustainable solution to balance the economy and environment. There is a need for research and innovation to make the GH systems technically and financially feasible as the replacement of fossil fuels.

In the context of Nepal and the Himalayas region, it is high time to investigate the Hydropower-to Hydrogen (H2H) technology and prepare the region to enter the Green Hydrogen era. The development of hydropower systems to produce GH for commercial applications can change the value chain of hydropower development in the entire Himalayan region. Nepal can generate revenue of up to USD 3 billion per year in 2030 by using an excess of 3000 MW of hydroelectricity for H2H by producing Green Hydrogen. With a need to prepare the academic institutions in Nepal to develop knowledge and resources in the field of Green Hydrogen studies, and initiate the production, transmission, and utilization of Green Hydrogen from hydropower projects, Kathmandu University (KU) has recently established a research lab named as Green Hydrogen Lab, 'GHLab'. This lab is in the inception phase now and would later be developed as a 'Centre for Green Hydrogen (CGH)' -an exemplary multi-disciplinary research unit with state-of-art research facilities. GHLab aims to identify the prospects of Hydropower-to-Hydrogen (H2H) technology in the Nepalese context and transfer the relevant knowledge to the region. The fundamental and applied research conducted at GHLab will lay the foundation for the commercial application of H2H technology in Nepal soon. The engagements in academic and research degrees will produce capable and competent human resources necessary for project development in the future [7].

The main thematic areas of research at GHLab are classified as:

—**Green Fuel:** The main aim of this thematic research area is to contribute to technology transfer and local adaptation for the production, storage, supply, and end-use of hydrogen as a future fuel for the transportation sector in Nepal. The surplus electricity and dedicated hydropower projects can be used to produce hydrogen as the alternative and future fuel for the transportation sector of Nepal. Our preliminary studies show a 2% cumulative transition to alternative fuels for the transportation sector in Nepal can cut the import of fossil fuels by NPR 71 billion in the year 2035. After 5% cumulative transition to the alternative fuel for the transportation sector in Nepal, the demand for petroleum starts decreasing by 2025. Also, the surplus energy will exceed by nearly 20000 GWh by 2035, when 5% replacement of petroleum fuel is done by hydrogen fuel in Nepal by 2035 as shown in Figure 1.

—**Green Power:** The main aim of this thematic research area is to develop a stand-alone electricity supply for

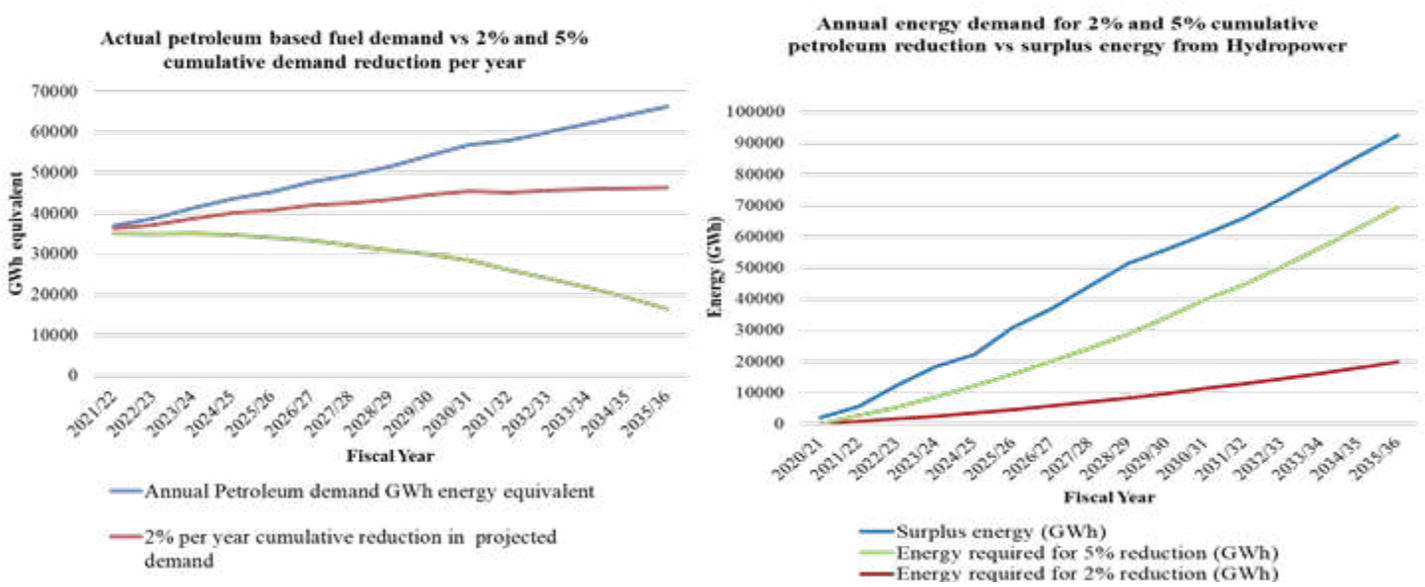


Figure 1: Cumulative petroleum demand reduction using hydrogen and energy demand scenarios

community schools, hospitals, and even households where regular supply is not available or reliable. Hydrogen is aimed to be bottled in a safe way like LPG gas and transported to the end-use center, where 1 kg of hydrogen can produce about 20 kWh of electricity by fuel cells. The future of rural Nepal could be a hydrogen society where each household owns a few hydrogen tanks and fuel cell generators of 1-3 kW. All the household energy for light, heat, cooking, and maybe personal transport could be fueled by hydrogen. The community owns a Solar-MHP hybrid station with a central electrolyzer, and a hydrogen storage and refilling facility. The entrepreneurs can run milk, food processing, and other small-scale industries with the uninterrupted supply of electricity from the fuel cells. For the urban sector, diesel-based electricity backup can be replaced by hydrogen-based supplies. We hope to install the prototype of 'Green Power Backup' at KU with supporting partners.

One of our studies considering utilizing hydrogen produced in Chauri Khola Micro hydropower (50 KW) to generate individual green power which can be used in isolated remote households shows that exactly 254 households can be supplied with nearly 82928 kWh of green electrical energy generated from spilled electricity in that micro HPP. The average electricity use in rural areas is estimated at 27.5 kWh per family per month based on the literature.

Table 1: Green power generation potential in Nepal from Micro HPP

	15 kW electrolyser system	**30 kW stacked electrolyzer system**
Electrical Energy	82928 kWh	82616 kWh
Number of Households	254	250

—Green Heat: The main aim of this thematic research area is to develop alternative fuels to LPG, coal, oils, etc. for heat application in household cooking and industrial applications. The target is to produce commercially feasible Methane gas from hydrogen and carbon dioxide and integrate it into the existing and future supply chain of Nepal. Such projects have already been successful in many other countries and are often referred to as 'Power to Gas Projects'. If green methods produce hydrogen the project will then be carbon negative. We have also done some preliminary tests on HHO as an alternative fuel for high-temperature gas for industrial applications.

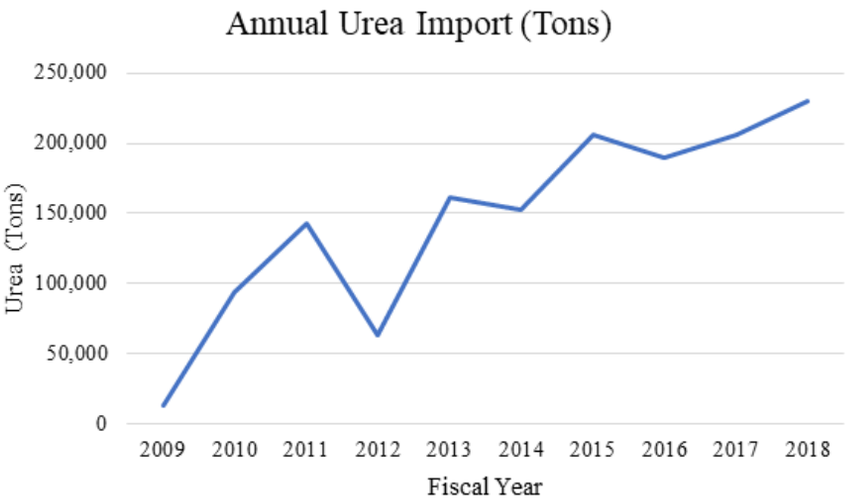


Figure 2: Annual Urea Import in Nepal [5]

—Green Process: The main aim of this thematic research area is to optimize the industrial processes to use green hydrogen as the primary commodity for the production process. The industrial sector including Urea production, Mining industry, Chemical Industry, Food processing industry, and Brick Industry can replace the carbon-intensive methods with green hydrogen from renewable energy. Other sectors such as hydrogen from municipal waste and sewage management also fall under this thematic area.

4. Green Hydrogen for Urea Production in Nepal-typical example of industrial application for Green Energy

Urea is one of the most important nitrogenous fertilizers, produced on a large scale and used mainly in agricultural sectors. The global demand and supply for Urea in 2019 was around 211 million metric tons with a large scale of this produced urea in the agricultural sectors. By 2021, the global demand for urea is projected to increase by 226 million metric tons, and 300 million metric tons by 2030 [8][9]. Urea is mainly synthesized using ammonia and carbon dioxide. And ammonia is mainly synthesized using hydrogen and nitrogen. So, hydrogen is one of the most elements required to synthesize urea fertilizers. Most of the global hydrogen demand used for this purpose is grey hydrogen. Studies and pilot plants are ongoing to search for alternatives to grey hydrogen and possibilities of green hydrogen. Studies have revealed that green urea can be produced by using green hydrogen. To produce 1 ton of urea, nearly 0.58 tons of green hydrogen is required theoretically.

Urea is one of the most consumed nitrogenous fertilizers in Nepal from a very early time in the agricultural-dependent economy of Nepal. The annual demand for Urea in Nepal has surged to around 800,000 tons per year as of today. Only around half of the demand is supplied in Nepal through imports from India and third countries. Urea has been imported to Nepal for decades and still, there is no domestic production although there is a scarcity of urea fertilizer in Nepal. Figure 2 shows the Urea Import in Nepal. The import data shows the consumption of urea-based fertilizers and urea-based resins in Nepal.

5. JICA Report Summary: Green Urea Production

The Japan International Cooperation Agency (JICA) with the request of the Government of Nepal, conducted a study investigating the feasibility of establishing a chemical plant for Urea fertilizer in Nepal between October 1983 and September 1984. The standard process of urea manufacturing at that time when the report was compiled was the Haber process followed by the urea manufacturing process. In this process, the gaseous nitrogen and hydrogen are reacted at high temperatures and pressure to produce ammonia. The produced ammonia is then reacted with carbon dioxide to produce urea in the second process. In most of the conventional processes popular worldwide, natural gas is subjected to steam reformation to produce hydrogen and carbon dioxide, necessary for urea synthesis.

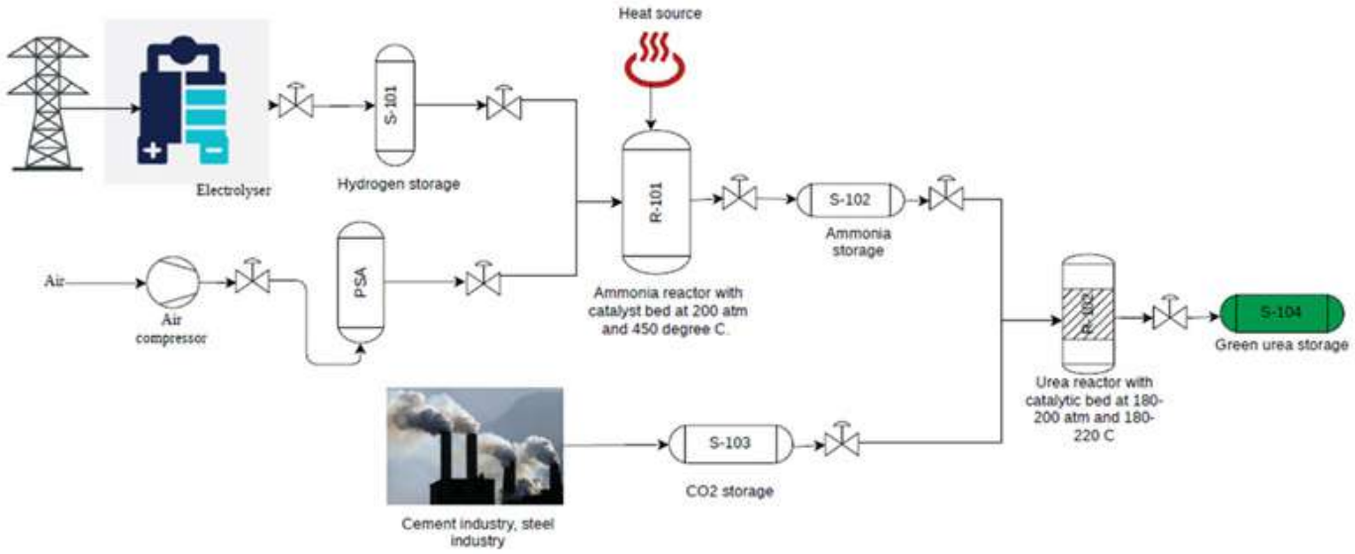


Figure 3 : Schematic representation of Green Urea Production process

Instead of the standard process, Hydrogen was produced from water by electrolysis process and carbon dioxide was to be extracted from flue gas produced in the cement factory. The targeted plant capacity was to be 275 tons of urea per day to meet projected demand in Nepal, even though the general trend was for plants to have a capacity between 1000 and 1800 TPD for economies of scale.

Technical Features of the Chosen Process:

- Urea production capacity to be 275 tons per day of dry, prilled urea.
- Plant to be located adjacent to Hetauda Cement Factory

Process plants required:

- Hydrogen plant - 28.4 TPD (tons per day) (25% KOH solution to be used as the electrolyte for the hydrogen production process)
- Nitrogen plant - 132 TPD
- Ammonia plant - 160 TPD
- Carbon dioxide plant - 207 TPD

Basic Financial Assumptions

The basic financial assumptions made during the JICA study in 1983/84 are:

- Economic Lifetime of the project is estimated to be 15 years
- Total financial requirements are estimated to be $145 million
- Prevailing electricity price of 3.56 cents per kWh
- The economic value of the produced urea was taken as equal to the selling price of the urea
- ERR (Economic Internal Rate of Return) was calculated to be 8.25% NPV calculated to be $ 1.02 million at an 8% discount factor.

Fertilizer Scarcity: Perennial problem

More than two-thirds of the population in Nepal demands agriculture as a means of livelihood. Urea is one of the most consumed nitrogenous fertilizers in Nepal from the very early time in the agricultural-dependent economy of Nepal. The demand for urea fertilizer has been increasing every year and is one of the most sought fertilizers in Nepal. The annual demand for Urea in Nepal has surged to around 800,000 tons per year as of today. However, only around half of the demand is supplied in Nepal through imports from India and third countries. Urea has been imported to Nepal for decades and still, there is no domestic production although there is a scarcity of urea fertilizer in Nepal. Most recently too, there was a huge demand for Urea fertilizer for paddy and the nationwide crisis of urea fertilizer is still ongoing. Most recently too, along with the COVID-19 crisis, Nepalese farmers have been going through the fertilizer crisis, and are fearing the decrease in agricultural productivity and hunger crisis.

Around 300,000 tons of urea imported into Nepal signifies the need for a green hydrogen-based urea fertilizer plant. So, urea production utilizing green hydrogen from hydropower, nitrogen from air absorption, and carbon dioxide from the flue gas are some of the potential future industries.

6. Role of green hydrogen in Urea Production

Most of the urea produced in the global market is extremely carbon-intensive with dependence on the ammonia produced from the grey hydrogen. The main chemical requirement for urea production is ammonia and carbon dioxide. The ammonia used in urea plants is mainly produced by synthesizing hydrogen and nitrogen. Hydrogen used in ammonia synthesis is mainly produced using steam methane



Figure 4: Farmers stand in a queue to buy Fertilizer amid of COVID-19 pandemic (Source: The Kathmandu Post, September 3, 2020)

reforming, coal gasification, and other carbon-intensive processes that release huge amounts of carbon dioxide. When green hydrogen is used as feedstock for the synthesis of green ammonia, then there is the possibility of producing green urea and decarbonization in the urea industry.

The urea fertilizer plant is not established yet in Nepal and the government has recently proposed to establish a urea plant based on natural gas supplied by Indian Oil Corporation. The use of green hydrogen instead of grey hydrogen from natural gas could be a better option to go for the urea fertilizer industry in Nepal. The new urea fertilizer plant is one of the industrial application sectors of hydrogen as the demand is increasing more and more.

6.1 Green Urea Production method

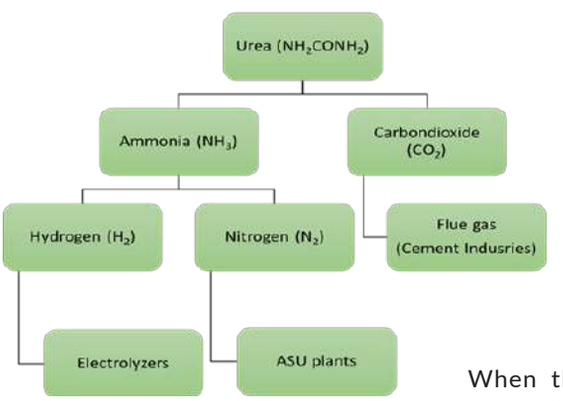


Figure 5: General flow diagram from Hydrogen to Urea

6.2 Urea Fertilizer Plant in Nepal: Economic Analysis

The government of Nepal has proposed a public-private partnership urea fertilizer plant led by the Office of the investment board and the Ministry of Agricultural Development. The plant is supposed to be built in Bardaghat, Nawalparasi. The plant would be an ammonia-urea plant with a capacity of 1220 metric tons per day of ammonia and 2125 MTPD of urea which is about 700,000 metric tons per year of urea. The total land required for the proposed plant is assumed to be around 400 Hectares [10].

In 2015 the investment board commissioned a detailed feasibility study from a firm called Infrastructure Development Corporation (Karnataka). The study was intended to provide an "economic and financial analysis before and after the establishment of the fertilizer plant" and specify the appropriate technology for Nepal and necessary raw materials. The feasibility study delivered the following economic analysis of the projected Capital Expense and Operating Expense for three modalities: natural gas, electrolysis, and coal [11][12].

When the capital cost, Opex cost, production cost per kg of urea from every three alternatives, urea produced from electricity is the most expensive and requires 30 rupees subsidies by the government to be competitive with the existing urea market cost in Nepal. A coal-based plant is the most expensive one when compared based on capital cost. The feasibility study has shown that the all-electric urea plant and coal-based plant are not feasible. The natural gas-based plant is the feasible one for Nepal with Natural gas provided from India via pipeline.

Urea Chemical Reaction
$CO_2 + 2\ NH_3 \rightleftharpoons NH_2COONH_4$ (Ammonium Carbamate)
$NH_2COONH_4 \rightleftharpoons NH_2CONH_2$ (Urea) + H_2O
Theoretically, 1 tonne of Urea requires 0.58 tonnes of Ammonia and 0.78 tonnes of Carbon dioxide
Ammonia Chemical Reactions (Haber Bosch Process)
$3H_2 + N_2 \rightleftharpoons 2\ NH_3$ (Ammonia); 150-200 bar pressure and 300°C-500°C)
Theoretically, 1 tonne of Ammonia requires 177 kg of H_2 and 832 kg of N_2
Hydrogen extraction from water; Chemical Reaction
Anode Reaction: $2\ H_2O \rightarrow 4\ H^+ + 4e^-$
Cathode Reaction: $4\ H^+ + 4e^- \rightarrow 2H_2$
Theoretically, 1 kg of hydrogen requires approximately 9 litres of water, but it depends upon electrolyzer size, capacity, efficiency, and electricity consumption
Nitrogen extraction from atmospheric Air
Cryogenic nitrogen plant/noncryogenic nitrogen plant

6.3 Challenges for Natural gas-based Urea Plant in Nepal:

- Nepal does not have its natural gas plant although it has been found that Nepal has a high amount of Natural gas stored within the Kathmandu Valley and must be relied upon imports from mainly India
- Natural gas should be supplied from India via a 200 km long pipeline, but the work related to the pipeline takes a minimum of three years to complete.
- India has been positive about starting work on pipelines but wants the economic, financial, and market assurance of the pipeline
- The Ministry of Commerce has given permission to Nepal oil corporation for the project to start, but none of the companies have shown interest to invest in the plant
- India itself has been dependent on other countries for Natural gas supply, so dependence on natural gas supply from India itself is contradicting and not sustainable in the long run

6.4 Opportunities for Nepal

- A lot of spilled electricity is going into the waste without creating any value. Instead of targeting the large-scale Ammonia-urea plant at the same place, the government of Nepal can establish a small-scale ammonia plant at several places near the hydropower stations, produce ammonia from hydropower and transport it to the urea plant for manufacturing of urea.
- Unlike hydrogen, ammonia is easier to transport and could be transported easily, doing this, surplus electricity could be utilized, and values could be generated.
- For the longer run and sustainable production, Natural gas and coal are not the best options. With the technologies on electrolyzer and mini-scale ammonia plants getting more and more mature, the efficiency is sure to be increased with reduced cost.
- With surplus electricity of 8 GW going to be produced in Nepal by 2030, electricity costs could be decreased which could be exciting for all-electric urea plants.

Table 2: Economic Analysis of three modalities for Urea fertilizer plant in Nepal

Fertilizer plant	Natural Gas	Coal	Green Hydrogen, Normal rate	Green Hydrogen, Subsidized rate
Capex, total, total	$665 Million	$1300 Million	$983 Million	$700 billion ($500 Million – $1.5 Billion)
Production cost per kg of urea	Rs. 31 (Rs 13 subsidies by the government per kg)	Rs. 40 (Rs 20 subsidies by the government per kg)	Rs. 49 (Rs 30 subsidies by the government per kg)	
Electricity cost 8/kWh	Rs. 18. 375 (IRR of 8% at an electricity cost Rs 3/kWh and IRR of 20% when electricity cost nearly zero)			
Electricity requirement	115 MW	-	500 MW (Separate 400 MW plant to be built for power supply)	Specific energy consumption: 0.35 MW per ton per day of urea (0.3 to 0.4 MW)
Natural gas and coal requirement	1197 Metric tons/day	16 million tons of coal import per year (approx. 43,836 tons/day)		220 tons of hydrogen/ day for 2125 metric tons per day urea production

5. References:

[1] Hydrogen: A Clean, Flexible Energy Carrier | Department of Energy n.d. https://www.energy.gov/eere/articles/hydrogen-clean-flexible-energy-carrier (accessed August 25, 2020).

[2] New-hydrogen-economy n.d. https://www.worldenergy.org/assets/downloads/WEInsights-Brief-New-Hydrogen-economy-Hype-or-Hope-ExecSum.pdf (accessed August 25, 2020).

[3] McKenzie B. Shaping Tomorrow ' S Global Hydrogen Market 2018.

[4] Bourne S. The future of fuel: The future of hydrogen. Fuel Cells Bull 2012;2012:12–5. https://doi.org/10.1016/S1464-2859(12)70027-5.

[5] Data Visualization - NTIP n.d. https://staging.nepaltradeportal.gov.np/web/guest/data-visualization (accessed October 18, 2020).

[6] Ale BB, Bade Shrestha SO. Hydrogen energy potential of Nepal. Int J Hydrogen Energy 2008;33:4030–9. https://doi.org/10.1016/j.ijhydene.2008.04.056.

[7] Thapa BS, Thapa B. Green Hydrogen as a Future Multi-disciplinary Research at Kathmandu University. J Phys Conf Ser 2020;1608:012020. https://doi.org/10.1088/1742-6596/1608/1/012020.

[8] Nitrogen Fertilizers Market Review 2015-2019 and Forecast to 2030 - Urea Fertilizers Witnessing Rapid Growth; Global Urea Capacity to Reach 226 Metric Tons by 2021 n.d. https://www.globenewswire.com/news-release/2020/02/11/1982844/0/en/Nitrogen-Fertilizers-Market-Review-2015-2019-and-Forecast-to-2030-Urea-Fertilizers-Witnessing-Rapid-Growth-Global-Urea-Capacity-to-Reach-226-Metric-Tons-by-2021.html (accessed September 30, 2020).
[9] World | Data Visualization n.d. https://staging.nepaltradeportal.gov.np/web/guest/data-visualization (accessed September 28, 2020).

[10] Urea-fertilizer plant n.d. https://ibn.gov.np/wp-content/uploads/2020/04/Chemical-Fertilizer-Plant.pdf (accessed October 1, 2020).

[11] Dhungana N. नेपालमै कनि खुल्दैन मल कारखाना? – Online Khabar. OnlineKhabar 2020. https://www.onlinekhabar.com/2020/09/893673?fbclid=IwAR1ISHzQ4EwTBnrBv6y-tKvSQMQcEmd_dae91LlmQDrwnS2_5WtB92NE2mM (accessed October 1, 2020).

[12] Trever Brown. Ammonia plant cost comparisons: Natural gas, Coal, or Electrolysis? – AMMONIA INDUSTRY 2017. https://ammoniaindustry.com/ammonia-plant-cost-comparisons-natural-gas-coal-or-electrolysis/ (accessed September 29, 2020).

1st Ranked College
Outside Kathmandu
4th Ranked College
of Nepal



The BEST COLLEGE of the nation

AROMA

Education par Excellence

+2

BIO Science | COMPUTER Science | GENERAL Management | HOTEL Management

Balmandir Road, Bharatpur-10, Chitwan | 056-595993, 595593 | www.aromaschool.edu.np

TANAHUN HYDROPOWER LIMITED

Tanahun Hydropower Limited was established as a subsidiary company of NEA to develop 140 MW Tanahun Hydropower Project (previously known as Upper Seti HEP).

The main features of the Project are :

Installed Capacity	:	140 MW
Annual Energy	:	585.7 GWh
Design Flow	:	131.2 m3/s
Dam Height / Type	:	140 m/concrete gravity
Headrace Tunnel	:	1162 m (7.4m dia)
Surge Shaft	:	61.5 m (ht.), 28 m (dia)
Penstock Pipe	:	650 m (l), 5.7 m to 4 m (dia)
Turbine	:	Vertical Shaft Francis 2 nos
Powerhouse	:	Underground Type
Transmission Line	:	36.9 km



TOP OPEN- ACCESS JOURNALS

LEARN WITHOUT BOUNDS



1

Advances in Industrial and Manufacturing Engineering

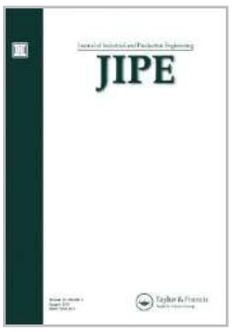
Advances in Industrial and Manufacturing Engineering is an open access gold journal that covers all aspects of industrial and manufacturing engineering. The journal's goal is to publish full research papers, review papers, and short communications with a focus on fundamental and applied science, as well as innovative technologies that advance knowledge in product handling and manufacturing at the component, system, and societal levels.

2

Journal of Industrial Engineering and Management

The Journal of Industrial Engineering and Management is an open access scientific journal that publishes theoretical and empirical peer-reviewed articles that advance understanding of phenomena related to all aspects of industrial engineering and management.





3

Journal of Industrial Engineering and Production Engineering

The Journal of Industrial and Production Engineering (JIPE) is a peer-reviewed, worldwide journal that publishes excellent research for the industrial engineering community. Operations Research, Soft Computing, Quality, Applied Statistics, Manufacturing Automation and e-Business, Human Factors and HCI, Information Technology and Management, Industrial Technology and Management, Product Lifecycle Management, Production and Operations Management are all included in its scope.

4

International Journal of Industrial Engineering: Theory, Applications and Practice



The International Journal of Industrial Engineering: Theory, Applications and Practice publish unique, high-quality articles on industrial engineering theory, techniques, methodology, applications, and practice, as well as general surveys, critical reviews, educational or training articles, including case studies, short communications, keynote papers, book reviews, announcements, and other articles addressing both traditional and modern aspects of the field.

5

Journal of Applied Research on Industrial Engineering



Journal of Applied Research in Industrial Engineering is a peer-reviewed, interdisciplinary, international scholarly open access journal. This journal's mission is to provide a forum for industrial engineering educators, researchers, and practitioners to advance the practice and understanding of applied and theoretical aspects of industrial engineering and related fields.



6

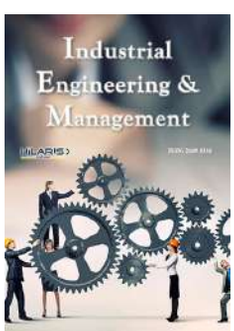
International Journal of Research in Industrial Engineering

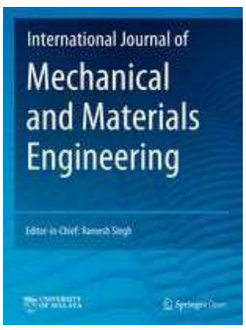
The International Journal of Research in Industrial Engineering is a quarterly international scholarly open access, peer-reviewed, interdisciplinary journal. This journal provides a forum for professionals, academics, researchers, policymakers, and practitioners working in the fields of industrial engineering, reliability engineering, TQM, management, applied mathematics, and globalization to present their research findings, propose new methodologies, disseminate the most recent findings, and learn from one another's research directions.

7

Industrial Engineering & Management

Industrial Engineering and Management is concerned with the design, construction, management, and application of scientific and engineering principles to improve the industrial environment. Manufacturing Systems, Logistics, Supply Chain Management, Materials Management, Entrepreneurship, Radiation Protection, Industrial Hygiene, Environmental Sustainability, and Public Health iIsues, Applied Statistics, Business & Management are among the topics covered. The journal provides an Open Access platform for the publication of the most recent contributions in the field of Industrial Engineering & Management.





8

International Journal of Mechanical and Materials Engineering

The International Journal of Mechanical and Materials Engineering is a peer-reviewed, international, and interdisciplinary journal that provides a forum for cross-disciplinary research contributions on a wide range of topics related to mechanical and machining properties of materials, as well as materials science, and how they apply to materials used in equipment and structures.



9

International Journal of Design

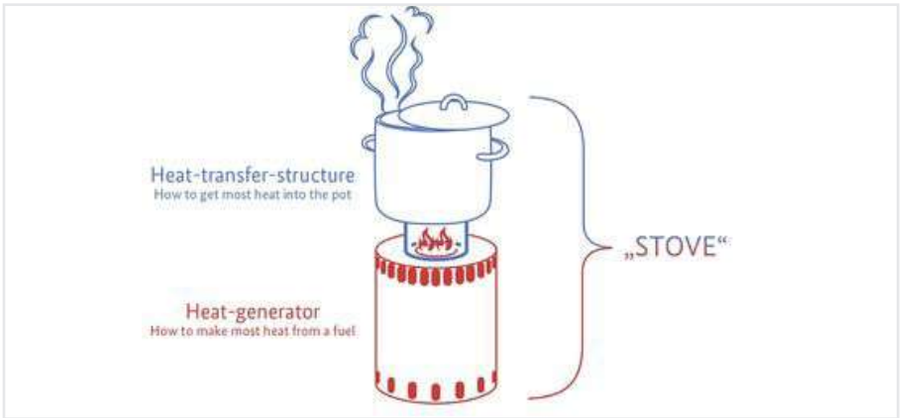
The International Journal of Design is a peer-reviewed, open-access journal that publishes research papers in all fields of design, such as industrial design, visual communication design, interface design, animation and game design, architectural design, urban design, and other design-related fields.



10

Engineering Management in Production and Services

Engineering Management in Production and Services is an Open Access journal that allows a free unlimited access to its contents without any restrictions upon publication to all users. It aims to publish original research in Engineering Management, Technology Management, Foresight, Technology Assessment, Quality Engineering, Logistics Management, Service Engineering, Production Engineering, and Industrial Marketing.



Water Boiling Test (WBT) for Cook Stoves

- Er. Ayush Parajuli

The purpose of designing and developing an improved cook stove is to achieve clean combustion and high efficiency that meets the cooking requirements and maintains a clean environment. Although field measurement can get representative and reliable results, it requires relatively high labor intensity, high cost, and is usually time-consuming [1]. Moreover, a field test (kitchen performance test) is a complex process and is limited by several constraints. Laboratory testing is intended to be reproducible and potentially suitable for comparing the performance of different cookstoves [2]. Thus, the Water Boiling Test (WBT) under lab conditions has been developed to assess the performance of a cooking stove. It measures the efficiency of heat transfer and emission levels. An institution like GACC and Aprovecho have set a benchmark and standards for WBT.

WBT prescribes three phases of testing: cold-start high-power phase, hot-start high-power phase, and simmering phase as shown in the figure 1. For the cold-start high-power phase, the tester begins with the stove at room temperature and uses fuel from a pre-weighed bundle to boil a measured quantity of water in a standard pot. The tester then replaces the boiled water with a fresh pot of ambient temperature water to perform the second phase. The materials used for the construction of a cookstove are of paramount importance.

> ***"Although field measurement can get representative and reliable results, it requires relatively high labor intensity, high cost, and is usually time-consuming"***

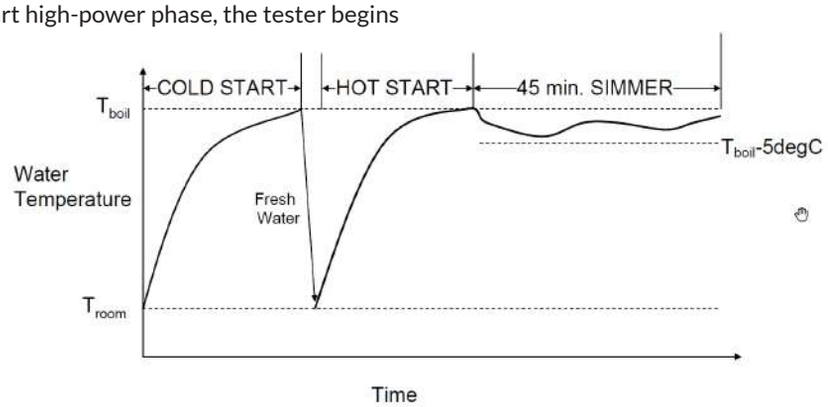


Figure 1. Temperature during the three phases of the water boiling test. (Figure credit: Nordica MacCarty)

During a cold start, a certain quantity of heat is absorbed by the cookstove, hence its temperature increases. The hot-start high-power phase is conducted after the first phase while the stove is hot. Again, the tester uses fuel from a pre-weighed bundle to boil a measured quantity of water in the same pot. Repeating the test with a hot stove helps to identify differences in performance between a stove when it is cold and when it is hot. WBT recommends the water temperature be maintained 5oC below the boiling point for 45 minutes for the simmering phase. The temperature is kept below boiling point to ensure maximum energy level during this phase. This step of simmering simulates the long cooking. It is important to understand that heat absorbed during the high-power phase is supposed to be released during the simmering phase. However, not all the heat absorbed is recovered in this phase only. Thus Ram et al. (2014) suggest adding the fourth phase for the estimation of residual heat and its recovery rate.

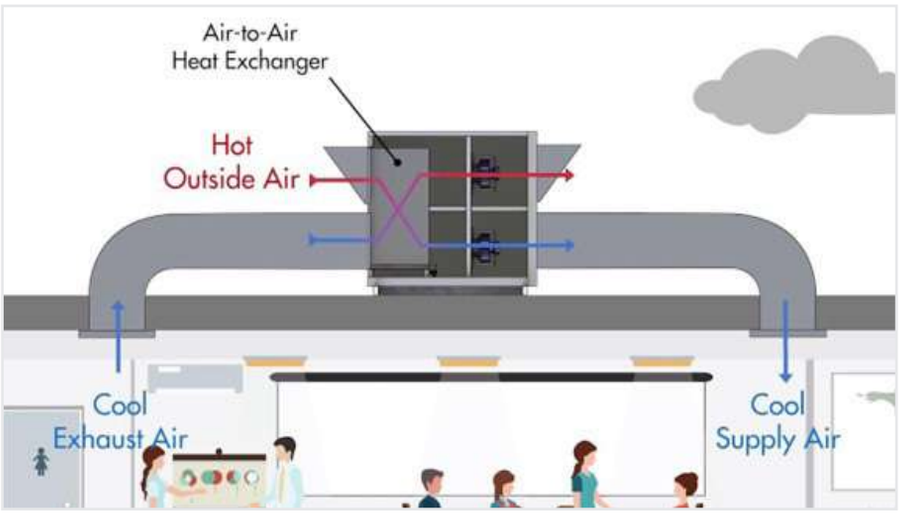
References:
[1] G. Shen et al., "Influence of fuel mass load, oxygen supply and burning rate on emission factor and size distribution of carbonaceous particulate matter from indoor corn straw burning," J. Environ. Sci., vol. 25, no. 3, pp. 511–9, 2013.

[2] R. P. Taylor, "The uses of laboratory testing of biomass cookstoves and the shortcomings of the domaint U.S. protocol," Iowa State University, 2009.

[3] P. Raman, N. K. Ram, and J. Murali, "Improved test method for evaluation of bio-mass cook-stoves," Energy, vol. 71, pp. 479–495, 2014, doi: 10.1016/j.energy.2014.04.101.



Er. Ayush Parajuli
Department of Mechanical Engineering & Science
Graduate school of Engineering, Kyoto University
parajuli.ayush.67c@st.kyoto-u.ac.jp



Energy Management and Indoor Air Quality Improvement with Energy Recovery Ventilation (ERV) System

- Er. Balkrishna Kharal

Energy has become the backbone of humanity's daily activities. Heating, ventilating, and air conditioning systems (HVAC), which consume around 40% of energy in the residential sector, have turned into an essential constituent for providing fresh air, especially after COVD-19, not only in hospitals but also in any simple construction. Thus, decreasing this percentage or recovering part of the energy lost is an essential issue in today's energy management scenarios. The essence of ventilation is the exchange of air in the room with outside fresh air.

The regulated ventilation system with heat recovery makes it possible to optimize the ventilation intensity based on a stimulus from the room user or automatically based on sensors monitoring the quality of the indoor climate (temperature and relative humidity, CO2 concentration in the air, etc.). In addition, if we use a ventilation system with heat recovery from the exhaust air to preheat the fresh supply air to the room, we can achieve high energy efficiency of the building by meeting the hygienic criteria of the indoor climate.

In the air-conditioning system, increasing fresh air is one of the important means of improving indoor air quality. Health and energy-saving, in the energy-hungry world, are two themes that all air conditioning products have to face today. Fresh air Energy recovery ventilation will not only bring high-quality air into the room but reduce energy consumption.

> ***"Health and energy-saving, in the energy-hungry world, are two themes that all air conditioning products have to face today."***

What is an Energy Recovery Ventilation (ERV) System?

Energy recovery ventilation (ERV) is the energy recovery process in residential and commercial HVAC systems that exchanges the energy contained in normally exhausted air of a building or conditioned space, using it to treat (precondition) the incoming outdoor ventilation air. Energy recovery ventilators (ERVs) transfer energy between the air exhausted from the building and the outdoor supply air to reduce the energy consumption associated with the conditioning of ventilation air. During the warmer seasons, an ERV system pre-cools and dehumidifies; During cooler seasons, the system humidifies and pre-heats.

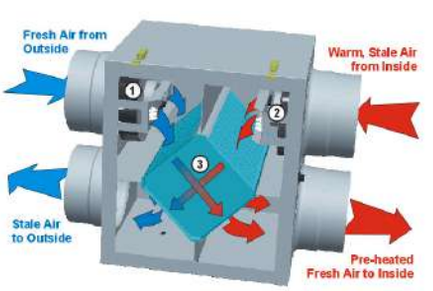


Figure 1 : ERV System

How does ERV Work?

ERV units (air-to-air heat exchanger) provide continuous clean, fresh, and filtered air from the outdoor to the living indoors and exhaust stale air from high moisture spaces: kitchens, laundries, and bathrooms. Up to 95% of exhaust air heat can be recovered by transferring it to the incoming air (depends on ERV model and brand). Indoor comfort is ensured by smart sensors that monitor the relative humidity of supplied air that adjust automatically the indoor air quality with minimum heat loss. Depending on installed windows quality, air permeability of the architectural project, and climate zone, ERV can save up to 30% in heat energy (Manz et al, Juodis, 2000,2006).

The ERV, also known as the heat recovery air exchangers, are equipped with two continuously running fans. The first one expels indoor stale air (saturated with smells, smoke, pollutants, etc.), and the second one supplies fresh filtered outside air. The fresh new air and expelled stale air never come into contact with each other; the air is not recycled. This technology captures heat or cold energy and recycles it; it does not generate it. It can recover heat during winter or cool during summer from the expelled stale air and transfers it to the fresh incoming filtered air. In ERV, energy transfers between the outdoor air and the indoor exhaust air. In summer, the indoor air pre-cools the outdoor fresh air, and in winter the indoor air pre-heats the outdoor air, thus the load of the fresh air can be reduced to make a lower energy consumption, and then reach the target of energy-saving and solve the contradiction.

Why is ERV important?

Insufficient ventilation can be the cause of various skin diseases, respiratory diseases, allergies, oncological diseases, and others. Insufficient ventilation increases the relative humidity, CO2 concentration, the occurrence of allergens, odor, and the concentration of pollutants. To meet the increasingly stringent standard



Er. Balkrishna Kharal
Industrial Engineer
Thermotech Pvt. Ltd.
kharalkrishna72@gmail.com

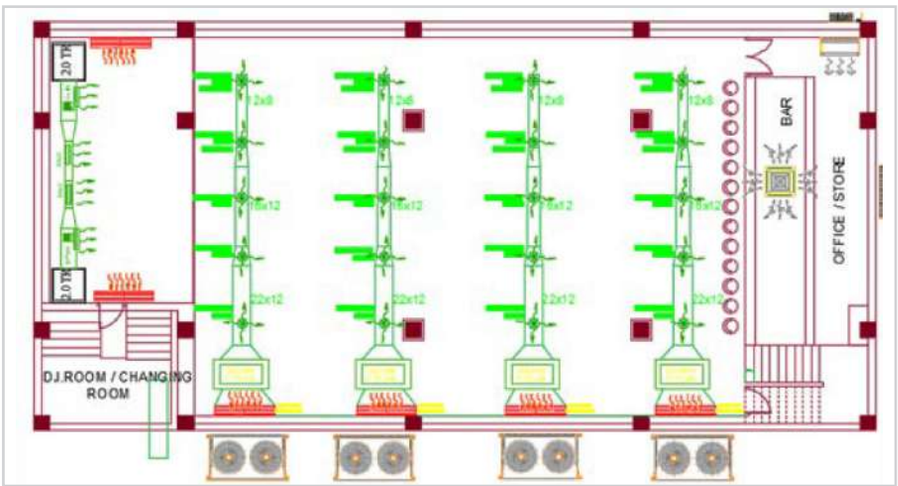


Figure 2: Air Conditioning Design without ERV Unit

requirements for energy performance and thus reduce the operating costs of buildings, it is necessary to use energy-saving elements of technical equipment and eliminate heat losses by building envelope structures.

Higher ventilation rates improve the IAQ by diluting pollutants such as airborne particles and Volatile Organic Compounds (VOC). On the other hand, studies have shown that higher ventilation rates increase the building energy consumption in a majority of cases, especially during the hot summer season. Therefore, more energy is required to provide the space with more outdoor ventilation air and consequently better IAQ. The ERVs is an important equipment for indoor air conditioning.

CASE STUDIES

Kathmandu Dance Bar and restaurant Case Study

Design Condition:

Maximum Outdoor Temp. = 40 °C
Required Indoor Temp. = 22 °C
Temp. difference: 18 °C
Space Area (sq. ft.) =2875 sq. ft.
Height: 12 Ft.

Propose For: Dance Bar and restaurant Considering all cooling load (Lighting, Person, Concrete Structure, Solar gain, etc.) of the space I propose 28 Ton of Air Conditioning for the Space:

Performance and Energy Consumption Analysis

Air Conditioning without ERV

Suppose at the time, outside temperature is 30 °C relative humidity 85%. We are using normal Ventilation (Normal fan Exhaust and fresh air system or small opening of window) for the fresh air system. Only taking the restaurant hall, total ac Tonnage is 20 TR, and I am using four numbers of Ac of 5 Ton capacity.

Here, the Rated Power consumption of one 5 Ton Ac to bring 30 °C temperature and 85 % relative humidity to a comfortable Temperature of 23 °C with a relative humidity of 55% is 6.25 KW.

Total Rated Power consumption of
4 Ac = 4x6.25 Kw **= 25 Kw**

Assuming Minimum running hour of AC per day is 12 hrs./day.

The total Energy consumption in a day
= 25 x 12
= 300 Kwh/day

Annual Energy Consumption= 300 x 350 (assuming 15 days restaurant closing)
= 1,05,000 Kwh/year
Rate of electricity bill = Rs 10 per unit (assume as per NEA Rate)
Total Cost of Electricity of 20 TR Ac
= 300 x 10
=Rs 3000 per/day

Annual Electricity cost of 20 TR Ac
= Rs 3000 x 350
= **Rs 10,50,000** *Per/year*

Air Conditioning System with ERV

Using the same outside temperature of 30 °C and relative humidity of 85 %. We are using the Energy recovery Ventilation System which will provide fresh air to the hall by recovering the exhaust air energy. ERV units (air-to-air heat exchangers) provide continuous clean, fresh, and filtered air from the outdoor to the Hall and exhaust stale air. Up to 95% of exhaust air heat can be recovered by transferring it to the incoming air (depending on the ERV model and brand). One ERV of 1000 cfm and two of 500 cfm i.e., a total 2000 cfm ERV system is used for Restaurant Hall.

After using the ERV, the air coming from outside will be about 26 °C and relative humidity of (65 to 70) %. Here Total heat load for Ac is decreased by 20 %, now Ac has to bring 26 °C temperature and 65 % relative humidity to a comfortable Temperature of 23 °C with a relative humidity of 55%. So, the Power Consumption of 5 TR Ac decreases to 5 kw. The total ERV unit consumed 1.3 kw power. Total Rated Power consumption = power consumption of 4 Ac +ERV units' consumption
= (4x5 + 1.3) Kw
= 21.3 Kw

Assuming Minimum running hour of AC per day is 12 hrs./day. The total Energy consumption in a day
= 21.3 x 12
= 255.6 Kwh/day

Annual Energy Consumption = 255.6 x 350 (assuming 15 days restaurant closing)
= 89,460 Kwh/year

Rate of electricity bill = Rs 10 per unit (assume as per NEA Rate)

Total Cost of Electricity of
20 TR Ac = 255.6 x 10
=Rs 2,556 per/day

Annual Electricity cost of 20 TR Ac = Rs 2556 x 350 (assuming 15 days restaurant closing)
= **Rs 8,94,600** per year
Saving amount by installing ERV unit in electricity bill
= Rs 10,50,000 – 8,94,600
= Rs 1,55,400.00 per year

Payback Period Calculation

Installation, Testing, and Commissioning of ERV units cost about Rs 7,39,140.00. The annual maintenance cost for ERV only is about Rs 5000.

Net annual saving by installing ERV = Rs **1,55,400.00 - 5000**
= Rs 1,50,400.00
So, Payback period

$$= \frac{Initial\ Investment}{Annual\ saving} = \frac{739140.00}{150400.00}$$

= 4.9 years

Here the Payback period is 4.9 years. I have taken the minimum number of running hours of ac and average electricity cost. When the running hour is increased the payback period decreases from 2 to 3 years.

Results of Case Studies

Incorporating an energy recovery system in our facility may require an initial investment, but it helps us reduce operating costs in the long run. At the same time, these systems can also improve individual areas of our operation. It was found that whilst the ERV had a significantly higher initial cost, the ERV option sees a 20% reduction in Grand Total Heat. The annual Energy consumption of Air conditioning without ERV for this studied site is 1,05,000 kWh per year whereas when we install ERV at the same site energy consumption is reduced to 89,460 kWh per year. This clearly shows that the ERV option reduces annual energy consumption by about 15 %. The initial investment cost for the installation of ERV is Rs 7,39,140. When implementing an ERV annual saving of about Rs 1,55,400.00 is found. The cost comparison yielded a payback period of between 4.9 years.

The efficiency of ERV plays an important role in minimizing the operating cost and energy consumption of the air conditioning system. The efficiency of Energy recovery defines how much heat we can transfer from the exhaust air to the fresh air in the heat exchanger. Here is my calculation, I have taken the minimum running hour of air conditioning. When the running hour increases, a more reduction in energy consumption due to ERV can be seen. When annual energy consumption is reduced more the annual saving due to ERV will increase, and this increased saving will reduce the payback period.

Whilst energy recovery ventilators are an established technology in many parts of the world, it is somewhat only an emerging technology in Nepal with very limited research undertaken or literature published. It is recommended that further study be undertaken into the effectiveness of energy recovery ventilators with air conditioning systems in different climate zones of Nepal to determine if the systems yield similar results for different climatic conditions.

The Benefits of an ERV

- **Increase in energy efficiency** – pre-treating the incoming fresh air helps reduce the amount of work your HVAC system has to do, which helps reduce your system's overall energy usage.

- **Balanced humidity levels** – during the summer, the ERV helps remove excess moisture from the incoming air; during the winter, the ERV adds needed moisture to the dry cool air, helping to balance the humidity levels in your home.

- **Reduced peak demand.** HVAC systems are some of the biggest contributors to peak demand—electricity use during the times of day when the utility is required to produce the most energy and when rates are highest. By reducing the amount of air that the HVAC must heat or cool, an ERV system can help lower a building's peak demand, thereby lowering its electric bill even further.

- **Improved indoor air quality** – the steady stream of air the ERV brings in can significantly improve your indoor air quality.

- **Compliance (Fulfillment).** Energy recovery systems meet ASHRAE ventilation and energy standards.

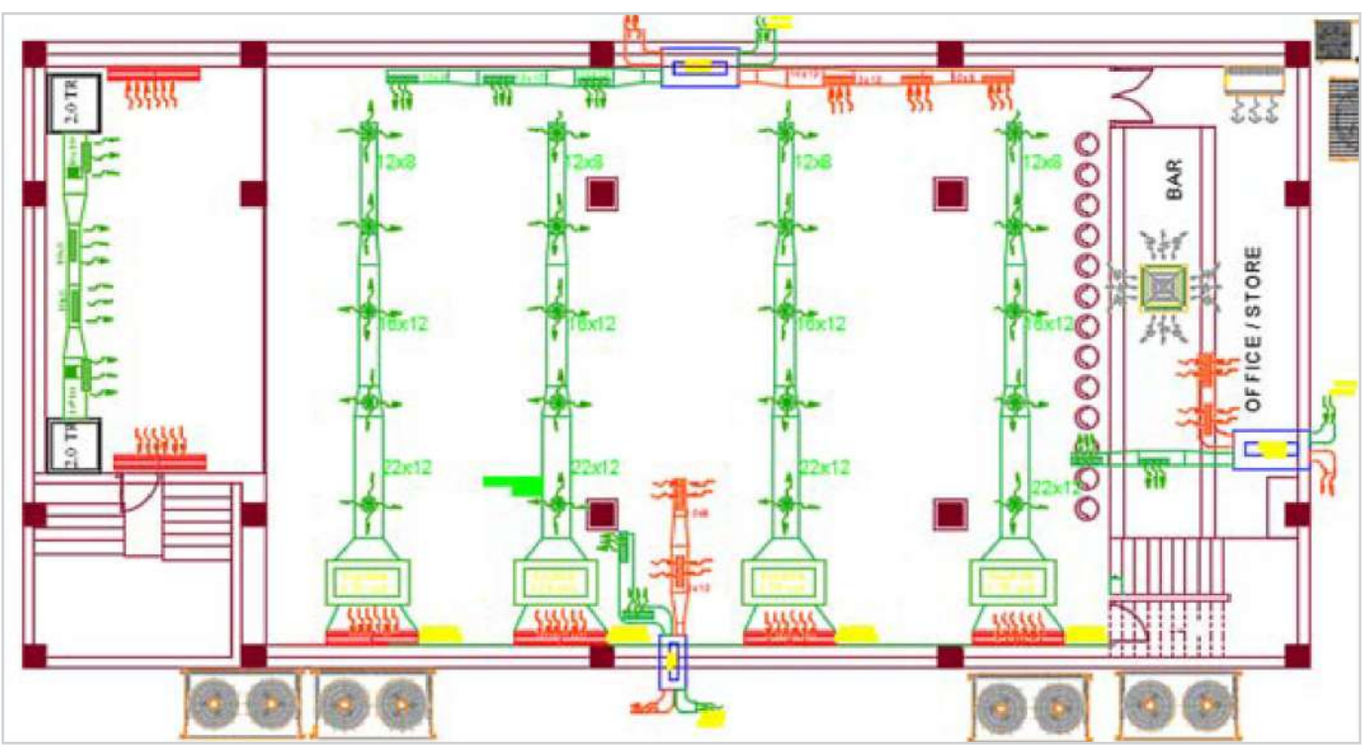


Figure 3: Air conitioning design with ERV unit

"If any student wishes to improve their skills through OJT or learn more about industrial processes, business processes, information and statistics, records, and so on, we are always available."

Mr. Ramchandra Tiwari

Director General
Department of Industry
Ministry of Industry Commerce and Supplies



INTERVIEW

What are the purposes of establishing the department of the industry? What are the services it rendered?

Overall, Nepal's industrialization and business development are not as positive as we had anticipated. Recent data indicates that the industry sector, particularly the production industries, makes the smallest contribution to the nation's GDP. Due to unemployment, our skilled labor force is forced to leave the country. Due to poor domestic production, imports are at their peak and are essential to Nepal's whole economy, which also has a trade deficit with other countries. In this regard, to facilitate the ease of the development of factories and industries and to provide required services and facilities to those industries from one spot i.e., as a single-point service center, the department of the industry is established.

The services rendered by DoI are to register new industries under the Nepal government's prevailing laws and rules, administer the work of industries, regulate laws for industries, supervise and amend the laws and policies as required, to work on policy improvements and other structural/infrastructure works that are required to attract foreign investments, to approve foreign investments, and to allow foreign investors to take their profits.

What were the challenges that DOI faced in the past, and how are you overcoming them now? Also, what changes are you making now that you've been crowned with this responsibility?

The process of improvement never stops. Currently, the country has over 8000 (approx.8600) registered industries. Works on details, records, regulation, and supervision of all those industries are currently being done manually, using paper-based system. In the first step, we are attempting to make our administration more open to information and technology in order to digitize it and create a comprehensive system that is paperless to the greatest extent possible. It would greatly benefit entrepreneurial business people, clients, and other concerned authorities because they would not have to come to the office for various minor matters. We are doing our best to make the necessary suggestions and recommendations to improve laws and policies in order to attract foreign investment. We are simplifying our working methodology in order to provide services for which DOI is established.

The Department of industry handles company registration to intellectual properties and all along. What is the status of industries?

More than 8600 industries have already registered with us. The estimated number of them is 1200+ large-scale industries, 5000+ medium-scale businesses, and more than 5000 small-scale industries. These statistics demonstrate that there aren't many large-scale industries in our country, therefore we can't anticipate export and employment dominance.

About 5000 foreign investment plans have received our approval. In terms of intellectual property (also known as industrial property), there have been 54000 trademark registrations, 268 designs, and 79 patents. There is very little demand for patent registration. We are still working to improve our ability to examine intellectual property to determine whether or not it represents genuine innovation, has gone through the correct channels, is novel, and has gone through all the necessary processes to qualify as an invention.

On the other hand, we also look for IP problems. About 700–800 distortions and IP dispute cases are still open. We are aiming to establish a fair business climate while also working to resolve those cases promptly.

You said that patents are not in high demand and not in practice as well. What is the procedure required for an inventor to register a patent?

Currently, we have 'The Patent, Design, and Trade Mark Act, 2022 (1965)'. This act isn't able to wrap up the other things and new areas of IP so we are preparing a draft for proposing a new act. But for now, the current act has covered lots of span of intellectual property. As per this act, for any new design, process, formula, product, an idea, innovation, or theory, to be registered as a patent, the person has to apply first and then we examine the overall contemplation of creation with our expertise through our internal process. We ask the creator about the background, the base of research, the methodology used to get the result, if it has novelty, if the idea is used elsewhere, and other related questions in various stages. If it fulfills all the criteria, then we register it as a patent. But as I said earlier, the practice is very rare. Though we know that for industrial development and innovation there should be more registration of patents, we are still lagging on this. So, we are working very well to facilitate this.

How long does it take to wholly register these intellectual properties after filing an application for registration?

It takes no more than a week to obtain the trademark and design, but it takes time to obtain the certificate of proof. This is because we first conduct a preliminary examination to determine whether the trademark or design has been registered by others. If it is not, we proceed with our process to publish the notice in the bulletin. This ensures that the IP is not copied from others and that it will not be claimed by others. If it is claimed, we will go through the legal process to resolve the issue. If not, the certificate is issued.

Yes, it takes longer for a patent. The same is true all over the world. Isn't it necessary to thoroughly examine it at various stages? Experts from various specifications are consulted. The creator must acknowledge and respond numerous times before the patent is finally registered. So it may take a few years at times.

We can see that preliminary trademark and design entry into the system takes more than a week. However, final trademark registration takes more than a year. Can a company sell its product before receiving a final certificate?

They can, indeed, work on their product. However, there are some procedures that must be followed in order to obtain the registration certificate. As I previously stated, we publish the notice in our industrial property bulletin, and if no claims of an idea are obtained from others, we issue the certificate.

If we have a patent or any intellectual property registered in a global market. How are these IPs protected?

In this regard, there are numerous global IP governance mechanisms. The Berne Convention, Paris Convention, World Trade Organization Treaty Convention, and others all provide trademarks with global safety and security. To do so, however, the author must first register the location where they wish to promote their work.

Let's say a trademark has been registered abroad. What is the procedure if that international corporation wishes to do its business in Nepal using the same trademark?

The process is similar to that for domestic registration. First, that person must provide an application for registration. S/he has to submit HRC(Home Registration Certificate) obtained in her/his country. Then we go through our internal process to verify it and finally register the claim in Nepal. For instance, if someone has his trademark registered in India, he comes with HRC and appeals here, same is the process again. We release it in the bulletin, and if no claim by others appears, we register her/his trademark in Nepal.
The same is the process for Nepali intellectual property being screened in other countries.

What are the available subsidies, policies, and grants to assist existing and emerging entrepreneurs and start-ups?

Rather than the DoI, the Ministry plays a larger role in this task. We also run various campaigns, awareness, and training programs, but tasks such as providing subsidies, facilities, training, organizing ability-building programs, and so on are handled by the Ministry at the tactical and policy levels. In fact, for this purpose, there are subdomains like MEDEP (Micro-Enterprise Development Program), Promotion Centers, and DCSI (Department of Cottage and Small Industry) inside the scope of the Ministry of Industry.

What do you believe to be the major issues facing industries? Is it a tax issue, a government policy, or what do you think the issue is?

The establishment and operation of industries are influenced by many elements like stability within the country, good governance, political stability and policy stability, etc. Also, issues related to investment security, labor, land, etc should be addressed together and necessary amendments should be done to attract investments. Again, the government should facilitate adequate supply of raw materials for production, manpower, market security, and profit guarantee for investors. The state has announced the Industrial Enterprise Act 2020, Industrial Business Rules 2019, and Foreign Investment and Technology Transfer Act 2019 in an attempt to provide entrepreneurs with promotions, grants, facilities, compensations, incentives, and so on. The government makes various provisions for subsidies and facilities in its budgets, policies, and programs, which are announced year after year. However, creating an investment-friendly environment by addressing these issues remains a challenge for us.

If you are unaware, Thapathali Campus has offered an Industrial Engineering course since 2062. How does the Department of Industry intend to employ graduates of industrial engineering?

Yes, a skilled and technical workforce is critical for industrial development. STEM (Science, Technology, Engineering, and Mathematics) education has been prioritized in many developed countries, including China. However, technical-based manpower is scarce in Nepal, and even among them, we are unable to retain them due to a lack of job opportunities. And I am pleased to learn about Nepal's industrial engineering scheme; it will undoubtedly aid in industrial growth. We can help connect such technical talent to the industry. In fact, if any student wishes to improve their skills through OJT or learn more about industrial processes, business processes, information and statistics, records, and so on, we are always available. Additionally, working with the industrial engineering department, we may increase public understanding of industrial rules and policies, intellectual property (IP) legislation, and the procedures involved from the registration stage through operation.

Has DOI collaborated with NGOs and INGOs to promote industrial growth? What are the initiatives that have been implemented?

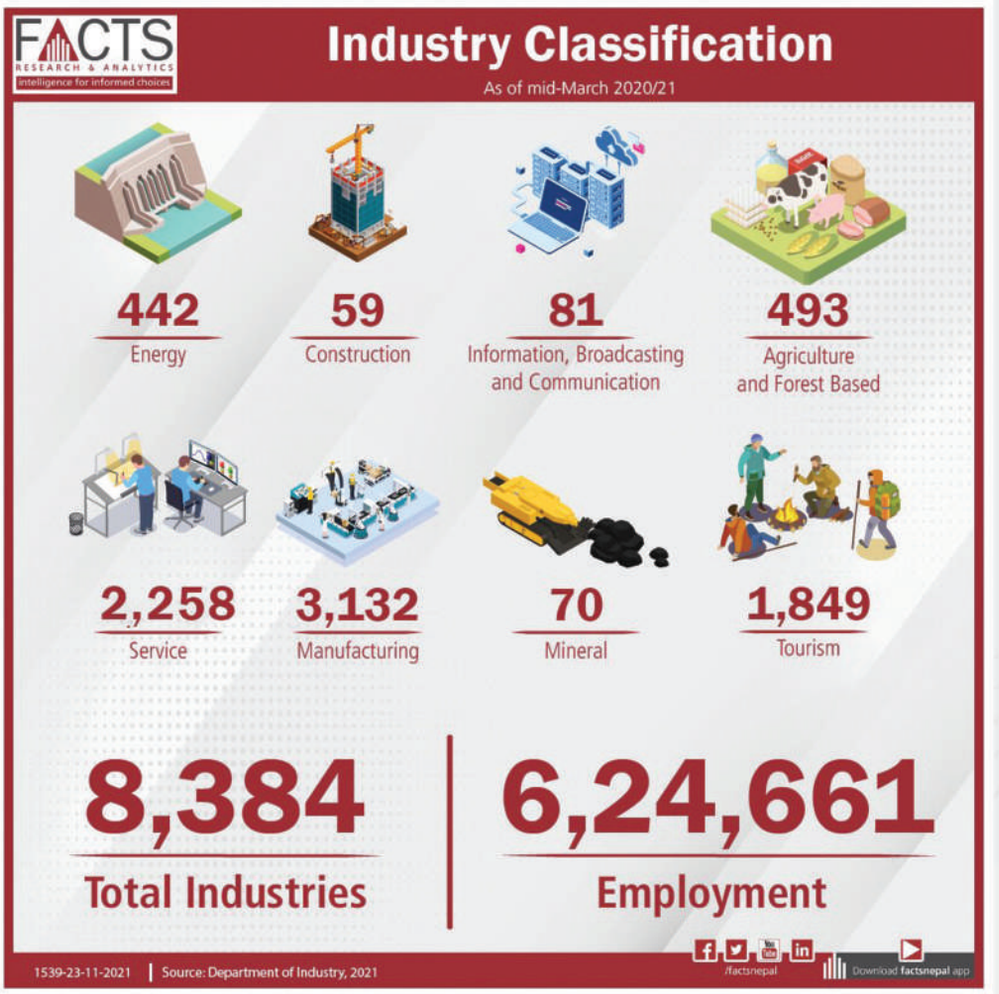
We have small and cottage industries programs for poverty alleviation. The Ministry of Industry has also done this in collaboration with other development partners including MEDEP (Micro-Enterprise Development Programme), MEDPA (Micro-Enterprise Development for Poverty Alleviation), UNDP, UNIDO, etc. Such programs are still in operation in various districts throughout the country. Such programs should be run and will run.

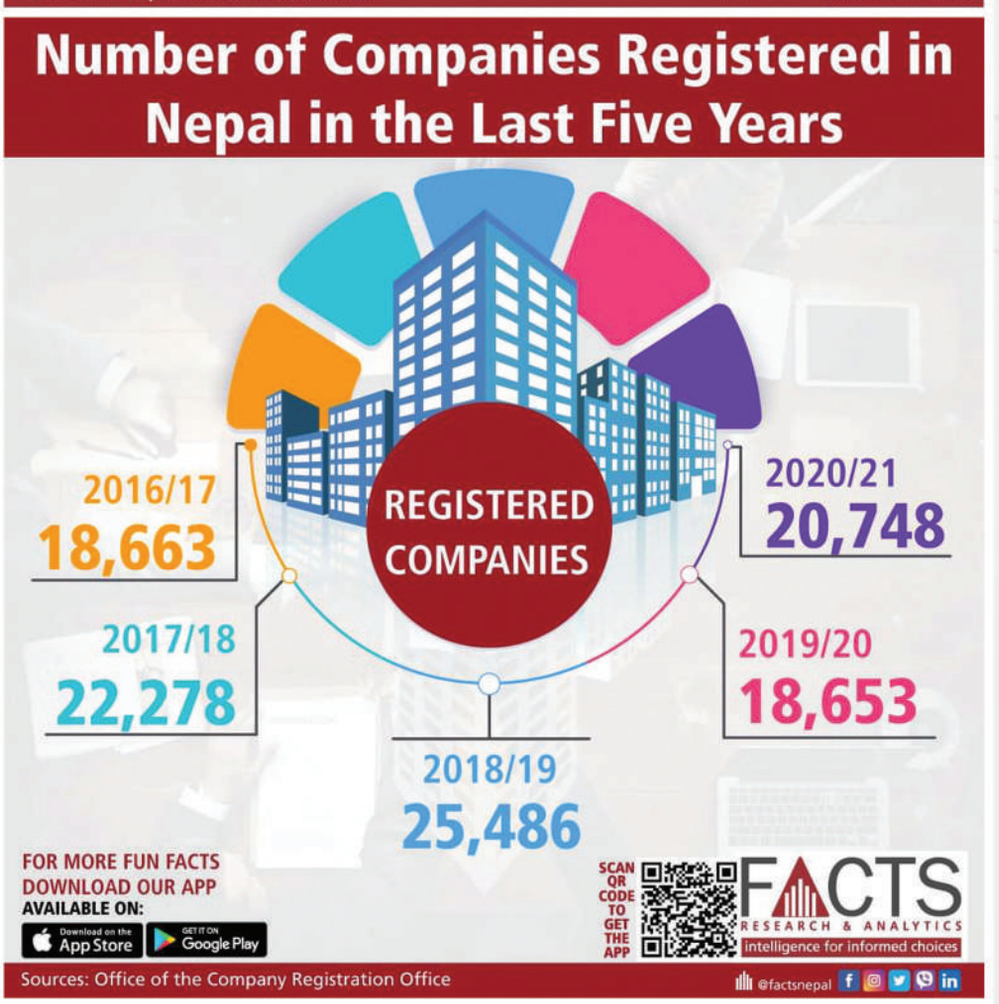
How does the DOI intend to decentralize its services in a provincial-based system?

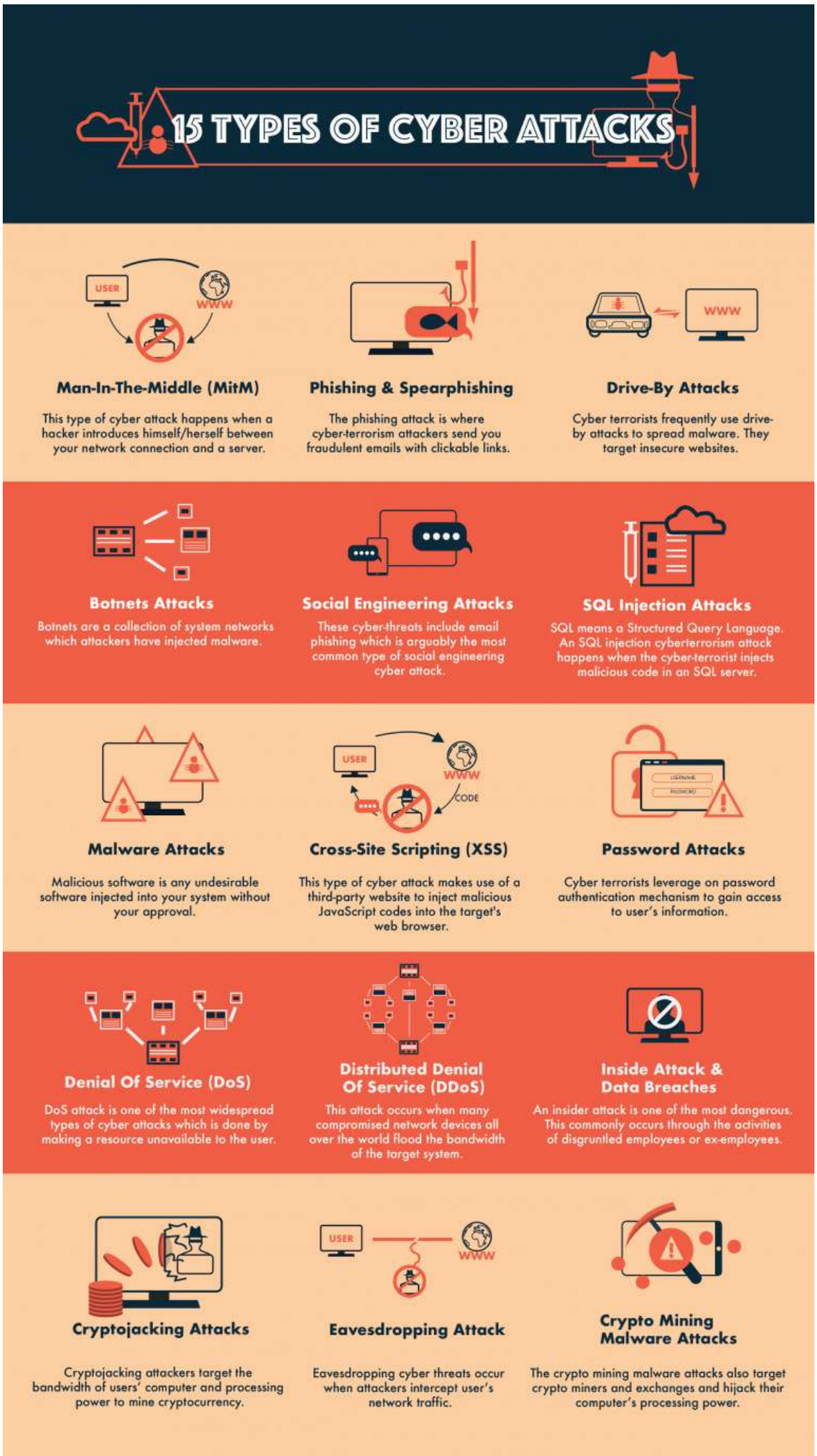
Since the country has moved to federalism, except for a few industries, all industrial work can be done by the state government. The Department of Industry approves foreign investments, registers and administers industries that require permission, industries that fall under the sole jurisdiction of the federal government, industries that belong to two or more provinces, and some other diplomacy-related industries. Furthermore, DOI governs IP registration. The state government handles all other tasks and issues.

From your current vantage point, where do you see industrial progress in the coming years?

If you look at the manifestos in the intellectual sphere, political sphere, or everywhere within the country, the economic development agendas/debates are given priority. We cannot achieve the goal of employment and economic prosperity in the nation without the adequate establishment of industries and factories and wise use of resources, capital, and technologies. If there is an environment for encouraging domestic investment and attracting foreign investment, there is policy stability, there is a consensus among political parties, there is the rectification of the shortcomings in governance then only we can increase the contribution of the industry sector in the economy, increase employment in the country, retain some of the young people who are going abroad, technical manpower can earn their living by working in their own country and contribute to the prosperity of the country. I am optimistic regarding progress.


FACTS
RESEARCH & ANALYTICS
intelligence for informed choices
Industry Classification
As of mid-March 2020/21
442
Energy
59
Construction
81
Information, Broadcasting and Communication
493
Agriculture and Forest Based
2,258
Service
3,132
Manufacturing
70
Mineral
1,849
Tourism
8,384
Total Industries
6,24,661
Employment
1539-23-11-2021 | Source: Department of Industry, 2021
/factsnepal
Download factsnepal app


Number of Companies Registered in Nepal in the Last Five Years
REGISTERED COMPANIES
2016/17
18,663
2017/18
22,278
2018/19
25,486
2019/20
18,653
2020/21
20,748
FOR MORE FUN FACTS
DOWNLOAD OUR APP
AVAILABLE ON:
Download on the App Store
GET IT ON Google Play
SCAN QR CODE TO GET THE APP
FACTS
RESEARCH & ANALYTICS
intelligence for informed choices
Sources: Office of the Company Registration Office
@factsnepal


15 TYPES OF CYBER ATTACKS
USER
WWW
Man-In-The-Middle (MitM)
This type of cyber attack happens when a hacker introduces himself/herself between your network connection and a server.
Phishing & Spearphishing
The phishing attack is where cyber-terrorism attackers send you fraudulent emails with clickable links.
WWW
Drive-By Attacks
Cyber terrorists frequently use drive-by attacks to spread malware. They target insecure websites.
Botnets Attacks
Botnets are a collection of system networks which attackers have injected malware.
Social Engineering Attacks
These cyber-threats include email phishing which is arguably the most common type of social engineering cyber attack.
SQL Injection Attacks
SQL means a Structured Query Language. An SQL injection cyberterrorism attack happens when the cyber-terrorist injects malicious code in an SQL server.
Malware Attacks
Malicious software is any undesirable software injected into your system without your approval.
USER
WWW
CODE
Cross-Site Scripting (XSS)
This type of cyber attack makes use of a third-party website to inject malicious JavaScript codes into the target's web browser.
Password Attacks
Cyber terrorists leverage on password authentication mechanism to gain access to user's information.
Denial Of Service (DoS)
DoS attack is one of the most widespread types of cyber attacks which is done by making a resource unavailable to the user.
Distributed Denial Of Service (DDoS)
This attack occurs when many compromised network devices all over the world flood the bandwidth of the target system.
Inside Attack & Data Breaches
An insider attack is one of the most dangerous. This commonly occurs through the activities of disgruntled employees or ex-employees.
Cryptojacking Attacks
Cryptojacking attackers target the bandwidth of users' computer and processing power to mine cryptocurrency.
USER
WWW
Eavesdropping Attack
Eavesdropping cyber threats occur when attackers intercept user's network traffic.
Crypto Mining Malware Attacks
The crypto mining malware attacks also target crypto miners and exchanges and hijack their computer's processing power.



Artificial Intelligence for Medical Diagnosis, Prognosis, and Treatment

- Kenya S. García B. / David A. García B.

A Brief Overview

Professor John McCarthy of Stanford University, who first coined the term "artificial intelligence" in 1957, defined AI as "the study of intellectual mechanisms for problem-solving, independently of whether they occur in man or machine". Recently, this field has become increasingly concerned with how knowledge is applied to solving ordinary real-world problems (Coles, 1977). One needs only look at almost any technical journal today to discover there is growing enthusiasm for practical AI applications. It is now common to hear about the remarkable advances in AI in many newspapers, professional journals, and business reports (Gardner, 1986). It is therefore natural to reflect on how AI might advance the field of medicine. As it turns out, AI can lead to many medical breakthroughs. It can help doctors diagnose patients with more precision, make predictions about patients' long-term medical outcomes, and offer better treatment suggestions (Meskó & Görög, 2020). In fact, most applications of AI in medicine fall into three main fields: diagnoses, prognoses, and treatments. Let us now briefly describe each of these.

In the field of medical diagnostics, AI has provided significant contributions based on deep learning algorithms. Convolutional neural networks (CNN), for example, are deep neural networks often used to scan visual imagery. They are also referred to as shift-invariant or spatially invariant artificial neural networks (SIANNs), a term which functions as a manner of describing their architecture of shared weights and translation invariance features, and their application has become increasingly common in diagnosis. Just to mention some important academic contributions, Steiner et al (2018) studied the impact of deep learning assistance on the histopathologic review of lymph nodes for metastatic breast cancer; Raman et al. (2019) explored fundus photograph-based deep learning algorithms in detecting diabetic retinopathy; and other authors like Esteva et al. (2017), conducted dermatologist-level classification of skin cancer with deep neural networks. Over 1.28 million images were labeled by doctors and organized in a tree-structured taxonomy of 2,032 diseases for this dermatology research project cited. Those images came from 18 different clinician-curated, open-access online repositories, as well as from clinical data from the Stanford University Medical Center. These images were then used to train a computer system using a machine learning algorithm. Over time, the AI system learned to predict malignant versus benign lesions of epidermal (keratinocyte carcinoma compared to benign seborrheic keratosis) or melanocytic (malignant melanoma compared to benign nevus) origin.

> ***"It can help doctors diagnose patients with more precision, make predictions about patients' long-term medical outcomes, and offer better treatment suggestions."***

Regarding prognosis, it is a specialized field of medicine that focuses on predicting the prospective health of patients. Nowadays, machine learning is a promising and powerful tool for prognosis and can give a major impetus to this branch of medicine by synthesizing different types of medical data to provide highly accurate predictions and allowing for the use of risk calculations as part of routine clinical practice. For instance, decision trees and random forests are used to model nonlinear relationships, which are typically observed in medical data, and then applied to the task of prognosis of mortality, which is the chance of a patient dying. There are many examples of recent research in this area: Hu, et al. (2020) presented a novel prognostic prediction approach for postoperative non-small cell lung cancer patients; Ahangaran et al. (2020) introduced a novel method for predicting the progression rate of Amyotrophic Lateral Sclerosis (ALS) disease based on automatic generation of probabilistic causal chains; Delgado et al. (2021) developed a predictive prognosis model to support medical experts in their clinical decision-making process in Intensive Care Units; and Barros et al. (2021) provided an overview of recent machine learning-based methods for schizophrenia classification using electroencephalography (EEG data), discussing their potentialities and limitations.

Medical treatments can have different impacts on patients depending on their health and many other factors. In the



Kenya S. García B.
Senior MD Student
Universidad del Norte
kenyag@uninorte.edu.co



David A. García B.
Industrial Engineer/Researcher
Universidad del Atlántico
davidagarcia@mail.uniatlantico.edu.co

field of medicine, advances in artificial intelligence are making it possible to develop more appropriate treatments for individual patients using data based on randomized control trials to understand the causal effect of any given treatment on a population. In addition, more and more researchers are applying interpretation methods to support decision-making in complex machine learning models. Not to mention the utilization of natural language entity extraction and question answering methods to help automate the process of labeling medical datasets. There have been several studies conducted that explore some of these applications. Just to mention a few of these: Kang (2018) presented a patient-level sequential modeling approach with neural networks to render a personalized prediction of drug efficacy for diabetes treatment. Zame et al. (2020) identified some challenges and suggested ways in which machine learning could help with ongoing clinical trials for non-COVID-19 drugs, repurposing drugs to treat COVID-19, and new drugs to treat COVID-19; In 2021, Roggeveen et al. developed and validated a new reinforced learning model for optimizing haemodynamic treatment for critically ill patients with sepsis;

Of course, all this is merely a brief introduction. For example, the way that AI can allow physically disabled people to move their bodies is worth mentioning. There are now smart prosthesis systems and even research initiatives focusing on helping people with atypical speech become better understood. Project Euphonia by Google centers on analyzing speech recordings to better train speech recognition models (Google Research, 2021). In addition, many hospitals already have robotic medical support staff. The RP-6 robot, made by InTouch Health Inc is being adopted by some hospitals such as the UCLA Medical Center (UCLA Health, 2021). This robot is mobile and has a monitor that displays a real doctor's face, who may be miles away. Robots like this could help alleviate the emergency room crises in which doctors are scarce. Similarly, robotic-assisted surgery with the da Vinci surgical system increases the adoption of minimally invasive surgery and extends the capabilities of doctors' eyes and hands (UC Health, 2021).

Conclusion

AI is providing a whole new generation of tools that can be applied to clinically relevant problems, and thus AI is really starting to democratize healthcare. However, a lot of things are unknown and there is still a lot of research to be done. For example, most medical datasets lack enough disease and non-disease examples to generate useful training algorithms. This reflects the prevalence or frequency of disease in the real world. Also, another major challenge concerns the reliability of AI algorithms among different population samples. Let us say a machine learning model is developed with U.S. data, and then applied to a hospital in a different country. In other countries, the patient population may have different genome characteristics (and hence experience differing outcomes) than what the model was based on. As a specific case, tuberculosis is a major public health issue in India. However, it is unlikely to be as prevalent in algorithms based on a US population.

8.0

5. References:

Ahangaran, M., Jahed-Motlagh, M. R., & Minaei-Bidgoli, B. (2020). A novel method for predicting the progression rate of ALS disease based on automatic generation of probabilistic causal chains. Artificial Intelligence in Medicine, 107, 101879. https://doi.org/https://doi.org/10.1016/j.artmed.2020.101879

Barros, C., Silva, C. A., & Pinheiro, A. P. (2021). Advanced EEG-based learning approaches to predict schizophrenia: Promises and pitfalls. Artificial Intelligence in Medicine, 114, 102039. https://doi.org/https://doi.org/10.1016/j.artmed.2021.102039

Coles, L. S. (1977). The application of artificial intelligence to medicine. Futures, 9(4), 315–323. https://doi.org/10.1016/0016-3287(77)90097-0

Delgado, R., Núñez-González, J. D., Yébenes, J. C., & Lavado, Á. (2021). Survival in the Intensive Care Unit: A prognosis model based on Bayesian classifiers. Artificial Intelligence in Medicine, 115, 102054. https://doi.org/https://doi.org/10.1016/j.artmed.2021.102054

Esteva, A., Kuprel, B., Novoa, R. A., Ko, J., Swetter, S. M., Blau, H. M., & Thrun, S. (2017). Dermatologist-level classification of skin cancer with deep neural networks. Nature, 542(7639), 115–118. https://doi.org/10.1038/nature21056

Gardner, R. M. (1986). Artificial intelligence in medicine—is it ready? International Journal of Clinical Monitoring and Computing, 2(3), 133. https://doi.org/10.1007/BF02915879

Google Research. (2021). Project Euphonia: Helping people be better understood. Retrieved January 11, 2021, from https://sites.research.google/euphonia/about/

Hu, D., Li, S., Huang, Z., Wu, N., & Lu, X. (2020). Predicting postoperative non-small cell lung cancer prognosis via long short-term relational regularization. Artificial Intelligence in Medicine, 107, 101921. https://doi.org/https://doi.org/10.1016/j.artmed.2020.101921

Kang, S. (2018). Personalized prediction of drug efficacy for diabetes treatment via patient-level sequential modeling with neural networks. Artificial Intelligence in Medicine, 85, 1–6. https://doi.org/https://doi.org/10.1016/j.artmed.2018.02.004

Meskó, B., & Görög, M. (2020). A short guide for medical professionals in the era of artificial intelligence. Npj Digital Medicine, 3(1), 126. https://doi.org/10.1038/s41746-020-00333-z

Raman, R., Srinivasan, S., Virmani, S., Sivaprasad, S., Rao, C., & Rajalakshmi, R. (2019). Fundus photograph-based deep learning algorithms in detecting diabetic retinopathy. Eye, 33(1), 97–109. https://doi.org/10.1038/s41433-018-0269-y

Roggeveen, L., el Hassouni, A., Ahrendt, J., Guo, T., Fleuren, L., Thoral, P., … Elbers, P. W. G. (2021). Transatlantic transferability of a new reinforcement learning model for optimizing haemodynamic treatment for critically ill patients with sepsis. Artificial Intelligence in Medicine, 112, 102003. https://doi.org/https://doi.org/10.1016/j.artmed.2020.102003

Steiner, D. F., MacDonald, R., Liu, Y., Truszkowski, P., Hipp, J. D., Gammage, C., … Stumpe, M. C. (2018). Impact of Deep Learning Assistance on the Histopathologic Review of Lymph Nodes for Metastatic Breast Cancer. The American Journal of Surgical Pathology, 42(12), 1636–1646. https://doi.org/10.1097/PAS.0000000000001151

UC Health. (2021). University of Cincinnati College of Medicine. About the daVinci Surgical System. Retrieved January 11, 2021, from https://www.uchealth.com/services/robotic-surgery/patient-information/davinci-surgical-system/

UCLA Health. (2021). Remote Presence Robots in ICU. Retrieved January 11, 2021, from https://www.uclahealth.org/neurosurgery/remote-presence-robots-in-icu

Zame, W. R., Bica, I., Shen, C., Curth, A., Lee, H.-S., Bailey, S., … van der Schaar, M. (2020). Machine learning for clinical trials in the era of COVID-19. Statistics in Biopharmaceutical Research, 12(4), 506–517. https://doi.org/10.1080/19466315.2020.1797867



Neural Networks

-Er. Bikram Panthee

INTRODUCTION

A neural network is a set of algorithms that seeks to cognize underlying relationships in a set of data through a process that imitates the way the human brain operates. Neural Networks, sometimes called an artificial neural network (ANN), are computational models that are used to solve complex problems. Normally when we get a sense of smell, this smell (data) is processed by neurons (data processing cells in the brain) and recognize what smell it is. A neural network works similarly to the human brain's neural network. A "neuron" in a neural network is a mathematical function that collects and classifies information according to a specific architecture. The network bears a strong resemblance to statistical methods such as curve fitting and regression analysis. A neural network contains layers of interconnected nodes. Each node is a known as perceptron and is like a multiple linear regression. The perceptron feeds the signal produced by a multiple linear regression into an activation function that may be nonlinear.

NEURAL NETWORK COMPONENTS

A single Neuron

The neuron, also known as a node or unit, is the basic unit of computation in a neural network. It takes input from other nodes or an external source and generates an output. Each input has a weight (w) associated with it, which is determined by its relative relevance to other inputs. As shown in the diagram, the node applies a function f (described below) on the weighted sum of its inputs.

> ***"An artificial neural network works similarly to the human brain's neural network."***

Neural Network Layers

The most popular sort of artificial neural network is made up of three groups, or layers, of units: an "input" layer is connected to a layer of "hidden" units, which is connected to a layer of "output" units.

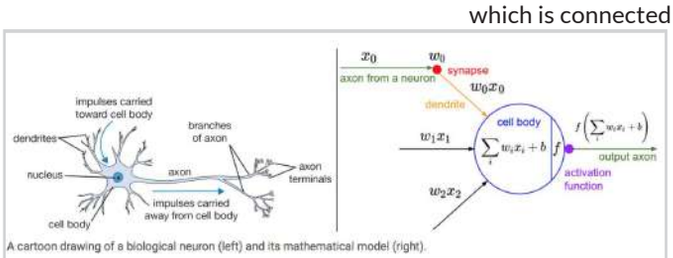


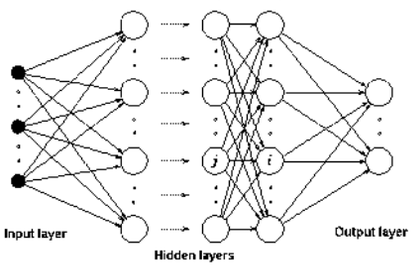
Figure 2.1: Biological Neuron vs Mathematical Model



Er. Bikram Panthee
Associate Business Analyst
Hitachi Energy Ltd.
bikram.panthee@hitachienergy.com/ bikrampanthee@outlook.com

- **Input Units:** The activity of the input units represents the raw information that is fed into the network. This is also called the input layer.
- **Hidden Units:** The activity of each hidden unit is determined by the activities of the input units and the weights on the connections between the input and the hidden units. This is also called a hidden layer.
- **Output Units:** The behavior of the output units depends on the activity of the hidden units and the weights between the hidden and output units. this also called output layer

Figure 2.2: Neural Network with Input Layer, Hidden Layers, and Output Layers



Activation Function

Activation function decides whether a neuron should be activated or not by calculating weighted sum and further adding bias with it. We know that a neural network has neurons with weights, biases, and activation functions that correspond to each other. The weights and biases of the neurons in a neural network would be updated based on the output error in a neural network. Back-propagation describes this procedure. Because the gradients are provided along with the error to update the weights and biases, activation functions make back-propagation viable. There are different types of activation functions like: ReLu, Linear, sigmoid, tanh etc. activation functions.

DIFFERENT TYPES OF NEURAL NETWORKS USED IN DEEP LEARNING

There are three Neural Networks models which are widely used in Deep Learning.

1. Artificial Neural Network (ANN)
2. Convolution Neural Network (CNN)
3. Recurrent Neural Network (RNN)

Artificial Neural Network (ANN):

Each layer of an Artificial Neural Network (ANN) is made up of many perceptrons or neurons. Because inputs are exclusively processed in the forward direction, ANN is also known as a Feed-Forward Neural Network.

This sort of neural network is one of the

most basic neural network versions. They send data in one way, through multiple input nodes, until it reaches the output node. The network may or may not contain hidden node layers, which makes its operation more understandable.

Some applications of ANN:

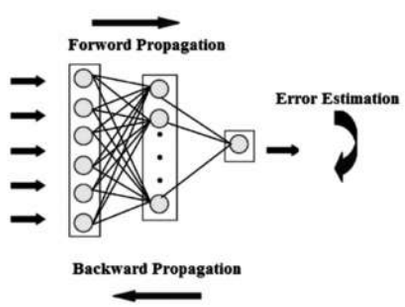
- Predictive analysis for business intelligence
- Speech-to-text transcription application
- Handwriting and facial recognition
- Spam email detection
- Weather prediction

Convolutional Neural Network (CNN):

Convolutional neural networks (CNN) are among the most widely used models today. This neural network computational model employs a variant of multilayer perceptron and includes one or more convolutional layers that can be completely linked or pooled. These convolutional layers provide feature maps that capture a portion of an image, which is then divided into rectangles and sent out for nonlinear processing.

Some applications of CNN:

- Recommend products that will likely complement an existing product or wardrobe.
- Provide suggestions for tagging people in a photograph as social media platforms do.
- Identify items as computer vision currently does for helping doctors better recognize cancerous tumors.



Recurrent Neural Network (RNN):

RNNs (recurrent neural networks) are more complex. They record the results of processing nodes and input them back into the model (they did not pass the information in one direction only). The model is said to learn to anticipate the outcome of a layer in this manner. Each node in the RNN model functions as a memory cell, continuing calculation, and operation implementation. If the network's forecast is erroneous, the system self-learns and continues to backpropagate towards the correct prediction.

- Some applications of RNN:
- Prediction problems
- Machine translation
- Speech recognition
- Sentiment analysis
- Stock price forecasting
- Generating text and language modeling

MATHEMATICS BEHIND NEURAL NETWORK WORKING

Neural Networks are mathematical representations of biological neural networks. Let's take a deep dive to understand how each component of neural networks performs its task. Neural Networks primarily work in two phases: forward and back propagation. The forward propagation model predicts output and calculates error, and the back propagation model tries to reduce error by using different optimization algorithms.

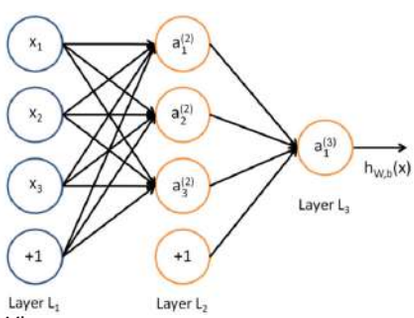
Every Neural Networks has two main parts:

1. Feed Forward Propagation/Forward Propagation.
2.Backward Propagation/Back Propagation.

Feed Forward Propagation/Forward Propagation

This process of Forward propagation is actually getting the Neural Network output value based on a given input. This algorithm is used to calculate the cost value.

In order to understand the mathematical equations let's use a simpler Neural Network model. This model will have 4 input nodes (3 + 1 "bias"). One hidden layer with 4 nodes (3 + 1 "bias") and one output node.



Where,

x_1, x_2, x_3: Input features
$a_1^{(2)}, \ldots, a_3^{(2)}$: Activation Nodes in Layer 2
$a_1^{(3)}$: Activation Nodes in Layer 3
$h_{W,b}(x) = h_\theta(x)$: Output or Hypothesis Function
Representation of activation node:

$$a_n^{(L)}$$

Where,
L: Layer
n: Node in layer

The "bias" nodes will be labeled x_o and a_o respectively. As a result, the input nodes can be placed in vector X and the hidden layer nodes in vector A.

$$X = [x_0\ x_1\ x_2\ x_3\ ]$$

$$A = \left[a_0^{(2)}\ a_1^{(2)}\ a_2^{(2)}\ a_3^{(2)}\ \right]$$

Weights (arrows) are typically denoted as θ or ω. Let us denote weights as θ. The weights of the input and hidden layers will be represented by a 3x4 matrix. And the weights between the hidden and output layers will be represented by a 4x1 matrix. Final weight matrix is obtained by transposing and stacking 4x1 matrix to get a 3x4 matrix.

$$\theta_1 = [\theta_{10}\ \theta_{11}\ \theta_{12}\ \theta_{13}\ ] \qquad \theta_2 = [\theta_{20}\ \theta_{21}\ \theta_{22}\ \theta_{23}\ ] \qquad \theta_3 = [\theta_{30}\ \theta_{31}\ \theta_{32}\ \theta_{33}\ ]$$

$$\theta^{(1)} = [\leftarrow \theta_1^T \rightarrow \leftarrow \theta_2^T \rightarrow \leftarrow \theta_3^T \rightarrow \leftarrow \theta_4^T \rightarrow]$$

$$\theta^{(1)} = [\theta_{10}\ \theta_{11}\ \theta_{12}\ \theta_{13}\ \theta_{20}\ \theta_{21}\ \theta_{22}\ \theta_{23}\ \theta_{30}\ \theta_{31}\ \theta_{32}\ \theta_{33}\ ]$$

Next, what we want is to compute the "activation" nodes for the hidden layer. In order to do that we need to multiply the input vector X and weights matrix θ^1 for the first layer ($X^*\theta^1$) and then apply the activation function f. What we get is:

$$a_1^{(2)} = f\left(\theta_{10}^{(1)} x_0 + \theta_{11}^{(1)} x_1 + \theta_{12}^{(1)} x_2 + \theta_{13}^{(1)} x_3\right)$$

$$a_2^{(2)} = f\left(\theta_{20}^{(1)} x_0 + \theta_{21}^{(1)} x_1 + \theta_{22}^{(1)} x_2 + \theta_{23}^{(1)} x_3\right)$$

$$a_3^{(2)} = f\left(\theta_{30}^{(1)} x_0 + \theta_{31}^{(1)} x_1 + \theta_{32}^{(1)} x_2 + \theta_{33}^{(1)} x_3\right)$$

The activation function f is we will be using in our model is ReLU activation function. We will look later how this activation function plays its role in the model. Now by multiplying hidden layer vector with transposed weights matrix θ for the second layer($A^*\theta$) we get output for the hypothesis function

$$\mathbf{A}= \left[a_0^{(2)} f\left(\theta_{10}^{(1)} x_0 + \theta_{11}^{(1)} x_1 + \theta_{12}^{(1)} x_2 + \theta_{13}^{(1)} x_3\right) f\left(\theta_{10}^{(1)} x_0 + \theta_{11}^{(1)} x_1 + \theta_{12}^{(1)} x_2 + \theta_{13}^{(1)} x_3\right) \right]$$

$$\mathbf{A}= \left[a_0^{(2)} a_1^{(2)} a_2^{(2)} a_3^{(2)} \right]$$

$$\theta^{(2)} = \left[\theta_{10}^{(2)}\ \theta_{11}^{(2)}\ \theta_{12}^{(2)}\ \theta_{13}^{(2)}\ \right]$$

$$h_\theta(X) = a_1^{(3)} = (\theta^{(2)})^T \,.\, A$$

$$h_\theta(x) = a_1^{(3)} = f\begin{pmatrix} \theta_{10}^{(2)}\, a_0^{(2)} + \theta_{11}^{(2)}\, a_1^{(2)} \\ +\theta_{12}^{(2)}\, a_2^{(2)} + \theta_{13}^{(2)}\, a_3^{(2)} \end{pmatrix}$$

Here $\theta_{10}^{(2)}\, a_0^{(2)}$ is bias of the model which can be represented by b.
Simply, for linear regression model output (Z) is given by,

$$Z = h_\theta(X) = \theta^T.X + b$$

This example is with only one hidden layer and 4 nodes there. If we try to generalize for Neural Network with multiple hidden layers and multiple nodes in each of the layers, we will get next formula.

$$a_n^L = \left[f\left(\sum_m \theta_{nm}^L \left[\cdots \left[f\left(\sum_j \theta_{kj}^1 \left[f\left(\sum_i \theta_{ij}^1 x_i + b_j^1\right)\right] + b_k^2\right)\right]\cdots\right]_m + b_n^L\right)\right]_n$$

Where we have **L** layers with **n** nodes and **L-1** layers with m nodes.

Bias Node (b_n^L)

Using the "bias" node is usually essential for developing a good learning model. In short, a bias value permits the activation function to be shifted to the left or right, resulting in a better fit to the data (better prediction function as output).

Cost Function

Let's begin by defining the cost function's general equation. This function represents the total error, or the difference between the predicted and actual (labeled) values.

$$J(\theta) = \frac{1}{m}\sum_{i=1}^{m} Cost(h_\theta(x^{(i)}), y^{(i)})$$

For Linear Regression Cost Function:

$$J(\theta) = \frac{1}{m}\sum_{i=1}^{m} (h_\theta(x^{(i)}) - y^{(i)})^2$$

Simply,

$$Loss(y, \hat{y}) = \frac{1}{m}\sum_{i=1}^{m} (y - \hat{y})^2$$

y: the actual output
ŷ: the predicted output
m: the total data-points
Where ŷ is given by,

$$\hat{y} = f\left(b + \sum_{i=1}^{m} x_i\, \theta_i\right)$$

Backward Propagation/Back Propagation

Following forward propagation, each neural layer produces an output vector, which is passed on as the input vector to the next layer, and so on until the last layer. The output of the entire network is now produced at the network's last layer. We randomly initialize the weights and biases during the initial forward propagation process (i.e., iterating across the network for the first time). The neural network algorithm treats these values as parameters. Now we must tune these parameters in line with the dataset, which we can refer to as "the problem statement" in general. The weights and biases are adjusted using a different set of algorithms known as backward propagation.

We now have a clear objective: to minimize the neural network's loss. We know we can adjust the weights and biases of the network to influence its predictions, but how can we do it in a way that minimizes loss?
To find the optimal parameters for which the loss function yields a scalar of minimum value. This task is often entrusted with an optimization algorithm called gradient descent. Gradient descent is a first-order iterative optimization process for determining a differentiable function's local minimum. We take steps proportional to the negative of the gradient (or approximation gradient) of the function at the current position to obtain a local minimum of a function using gradient descent.

Gradient Descent Algorithm

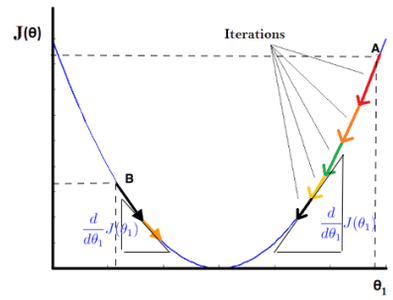
In order to use the acquired gradient descent to learn the model coefficients, we simply update the weights θ by taking a step into the opposite direction of the gradient for each pass. This motion of the algorithm terminates when we reach a global minima, which is a point having zero gradient. The equation involving the update of weights is:

$$Repeat\ \{$$

$$\theta_j := \theta_j - \alpha \frac{\partial}{\partial \theta_j} J(\theta)$$

$$\}$$

where α is the learning rate, ∂ J(θ) / ∂θ is the partial derivatives of the loss function with respect to the weights.



If $\frac{\partial\, Loss(y,\hat{y})}{\partial \theta}$ is positive, θ will decrease,

which makes Loss decrease.

If $\frac{\partial\, Loss(y,\hat{y})}{\partial \theta}$ is negative, θ will increase,

which makes Loss decrease.

For each iteration we will obtain the values of the partial derivatives of the loss function with respect to each of the parameters of our network, which can be decomposed as below using the chain rule.

$$\frac{\partial\, Loss(y,\hat{y})}{\partial \theta} = \frac{\partial\, Loss(y,\hat{y})}{\partial \hat{y}} * \frac{\partial\, \hat{y}}{\partial z} * \frac{\partial\, z}{\partial \theta}$$

$$Where, Z = \theta^T.X + b$$

The detailed definition of each term in the above equation are as follows.

$\frac{\partial\, Loss(y,\hat{y})}{\partial \hat{y}}$: Partial derivative of

loss function with the predicted output

$\frac{\partial\, \hat{y}}{\partial z}$: Partial derivative of predicted

output with weighted average

$\frac{\partial\, z}{\partial \theta}$: Partial derivative of weighted

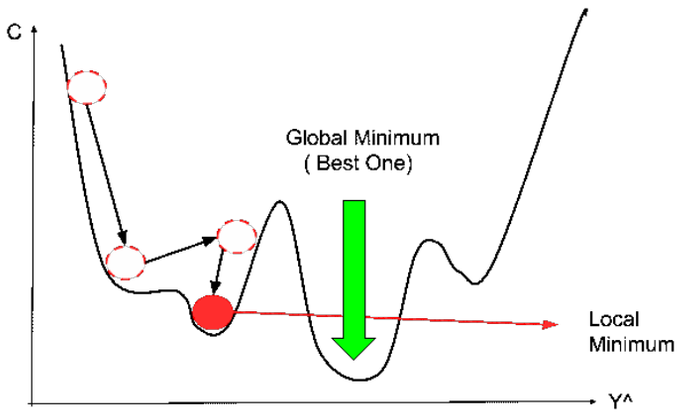
average with weights

Training: Stochastic Gradient Descent

Training is a continuous process. We do numerous training iterations to achieve better results. The number of training rounds reduces the neural network's total error. The neural network creates more desired outputs when the weights are adjusted. As the neural network is taught, its overall error should decrease. The graph below depicts the gradient decrease trying to find an optimal minimum for the loss function. The network's final model parameters are the weights and biases that correspond to the optimal minimum.

Figure 4.2: Gradient Descent, local and

DATAVERSE



global Minima

References

Er.Parveen Kumar, E. S. (May 2018). Artificial Neural Networks-A Study. International Journal of Emerging Engineering Research and Technology Volume 2, Issue 2,, 143-148.

Gautham (2020, 8 3). Analytical Vidhya. Retrieved from Medium: https://medium.com/analytics-vidhya/an-introduction-to-mathematics-behind-neural-networks

PANTHI GROUP OF INDUSTRIES

PANTHI GROUP OF INDUSTRIES

Head Office: Kathmandu

Branch: Butwal

Our Valuable Brands:

NHS NOBEL
HOUSEHOLD SOLUTIONS (NHS)
ALWAYS TOWARDS SUCESS

OJAH
ओज
ALWAYS TOWARDS SUCESS

PG
PANTHI GROUP
ALWAYS TOWARDS SUCESS

www.panthigroup.com.np | 9857042144, 071-547944



Technical Advancement in External Beam Radiation Therapy

- Bhuwan Mani Pokhrel

In radiotherapy cancer can be treated with high energy radiation which breaks double strands of DNA so that cancer cells cannot undergo division and ultimately die [1]. These radiation may be photons (X-ray or γ-rays), and other particles such as electrons, protons, neutrons and heavy ions. Radiation therapy is crucial for cancer treatment besides chemotherapy and surgery; up to 50% of carcinoma patients receive it at some stage in their disease either in adjunct or in palliative [2, 3].

After the discovery of X-rays in 1895, by Wilhelm Conrad Rontgen there has been rapid progress in development of high energy generators for production of high energy radiation for use in cancer treatment. In addition to this, understanding of radiobiology of tumor along with normal organs anatomy nearby cancer cells has paved the paths for development of different modality of cancer treatment and will continue in the future. However, the basic principle of radiation therapy remains the same of delivering high energy radiation to kill cancer cells or genetically alter them so that they lead to apoptosis and cell death [4].

Radiotherapy technique has been changed significantly after the development of megavoltage cobalt units and linear accelerators. With the introduction of megavoltage therapy, the skin sparing problem has been solved, however, the smaller treatment volumes, the reduction of normal tissue dose and volume irradiated, and the increase in achievable dose to the tumor target still matters for clinical gains in cancer therapy. Most recently, the combination of computer-based treatment planning and modern imaging technologies (computed tomography, magnetic resonance imaging, and positron emission tomography) have enhanced the delivery of radiation to the tumor while minimizing normal tissue dose [5]. These technological advancements have led to development of 3D Conformal Radiation Therapy (3D-CRT), Intensity Modulated Radiation Therapy (IMRT), Image Guided Radiotherapy (IGRT), Tomotherapy and Proton therapy.

> ***"Understanding of radiobiology of tumor along with normal organs anatomy nearby cancer cells has paved the paths for development of different modality of cancer treatment and will continue in the future."***

i) 3D Conformal Radiation Therapy (3D-CRT)

In '3D CRT', multiple beam arrangements are configured to irradiate the target as in conventional treatments. The shape of each beam cross-section is planned to cover the target volume and block the normal tissues in the beam's-eye views, hence the name 'conformal'. To achieve this, a patient's digital CT scan images are transferred to computerized-graphic workstations, and the outlines of target volumes and organs to be protected are delineated. Conventional 3-D planning computer systems use trial and error to develop a treatment plan [6]. A medical physicist on recommendation with radiation oncologist creates a plan with specific beam geometries and shapes, after which dosages are calculated and evaluated. Each plan is then modified iteratively until an acceptable plan is reached.

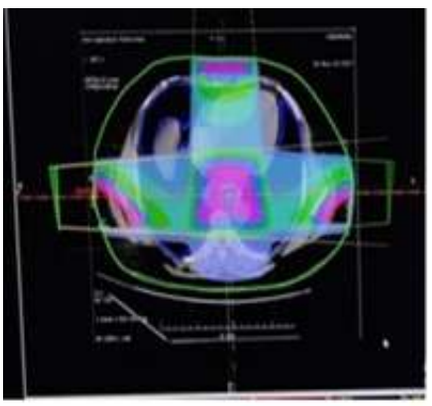


Fig.1: 3D-CRT beam arrangement

ii) Intensity Modulated Radiation Therapy (IMRT)

It is advanced form of 3D-CRT which modulates the beam for divide the treatment beam into a set of small beamlets, the intensity of which can vary from 0 to 100% independent of all other beamlets. It uses inverse planning

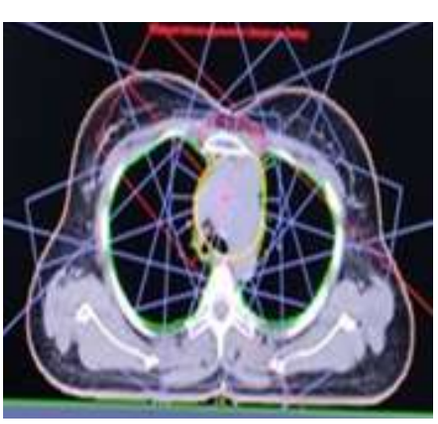


Fig.2: IMRT beam arrangement



Bhuwan Mani Pokhrel
Medical Physicist (Radiation scientist)
PGIS, University of Peradeniya, Sri Lanka
bhuwanmanipokhrel92@gmail.com

DATAVERSE

algorithm. Due to the enormous number of treatment fields needed for IMRT, large regions that would have received little to no dose with 3DCRT receive low doses in IMRT. Routinely, more beams are required in IMRT than with other techniques, such as 3D conformal treatment planning, and these beams may be irradiating tissues that previously were outside the fields [7]. There are pros and cons with IMRT with respect to 3D-CRT. The major advantage is the highly conformal nature of the dose delivery; however, a disadvantage is the low dose smearing around the target area. This low dose might cause secondary cancer.

iii) Image Guided Radiotherapy (IGRT)

With the improvement of treatment imaging modalities like CT, MRI and PET, to adjust patient localization in a nearly real-time basis becomes feasible especially



Fig.3: MRI used in IGRT [8]

when breathing and bowel motion is considered. IGRT ensures accurate delivery of RT by using imaging before or during treatment delivery [8]. It checks for tumor movement or shape change and allows smaller safety margins to be used, thereby sparing healthy tissue. Excessive dose from intensive imaging procedures is a severe problem in IGRT. So, there is a need to evaluate stochastic as well as non-stochastic risks involved in all the imaging procedures used in radiation therapy.

iv) Tomotherapy

Tomotherapy is a new modality of radiation treatment that combines the use of very sophisticated computer-controlled radiation beam collimation with an on-board computed tomography (CT) scanner to image the treatment site. Unlike traditional radiation therapy systems which have beams projecting onto the tumor from a few different directions, tomotherapy rotates the beam source around the patient, thus allowing the beam to enter the patient from many different angles in succession, allowing delivery of precise and powerful doses of radiation therapy from 360-degrees [9]. They have

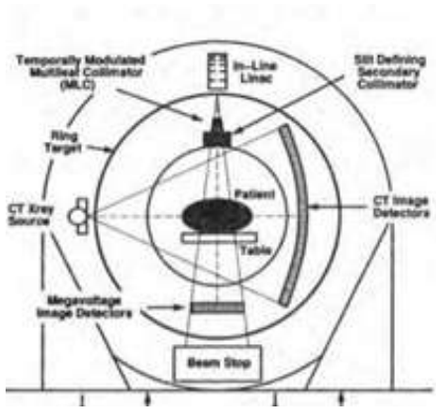


Fig.4: Tomotherapy unit [9]

a short 6MV waveguide spinning around the patient which produces a fan beam of 6MV photons. This beam is modulated by a mini-MLC.

v) Proton therapy

Protons allow delivery of RT with greater sparing of OARs as dose builds up to a peak and then falls off steeply. The proton loses a great deal of energy toward the end of its range, depositing an increased dose at the end of its range. This increase in dose is called a Bragg peak (BP). The tumor size is extended in most cases so, the Bragg peak is spread out (SOBP) by superposition of several beams of different energies. Then, just after the Bragg peak or SOBP, the depth–dose curve drops off sharply to zero dose value with no more exit dose [10]. The width of the peak is higher, as the energy becomes higher. However, the proton beam has a spectrum of energy so, height of Bragg peak decreases with depth although energy decreases.

Conclusion

Radiotherapy remains a vital component of the management of malignant disease. There are various treatment devices and methodologies developed in external beam radiotherapy with the hope that

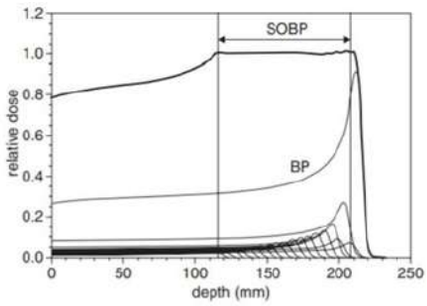


Fig.6: BP and SOBP in proton beam [10].

these will lead to the highest efficacy in management of cancer. The main focus in this article is to introduce briefly introduce modern technology developing in radiation oncology and its use. In summary, the new developments in three-dimensional treatment planning along with particle therapy that helps in precise delivery of high-dose radiation to cancer cells promise to increase the benefit of radiation treatment with minimal side effects.

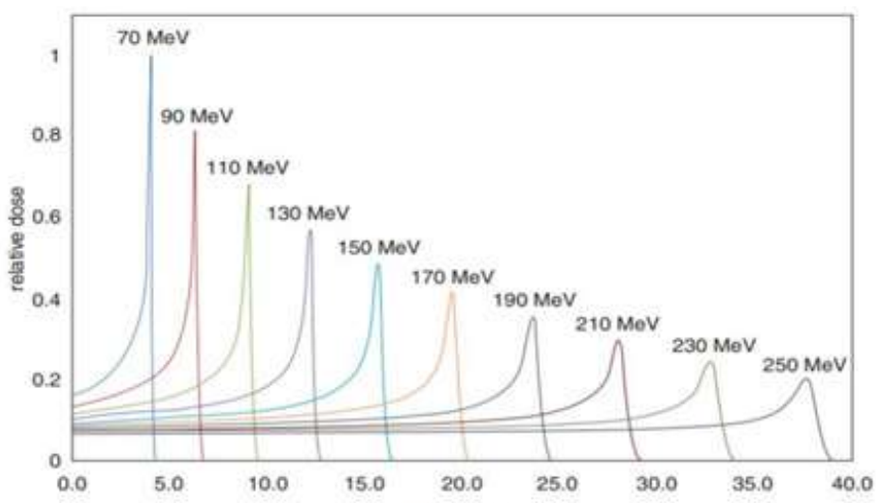
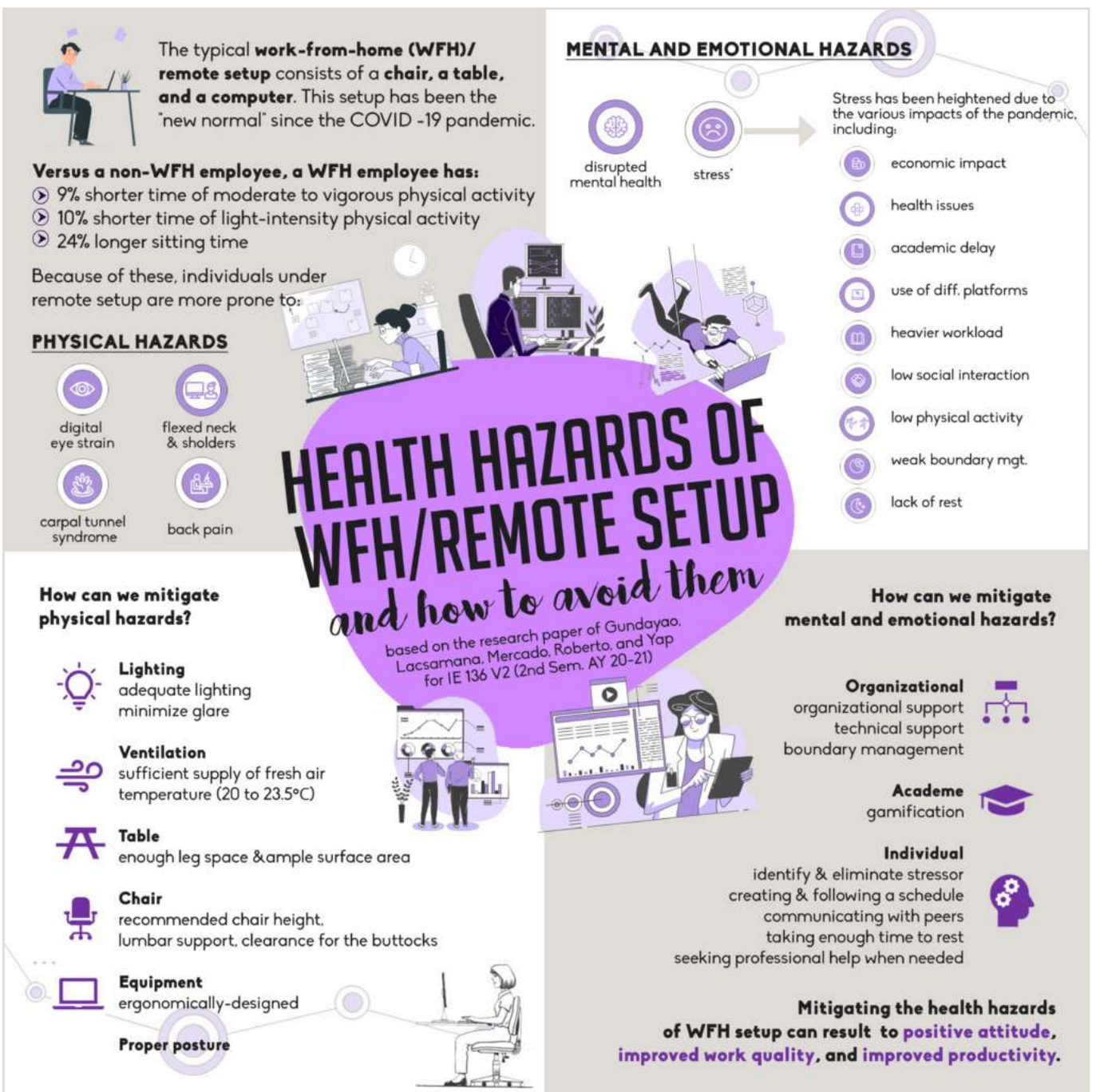


Fig.5: Proton beam Bragg peak increases with increase in energy [10].

References

1. Coleman C.N., Stevenson M.A., The hallmark of modern radiation oncology. Int. J. Radia. Oncol. Biol. Phys. 1994, 30(5), 1247-1249
2. Barton M.B, Frommer M., Shafiq J., Role of radiotherapy in cancer control in low-income and middle-income countries. Lancet Oncol. 2006, 7, 584–595
3. Tyldesley et al., Estimating the need for radiotherapy for patients with prostate, breast, and lung cancers: verification of model estimates of need with radiotherapy utilization data from British Columbia. Int. J. Radia. Oncol. Biol. Phys. 2011, 79, 1507-1515
4. Lomax M.E., et al., Biological Consequences of Radiation-induced DNA Damage: Relevance to Radiotherapy. Clinical Oncology 2013, 25, 578-585
5. Pereira G.C, et al., The Role of Imaging in Radiation Therapy Planning: Past, Present, and Future. BioMed Research International 2014, http://dx.doi.org/10.1155/2014/231090
6. Tubiana M., Eschwege F., Conformal Radiotherapy and Intensity-modulated Radiotherapy. Acta Oncologica 2000, 39(5), 555-567
7. Eisbruch, A., et al., Dose, volume and function relationships in parotid salivary glands following conformal and intensity modulated irradiation of head and neck cancer. Int. J. Radiat. Oncol. Biol. Phys. 1999, 45(3), 577– 587.
8. Faiz M. Khan, John P. Gibbons. The Physics of Radiation Therapy, 5th edition. Lippincott Williams & Wilkins, 2014.
9. Storme G., Verellen D., Soete G., From linac to tomotherapy: new possibilities for cure. Adv. Exp. Med. Biol. 2006; 587, 303-308.
10. Tsuboi K., Sakae T., Gerelchuluun A., Proton Beam Radiotherapy. Springer Nature Singapore Pte Ltd. 2020. pp. 1-50.



TOP **PRODUCTIVITY APPS FOR** STUDENTS

1



ShareX

ShareX is an open-source app designed to make it easier to take a screenshot or record a video of anything on your screen. This lightweight app comes with tons of tools to help you capture, edit, and share your screenshots and screen recordings. With a variety of capture methods, you can record the full screen, active window, active monitor, window menu, or monitor menu. You also have the option to capture different regions of the screen, including a rectangle, ellipse, or freehand area. ShareX offers scrolling capture, text capture, and auto-capture as well. You can even change the default hotkeys for taking a screenshot.

2



KeePass

KeePass is a free open source password manager, which helps you to manage your passwords in a secure way. You can store all your passwords in one database, which is locked with a master key. So you only have to remember one single master key to unlock the whole database. Database files are encrypted using the best and most secure encryption algorithms currently known (AES-256, ChaCha20 and Twofish).

3



Trello

Trello, a Kanban-style application that lets you create "cards" for things that need to get done and organize those cards into different lists. If you're familiar with the Kanban project management system, Trello offers a similar solution: you have a list of "To-Dos," a list of things you're "Doing," and a list of things that are "Done." As you make progress, you move cards from one column to the next so you can see your improvement over time.

4





RescueTime & toggl

RescueTime and Toggl are time-tracking apps that help busy students manage their time. These apps track your time and display your habits in a simple dashboard. They can even block your time and prevent you from accessing your favorite time-wasting websites, allowing you to focus on more important tasks. You'll know exactly how much time you're wasting on each application and site this way.

To become more productive, you must first understand where your time is going. Both of these apps are ideal for this purpose.

5

Any.do



Any.do is the most basic task management app on this list. It's simple interface shows you what you need to do today, tomorrow, later, and someday, so you're not overburdened with tasks. Any.do walks you through a "daily review" at the start of the day, where you decide what you want to tackle that day and what you want to defer until later.

Any.do also integrates with Google Apps natively. That means you can use a Chrome extension to add to-dos to Gmail, and the Android app even asks if you have any action items when you leave a meeting on your Google Calendar.

6

Notion

Notion is a productivity suite that includes databases, kanban boards, wikis, calendars, and other features. It allows you to take more detailed notes, organize thoughts, create integrated to-do lists, and link all of your content together in an incredibly organized manner. It's free to use for personal purposes, and it's an incredibly comprehensive organizational tool for your thoughts, data, and tasks.

7

Pocket

If you struggle to store and arrange articles and videos you discover from different platforms, on different devices, then you need to give Pocket a shot. You can curate content and sort it with the help of tags, for later consumption or just to maintain an archive. What's great is that it's available on most popular platforms, meaning adding content to your curation is only a share away.

8

Spendee

Spendee is an excellent household budget planner for managing income and expenses. Anyone, whether a student or a working adult, can benefit from using this app to track expenses. You will have better control over your personal finances if you link your credit card and bank account to your Spendee account.

The Spendee app also includes charts and graphs that can help you visualize your spending versus your income. Overall, Spendee is a fantastic free expense tracker app for anyone looking for a simple way to track personal finances.

9

Epic Pen

Epic Pen is a screen markup tool for artists, animators, and graphic designers to use during virtual meetings to highlight information across multiple screens. Students and teachers can use the click-through functionality to annotate learning materials and switch between multiple screens.
Designers can use the platform to draw and write over desktop applications on a unified interface. Epic Pen enables groups to capture content, hide notes, and drag the drawing toolbar across the screen. Overlays can also be created by supervisors to sketch across 3D models and animations in real time.
Epic Pen allows users to mark the displayed information on the screen by erasing, undoing, and clearing drawings, cropping screenshots, selecting personalized colors, and more.

10

Motion

As a university student, you'll be using laptops frequently, and if you're using the internet to work and take notes, there will be plenty of distractions in your browser. Distracting websites such as Facebook and YouTube will be blocked by Motion's free plan. You'll also get a report on how much of your online time is productive versus distracted. It is accessible as a Chrome Extension.

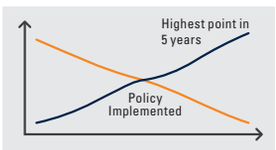
Core Principles of Data Visualization

Audience



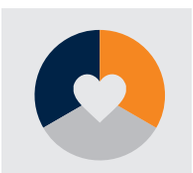
Always consider your audience—whether they need a short, written report, a more in-depth paper, or an online exploratory data tool.

Include annotation



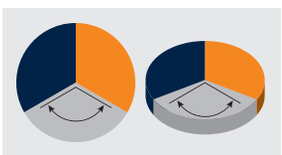
Add explanatory text to help the reader understand how to read or use the visualization (if necessary) and also to guide them through the content.

Use pie charts with care



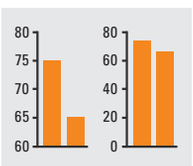
We are not very good at discerning quantities from the slices of the pie chart. Other chart types—for example, bars, stacked bars, treemaps, or slope charts—may be a better choice.

Avoid 3D



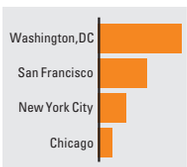
Using 3D when you don't have a third variable will usually distort the perception of the data and should thus be avoided.

Start bar and column charts at zero



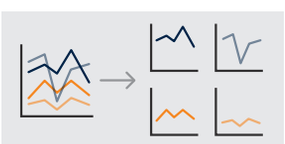
Bar and column charts that do not start at zero overemphasize the differences between the values. For small changes in quantities, consider visualizing the difference or the change in the values.

Make labels easy to read



When applicable, rotate bar and column charts to make the labels horizontal. If possible, make vertical axis labels horizontal, possibly below the title. In general, make labels clear, concise, and easy for your reader to understand.

Try small multiples



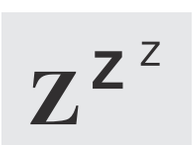
Breaking up a complicated chart into smaller chunks can be an effective way to visualize your data.

Use maps carefully

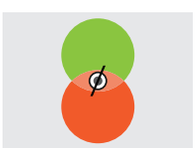


Use maps carefully, always being sure it is the geographic point you are trying to make. Column and bar charts, for example, are often better at enabling comparisons between geographic units.

Color and font considerations



Avoid default colors and fonts—they all look the same and don't stand out.

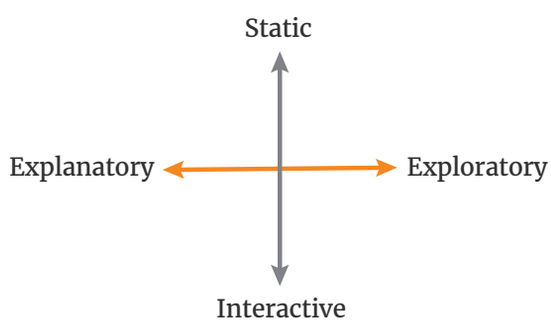


Consider color blindness—about 10% of people (mostly men) have some form of color blindness.



Avoid the rainbow color palette—it doesn't map to our number system and there is no logical ordering.

Visualization Mapping: Form and Function



PolicyViz



Data Analytics

Prominent Tool for Future Technology

- Rijana Shrestha

In the era of digitalization, data plays an imperative role in our life whether it might be part of a study helping to cure a disease, boost a company's revenue, make a building more efficient or be responsible for those targeted ads that keep popping. Data helps to make better decisions and allows us to measure and establish baselines, find benchmarks, and set performance goals. Data is crucial in every field to understand the outlines.

Introduction:

Data analytics is the concept and practice of all activities related to data. The primary goal is, for data experts, including data scientists, engineers, and analysts, to make it easy for the rest of the business to access and understand these findings. Data that sits raw, as-is, has no value. Instead, it's what you do with that data that provides value. Data analytics includes all the steps, both human and machine-enabled, to discover, interpret, visualize, and tell the story of patterns in data to drive business strategy and outcomes. A successful data analytics practice can provide a better strategy for where a business can go. When done well, data analytics can help to find trends, uncover opportunities, predict actions, triggers, or events to make decisions.

Data analytics is systematic, consisting of many computational and management steps. Being systematic is vital because data analytics uses many different activities and draws on all types and sizes of data sources. Many subject areas comprise data analytics, including data science, machine learning, and applied statistics. One tangible result of a data analytics practice is likely well-planned reports that use data visualization to tell the story of the most salient points so that the rest of the business who aren't data experts can understand, develop, and adapt their strategies.

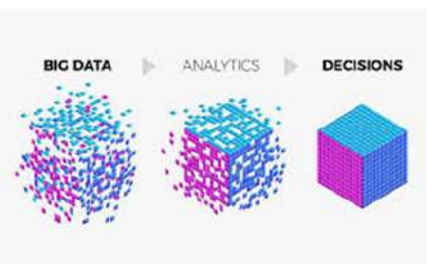
Data analytics is beneficial in business as it uses facts, not guesses, to understand how customers engage might mean to change sales or marketing processes. A bakery might use its data to realize its demand for bread bowls increases in the winter which means there is no need to discount the prices when demand is high.

> ***"If knowledge is power, then the vast knowledge contained in big data is powerful enough to change the world."***

Why data analytics?

Data analytics examines large amounts of data to uncover hidden patterns, correlations, and other insights. With today's technology, it's possible to analyze your data and get answers from it almost immediately – an effort that's slower and less efficient than more traditional business intelligence solutions. Most organizations deal with a massive amount of data (both historical and real-time). Data analytics helps in unveiling hidden business opportunities and insights by effective use of the data assets. Leveraging and transforming the huge volume of data available into actionable insights, making faster and better business decisions, and unraveling potential revenue sources by optimizing the data assets.

Big data has become a major component in the tech world today, thanks to the actionable insights and results businesses can glean. However, the creation of such large datasets also requires understanding and having the proper tools on hand to parse through them to uncover the right information. To better comprehend big data, the fields of data science and analytics have gone from largely being relegated to academia, to instead becoming integral elements of Business Intelligence and big data analytics tools.



Data analytics focuses on processing and performing statistical analysis of existing datasets. Analysts concentrate on creating methods to capture, process, and organize data to uncover actionable insights for current problems, and establishing the best way to present this data. More simply, the field of data and analytics is directed toward solving problems for questions we know we don't know the answers to. More importantly, it's based on producing results that can lead to immediate improvements. Data analytics also encompasses a few different branches of broader statistics and analysis which help combine diverse sources of data and locate connections while simplifying the results.

Data analysis, therefore, is a necessity for making well-informed and efficient decisions. Data analysis is what helps organizations determine their positions in the market relative to competitors. It is what helps us identify the potential risks that need to be avoided and the opportunities that must be grabbed to grow. Technology has evolved rapidly in response to the scale of data generated, with systems for business intelligence and data lakes now an essential part of operational excellence. However, for many engineers little has changed. They use the same systems and experience few benefits from the digital transformation taking place in their plants as they are unable to directly access the insights this new data provides.



Rijana Shrestha
Final Year Student
Industrial Engineering, Thapathali Campus
sthareezu@gmail.com



Just as technology has evolved to create connected plants, engineers must be empowered to manage these factories. This is a critical shift in business culture as the entire organization must be educated and made aware of the potential of analytics as it applies to their role. Instead of relying solely on a central analytics team that owns all the analytics expertise, subject matter experts such as process engineers should be empowered to answer their day-to-day questions. Not only will this spread the benefits to the engineers involved in process management, but it will also free the data scientists to focus on the most critical business issues. If knowledge is power, then the vast knowledge contained in big data is powerful enough to change the world.

Data Analytics Methods

Several methods can be used for processing any set of data.

—**Data mining:** Data mining breaks down huge reserves of raw data into small chunks of information that can be usable. They also identify anomalies in groups of data and assess the dependencies between different data groups to come up with correlations between them. Data mining is used for determining behavioral patterns in patients' data in many clinical trials.

—**Text analytics:** Text analytics is used to develop auto-correct for your phone and predictive typing for your emails. It involves processing huge chunks of unstructured texts to develop algorithms. It includes linguistic analysis, pattern recognition in textual data, and filtering out junk emails from useful ones.

—**Data visualization:** It involves laying out data in a visual format for a better assessment. It helps make complex data understandable. Examples include bar charts, histograms, graphs, and pie charts.

—**Business intelligence:** It involves transforming data into actionable insights for a business. These results are used for making business strategies such as product placement and pricing. It involves using visual tools such as heat maps, pivot tables, and mapping techniques.

—**Visual Text Analytics:** With SAS Visual Text Analytics, you can detect emerging trends and hidden opportunities, as it allows you to automatically convert unstructured data into meaningful insights that feed machine learning and predictive models.

Essential tools for data analytics

Analytics software is a tool that helps humans and machines perform the analysis that allows us to make mission-critical business decisions. Some tools for performing data analytics are:

- Spreadsheet Software (Microsoft Excel, Google Sheets, SPSS etc.)
- Business Intelligence Software (Microsoft Power BI, Tableau etc.)
- Programming Language (R analytics, python etc.)
- Structure Query Language (SQL)
- Google Analytics etc.

Benefits of data analytics for businesses

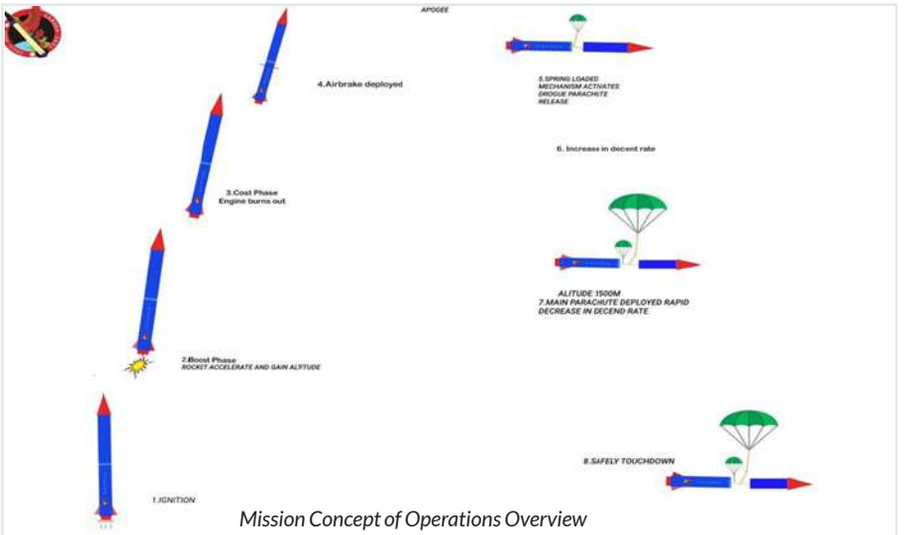
Data analytics is an essential asset for companies for obtaining a competitive advantage. Here are a few sectors where data analytics can make a difference.

—**Product development:** Data analytics enables both prediction and knowledge discovery capabilities. Data analytics enables businesses to understand the current market scenario and change the process or trigger a need for new product development that matches the market needs.

—**Targeted content:** Knowing what customers want beforehand makes marketing campaigns more customer-oriented. It enables companies to customize their advertisements to target a segment of their entire customer base. Moreover, it saves money on the cost of convincing a customer to make the purchase and improves the overall efficiency of the marketing efforts.

—**Operational efficiency:** Data analytics can also help companies identify other potential opportunities to streamline operations or maximize their profits. It helps identify potential problems, eliminating the process of waiting for them to occur, and then taking action on the same. This allows companies to see which operations have yielded the best overall results under various conditions and identify which operational areas are error-prone and which ones need to be improved.

—**Decision making:** Companies may use the information they obtain from data analytics to guide their decisions, leading to improved results. Data analytics removes a lot of guesswork from preparing marketing plans, deciding what material to make, creating goods, and more. With advanced data analytics technologies, new data can be constantly gathered and analyzed to enhance your understanding of changing circumstances.



Mission Concept of Operations Overview

Project Garuda

Nepal's First Sounding Rocket

-Amrit Dhungana

Team 44-Kathmandu University presents its rocketry project, the rocket GARUDA. The project was carried out by students at different universities with the support of Students for the Exploration and Development of Space – Nepal, Open Rocketry and Space Society- Nepal, and Kathmandu University. A sounding rocket was designed and built within project GARUDA during two semesters for Spaceport America Cup 2021 held in New Mexico, USA. GARUDA targets an apogee of 10'000 feet above ground level with a commercial off-the-self Aerotech M2400T solid motor. For recovery, a dual deployment system using a spring-loaded mechanism to deploy the parachutes is used. First, the separation of the rocket body in the middle will eject the drogue parachute at 10,000 feet and the main parachute at 1,500 feet above ground level. As a payload, the rocket carries a 2U non-deployable CubeSat used for surveillance experiments and boilerplate mass. Furthermore, the rocket has an altitude control system consisting of air brakes which will be deployed after the motor has burnt out.

GARUDA is the first sounding rocket from Nepal designed and manufactured by ORASS-Nepal, a chapter of SEDS-Nepal. Team GARUDA consists of 30 bachelor's and master's students who matriculated at Kathmandu University, Tribhuvan University, and Pokhara University.

The objectives of the project:

- Launch GARUDA stable and safely Reach target apogee of 10.000ft. AGL as precisely as possible
- Recover without significant damages
- Recover, save, and validate collected data and learnings for future projects

A. Prelaunch

First, the rocket is transported to the competition grounds where it is fully assembled. The rocket is then placed on the launch rail. A final inspection is done to make sure everything is ready. The avionics team will remain on standby and oversee the avionics system is switched on and ready for the flight test. The recovery system is also switched on and made ready.

B. Launch

The propellant is ignited and the liftoff will begin as soon as the countdown ends. Then the rocket shoots upwards leaving the launch rail. After reaching the required apogee of 10,000 ft, avionics detect the apogee, and the air brakes system is released ensuring the rocket doesn't go above its required apogee. The payload system starts running the experiments and collecting data. The separation of the nose cone and the rocket body takes place ejecting the drogue parachute. Then at the second deployment event, the release device will disconnect the nylon cord from the bulkhead that holds the main parachute inside the rocket, thereby pulling the main parachute out of the bag at 1,500 feet above the ground level.

C. Recovery



The rocket falls to the ground and thus its flight is completed. The ground station helps track the landing site of the rocket. A ground crew will follow a set of search operations checklist and retrieve the rocket.

System Details:

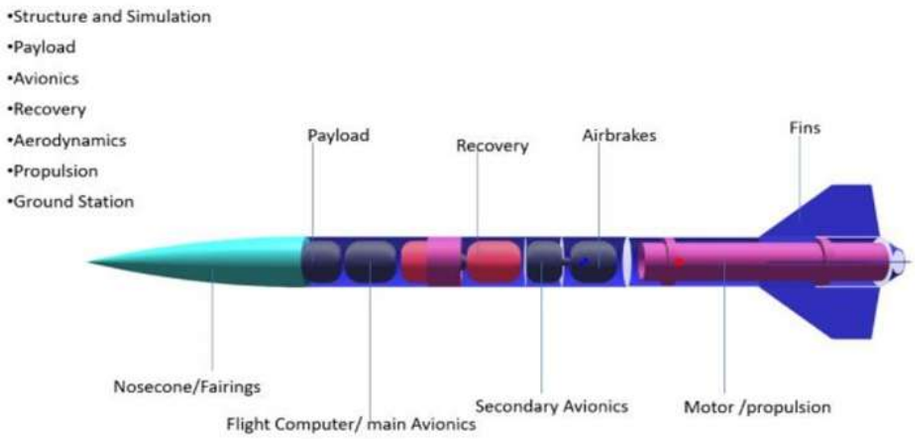
GARUDA subsystems diagram shows the whole GARUDA system as a simulated diagram and indicates with arrows the interfaces and connections. All the subsystems of the rocket are clearly outlined. Note that the recovery system is entirely electrically independent.

Structure System

OpenRocket (a flight modeling software) was used to model precise layout, mass, and CG, trajectory analysis. Our rocket will encounter three predominant forces: gravity, thrust, and aerodynamic forces throughout its flight. Gravity's effect on the rocket can be found by locating its center of gravity (CG). The CG of an object is when all the forces and moments generated by gravity are resolved into a single force acting on a single point. This means to calculate gravity's effect on our rocket we simply need to find its mass and apply the force at the CG. The motor will generate the thrust force acting on the rocket. Our team is using a sugar-based Student Researched and Developed Rocket Motor. This means that thrust data from a static test will be available for our team to use which can then be treated as a simple axial force.

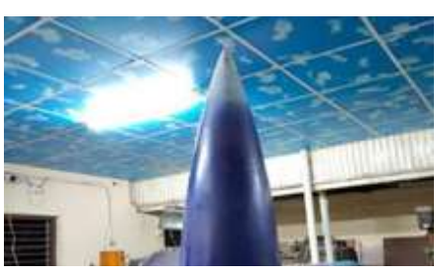


Amrit Dhungana
Final Year Student
Industrial Engineering, Thapathali Campus
golmely.amrit21@gmail.com



Body Tube:
The outer diameter and inner diameter of each fiberglass tube are 6.11 with 0.079''thickness. There are three body tubes of length 18'', 10'', and 52''respectively. The concentric couplers will connect the separation points of the rocket via shear pins. The parachute body tube houses both the drogue and main parachutes and connects to the upper and lower couplers.

Nose Cone:
The nose cone material for Project Garuda is fiberglass. The nose cone has an aluminum tip to protect against Mach heating. As the 2U CubeSat is integrated into the nose cone, its material must be permeable for the GPS and ground communication signals. To comply with these requirements the nose cone is manufactured using glass-fiber-reinforced polymer.



The nose cone design and the manufacturing are based on a tangent ogive-shaped nose cone. This fiberglass nose cone-shaped shell has manufacturing simplicity and a smooth transition to the body tube.

Fins:
Our fins have a root chord length of 15 in, a tip chord of 5 in, a height of 6 in, a sweep length of 7.409 in, 0.0118 in thick, and a sweep angle of 51 degrees.

Avionics Subsystem
The avionics system is integrated into GARUDA to develop a reliable SRAD





flight computer and a telemetry module. It consists of the Electrical Power System (EPS), ground station, upper body avionics (UB AV), and lower body avionics (LB AV). The signals will be transmitted before and after the nose cone deployment. The EPS consists of the battery pack and the power supply for the system. The UB AV consists of all the sensors, GPS modules, and data storage systems for the avionics subsystem. The LB AV consists of the main flight computer and motor stacks responsible for controlling the avionics system. The ground station ensures a connection with the ground station and the systems of the rocket body. The avionics subsystem can communicate with the flight computer via the 33 cm band using 900 MHz frequency. In one cycle, the flight computer gathers all the data from the sensor. Then the data is packed according to the APRS Telemetry Format. The GPS data are packed according to APRS Position Report Format. The flight computer sends a data packet to the RF module, when theRF module receives the data from the flight computer it immediately transmits data on the air from the antenna. Now the digital data is converted into electromagnetic waves. Similarly, other packets are sent over the air.

APRS Telemetry System Format:
Since the antenna has characteristics of transmitting electromagnetic waves as well as receiving electromagnetic waves. The antenna in the ground station receives the waves transmitted from the transmitter of the flight computer. These waves produce the electrical signal, and the XBee receiver decodes those signals into digital data and again transfers them to the microcontroller via serial communication. From the microcontroller, the data are further transmitted according to the mission control and tracking mobile app.

Payload
The non-deployable payload system consists of a 2-unit CubeSat. The payload subsystem is integrated into the rocket to take environmental data such as temperature, humidity, altitude, pressure, the position of the satellite, and also capturing images of the surroundings. It consists of the Electrical Power System (EPS) and On-Board Computer (OBC). The EPS consists of a battery pack, battery charger, DC-to-DC convertor, linear



voltage regulator, capacitors, diodes, and other electronic components. The OBC of the CubeSat consists of a microcontroller, sensors, GPS module, gyroscope, and data storage system.
Boilerplate spacecraft is a non-operating spacecraft that is used to test various configurations, sizes, load, and handling characteristics. Developing a full system that includes multiple phases like designing, testing, redesigning, and launching, costs a lot. In contrast, boilerplate spacecraft allows rocketry and aerospace projects to be tested relative to an actual model.

In the payload, the boilerplate consists of aluminum plates that can be freely adjusted. Like most iterations of boilerplates, ours is also 1 unit. The length, breadth, and height of the boilerplate are made to be 10 cm each. This consists of aluminum plates stacked together. The total weight of the boilerplate is ~4KG.

Recovery system

A recovery system is any device incorporated into the model to return it safely to the ground. All recovery systems work by developing either lift or additional drag to counteract the force of gravity. It plays the main role to bring our rocket parts soundly into the ground.
The recovery system includes the rocket's parachutes and all components that facilitate their deployment, as well as the tracking systems that will locate the rocket. This includes the altimeters and wiring, deployment of the drogue parachute and the main parachute release mechanism, the parachute rigging, and the avionics suites. Our recovery system consists of two event parachute ejection systems: Drogue Parachute deployment and Main Parachute deployment. The drogue parachute is located in the booster section which is deployed when the rocket reaches the apogee at 10000 ft. The main parachute is located in the compartment below the nose cone which is released when the rocket reaches 1500ft.

Recovery of the rocket will follow a typical dual deployment recovery profile using a spring-loaded mechanism to deploy the parachutes. At 10,000 feet above ground level, the rocket will deploy the drogue parachute and then at 1,500 feet, the rocket will deploy the main parachute which is placed in a different section of the same compartment. Under the drogue parachute, there will be three separate sections all tethered together and under the main/drogue configuration, there will be three separate sections all tethered together. With this dual deployment configuration, the rocket will not drift considerably far. It will land safely on New Mexico's hard desert terrain and be recovered successfully to be re-flown if desired.

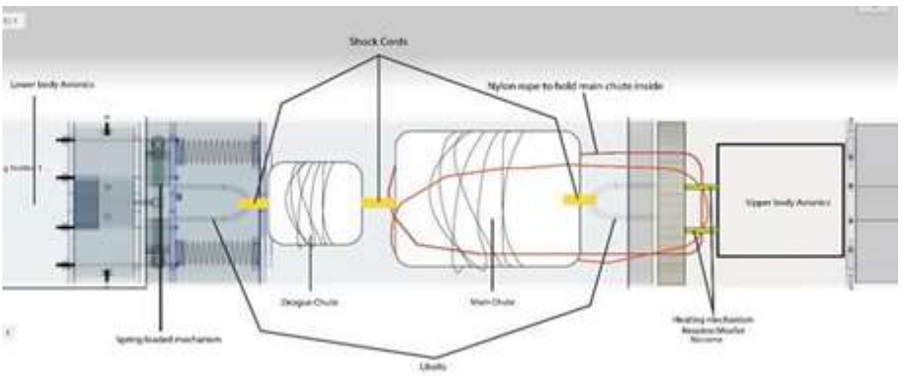
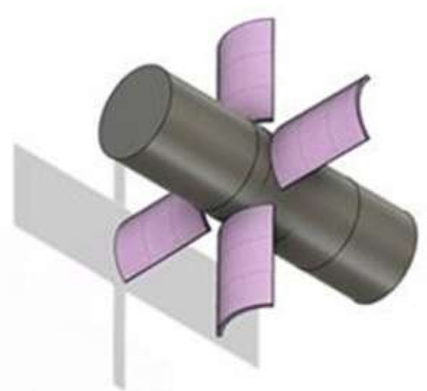


Fig: Recovery System

Air brake altitude control system:

Air brakes are the type of flight control surfaces used on a rocket to increase the drag which helps the rocket to achieve its required apogee. It is a small mechanism that opens and closes like an umbrella and changes the rocket's drag. In our system, this mechanism helps us to achieve a 10,000 feet apogee. After the rocket is deployed, it will be difficult to stop the rocket at our required apogee. This is not ideal when attempting to achieve an exact altitude as many flight variables are difficult to account for before launch. To increase the chance of achieving our target altitude, a novel airbrake solution was introduced. The solution's goals were for the system to be fully controllable, light, structurally sound, volume efficient, and inexpensive. The controller is located on a sensor board with two redundant barometers in the lower body avionics.
Air Brakes are made of a "Flaps" system made of four flaps flush with the rocket's body tube when closed and lifted open by a linear screw and links. The sensors measure the rocket's speed and altitude. After receiving the sensor's signal, the stepper motor attached to the top provides the necessary rotational motion to the system. A leadscrew is introduced and coupled with the stepper motor which helps to transform the rotational motion to the linear motion which results in the linear transformation of the wooden plate placed in between. The required number of hinges are attached to the flaps to give the necessary angle of rotation to open the flaps. The levers are deployed to establish the connection between the flaps and plate. Here, the levers and hinges play an important role in opening the flaps.



Propulsion Subsystem

The propulsion system provides the required thrust to propel the rocket in the vertical direction. The motor that we planned to use was a COTS Aerotech M2400T motor. But, initially for testing proposed student research and developed (SRAD) motor was planned and executed as well. Various tests were done on small as well as in required scale and data were noted. The chemicals that we intended to use during the competition for our propulsion system were not available so we had to use locally available sugar-based propellant.



Ground Station Subsystem

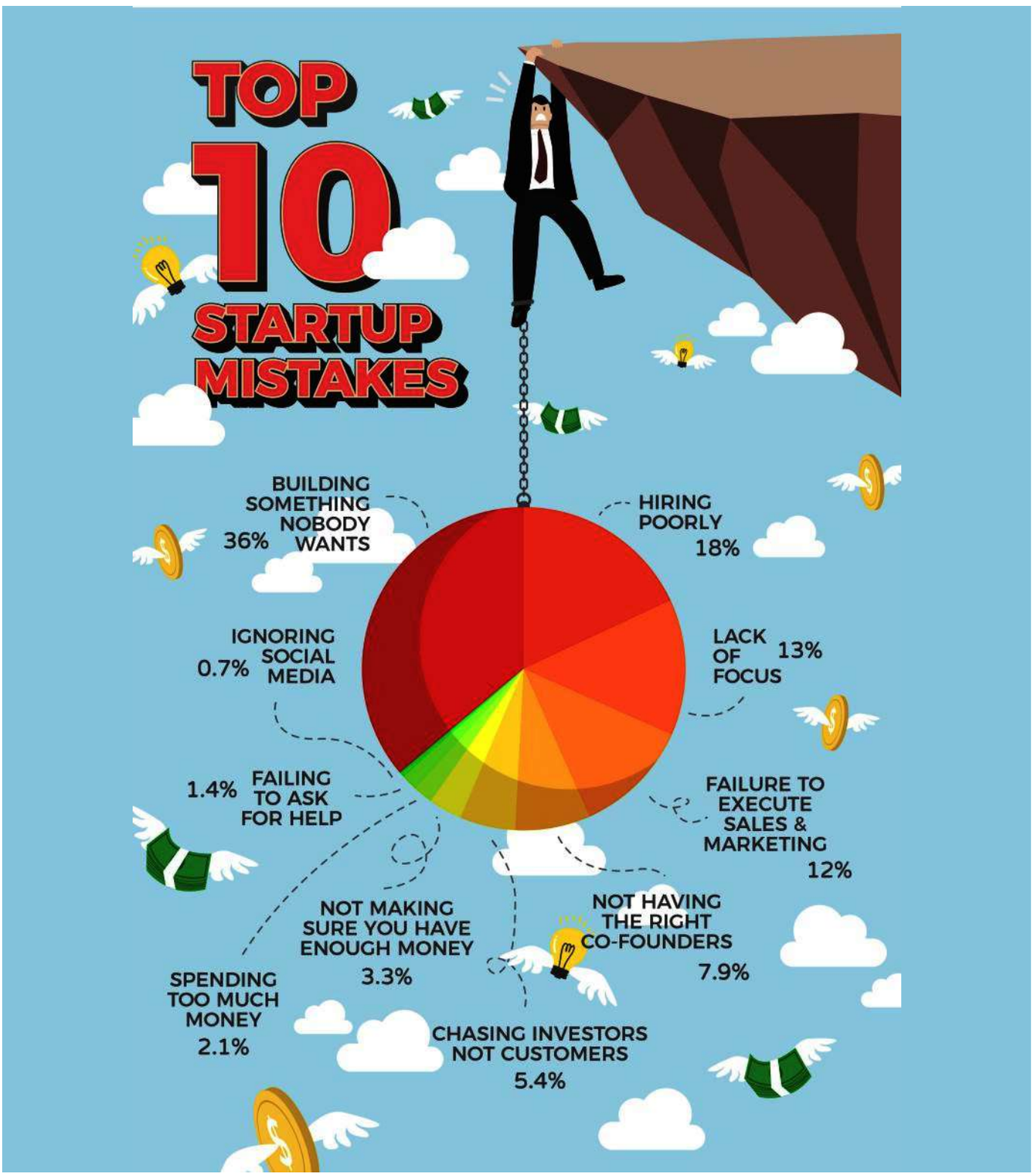
The Ground Station is an element of the ground segment that provides the radio

CREATION

interface with the rocket. It is used for telemetry, tracking, and command. **For Garuda**, the ground station is the system concerned with collecting and visualizing the real-time telemetry data from the moving rocket. The mobile and desktop application built for Garuda receives sensory input from onboard components, decodes them, and displays the information in a user-friendly manner. These illustrations aid in predicting the success of the launch and in case of failure allow the team to better predict and resolve the issues. The web application for the ground station is similar to the desktop application but uses the Express JS package. The application has APIs that communicate with the communication system. The JSON responses from API are used in visualizing data in the web-based ground station. The responses are stored in MongoDB.



8.0



भरतपुर महानगरपालिका

नगर कायरपालिकाको कार्यालय

भरतपुर, चितवन, नेपाल

Bharatpur Metropolitan City

Office Of Municipal Executive

Bharatpur, Chitwan, Nepal

अनुरोध

- अनिवार्यरुपमा नक्सा पास गरेर मात्र घर, कम्पाउण्डवाल आदिको निर्माण गरौं। सम्भावित विपदबाट बचौं, बचाऔं।
- सडक मापदण्ड पालना गरेर मात्र भौतिक संरचनाहरू निर्माण गरौं। सडकमा जथाभावी निर्माण सामाग्री नथुपारौं।
- हरियाली प्रवर्द्धनको लागि सडकको दायाँबायाँ वृक्षारोपण गरौं। रोपिएको विरुवाका संरक्षण गरौं।
- फोहरको उचित व्यवस्थापन गरौं। रोग लाग्नबाट बचौं। फोहरको वर्गीकरण गरी गल्ने फोहरलाई प्राङ्गारिक मल बनाई कृषि उत्पादन बढाऔं।
- महानगरपालिकालाई तिर्नु पर्ने एकीकृत सम्पत्ति कर, भूमि कर, व्यवसाय कर, घर बहाल कर आदि बेलैमा तिरौं। समृद्ध महानगर निर्माणमा सहभागी बनौं।
- महानगरले प्रदान गर्ने कर छुटको फाइदा लिऔं, म्याद नागेपछि लाग्ने जरिवानाबाट जोगिऔं। तिर्नु पर्ने कर रहरले तिरौं, करले होइन।
- महानगरको अनुमति बिना कुनै पनि सार्वजनिक स्थानमा रोडक्रस गेट, ब्यानर, होडिङ बोर्ड, फ्लेक्स, पर्चा पम्प्लेट नराखौं, नटाँसौं। सुन्दर महानगर निर्माणमा जुटौं।
- कोरना कहरबाट बचौं, बचाऔं। नेपाल सरकारले तोकेका मापदण्ड पूर्णरुपमा पालना गरौं।
- "सूर्तीजन्य पदार्थको प्रयोग नगरौं, स्वास्थ्य रोजौं: सूर्तीजन्य पदार्थ होइन"।

थप जानकारी तथा समन्वयको लागि नजिकको वडा कार्यालय वा महानगरमा सम्पर्क गरौं।
फोन नं. ०५६ ५२०१६७, ०५६५२१४६७, ०५६५२५७७१ दमकल ०५६५२१०८३
मोबाइल नं. ९८४५१४३८७८ टोल फ्री नं. १६६०५६५२२२२
इमेल bmc@ntc.net.np वेभसाइट www.bharatpurmun.gov.np

Himalayan Institute of Science and Technology

HIST - Engineering College

(Affiliated to Purbanchal University)

Program offered:

Morning Shift 6:30 to 12:30

1. Bachelor in Civil Engineering.
   (4 years / 8 semesters)

Evening Shift 17:30 to 20:30

1. M.Sc.in Engineering Management.
2. M. Sc. in Information System Engineering.
   (Both Programs 2 years / 4 semesters)

M8QM+C4 New Baneshwor, Kathmandu, Nepal.

4794951, 4794954 4794954, info@hist.edu.np www.hist.edu.np

Smart Gadgets

INNOVATIONS IN INFORMATION TECHNOLOGY



1

Gocycle G4 Electric Bike

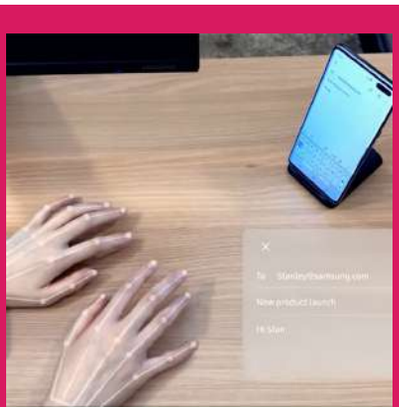
Can your electric bike be folded? This is what differentiates the Gocycle G4 electric bike from the others. The Gocycle G4 is a premium electric bike that is easily foldable and connects with an app that helps you start your electric bike even from a remote location including the speed of the bike and the battery remaining. This bike is worked on unique terrains including grass and roads.

2

Smart Chessboard



This is an AI-based chessboard that can play on its own. It has sensors, and it uses artificial intelligence and robotics to make the move on its own. It has different difficulty levels to play. It also makes you play chess with anyone in the world. It will be a great time pass for people who are alone.



3

Invisible Keyboard

Samsung has introduced the invisible keyboard for laptops and keyboards. It has a front camera and a virtual camera. The finger movements will be analyzed by the front camera and will be converted to inputs.

4

All-New 360 Smart Bed



The Sleep Number brand's latest smart bed integrates sensors and technologies to respond to the evolving needs of the sleeper(s). As everyone's individualized comfort varies, the bed can adjust accordingly. The bed can vary the heating or cooling on each side of the bed, sense snoring and adjust the head of the bed as needed, tilt to better maintain proper spinal alignment while elevating the head, or completely lower and elevate to help sleepers get in and out of bed more readily. In the future, the integrated sensors may also be capable of helping detect and monitor other health conditions.

5

The Freestyle - all-in-one projector



Samsung took the regular projector one step further, incorporating sound, mobility, and picture quality into a single device. The portable device can be easily moved about, showcasing high-quality video and audio from just about anywhere (you can purchase a separate battery for an entirely wireless option). It even includes surround sound for a cinema feel. And it's pocket-sized!

6

Interactive Mirror



The Interactive Mirror is a system for recommending and cross-selling retail store products. It uses RFID technology and a touch screen integrated with a mirror to enhance the shopper or gallery shopping experience. Customers, along with their reflections, see images of the products they have purchased, detailed information, and recommendations from other articles.

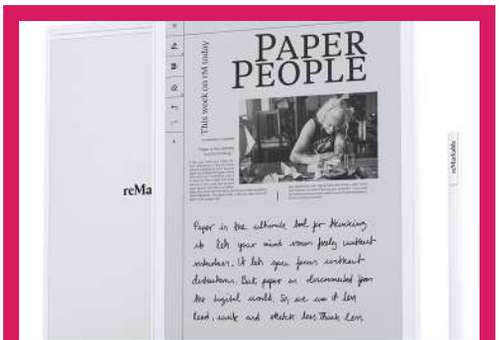
The customer can choose an item that s/he finds interesting and approach the product close to the Interactive Mirror and the RFID subsystem detects it. The Interactive Mirror screen shows customer reflection and product images, along with information such as available colors and sizes, composition, price, and others. The customer also receives product and accessory recommendations. With the Interactive Mirror touch screen, the customer can browse other products, and ask an employee to bring a product, among others.

7

Nest Doorbell



Google-owned Nest has finally released a battery-powered option three years after the launch of its first video doorbell, Nest Hello. While Nest Hello was and continues to be a superb video doorbell, its hard-wiring installation requirements make it unsuitable for everyone. The Doorbell Battery, on the other hand, looks more modern than the wired Nest Hello and is much easier to install due to its battery-powered nature.



8

Remarkable Digital Notepad

This device provides an improved paper-like reading experience, allowing editors and artists alike to quickly sift through notes, alter PDFs, and even review their designs.

The reMarkable paper tablet is used for taking notes, reading books, or even sketching.
Featuring very low latency, the reMarkable has a CANVAS display with 226 DPI resolution that will make your reading and writing experience as comfortable as it could be. Eight additional pen tips and a free charging cable make this model the best digital paper tablet in terms of convenience.



9

Solar Roof Tiles

Brought to you by Timberline Solar and GAF Energy, the solar shingles are designed to be installed like a regular roof shingle with a nail gun! The company offers all-in-one solar solutions for roofers, so you don't have to sacrifice quality or convenience. Manufactured in San Jose, California, the product achieved UL 7103 certification in the fall of 2021, meaning it can be classified as a building-integrated photovoltaic (BIPV) roof covering that can be installed on residential roofs as a roofing + solar energy product.



10

Withings Body Scan

French tech company Withings is taking smart scales to the next level. Called the Body Scan, this new scale from the company comes with a set of health monitoring features such as ECG, body composition, nerve activity, and vascular age. To monitor these additional biomarkers, Withings' latest scale is equipped with a tethered handle packed with sensors and electrodes. It scans your body composition more accurately and can alert you to potential anomalies. Future updates to the associated app will collect feedback on nutrition, sleep, exercise, and stress management and will allow access to medical professionals within the app. The gadget makes perfect sense in the current scenario where people can keep track of their health without leaving the house. As per the company, the Withings Body Scan is under regulatory validation.



ANEST IWATA MOTHERSON

Air Cooled Screw
Air Compressor.

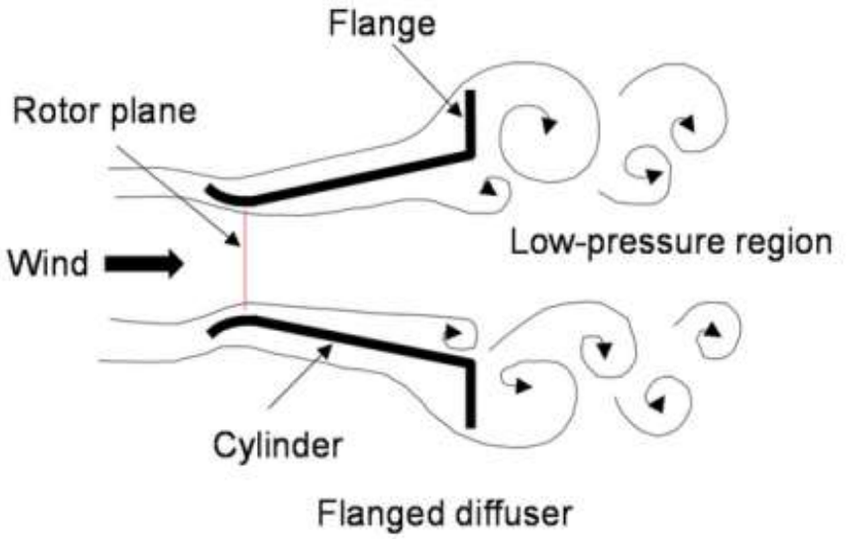
Proud to be part of samvardhna **motherson**

EASY TECH ENTERPRISES
2064
Kirtipur-9

EASY TECH ENTERPRISES

Teku, Machali, Kathmandu, Nepal
G.P.O. Box: 26080
Tel: 9771-5330868, Mob: 9851107563
easytech@mcmail.com.np | easytechenterprises@gmail.com





Design, Analysis and Optimization of Diffuser of the Diffuser Augmented Wind Turbine

- Bijay Chhetri, Kamal Kunwar, Jayanta Bhattarai, Manoj Poudel

ABSTRACT

The research on clean energy has become popular in recent years due to the considerable impact of global warming and the growing depletion of fossil fuels. And among several alternative energy sources, wind energy is widely accepted because of its low carbon footprints. The theme of this project is to study power augmentation in diffuser augmentation wind turbines (DAWTs) with and without flanges. DAWTs are used to harness more wind energy compared to conventional wind turbines. In this project, design and simulation of the diffuser having normal and airfoil cross section shaped was performed. The project is aimed at obtaining the optimum shape of the diffuser. The perfect shape for a duct or diffuser is always a topic for further research. Using Reynolds Averaged Navier Stokes equation along with k- ω turbulence models, the flow properties through the diffuser are obtained. NACA 4415 airfoil was used to model the diffuser. Diffuser designs are simulated using CFD software ANSYS Fluent with wind inlet velocity of 4m/s and the values are compared to get an optimized model to achieve good power output. From the results, airfoil diffuser with flange gave optimum results at 10° flange angle for 8° AOA and the average velocity was found to be 6.025m/s and the coefficient of power of 3.4174.

INTRODUCTION

The research and implementation of renewable, clean energy has become a significant issue in recent years due to the considerable impact of global warming and the growing depletion of fossil fuels. To solve the current energy crisis, various alternative energy sources are being investigated. Wind energy is one of the world's fastest-growing energy sources, and it is a realistic alternative because of its endless resources.

Wind power consumption, however, is still modest when compared to total energy demand. There are several reasons for this, including financial constraints. As a result, introducing new wind power technology that can produce higher power output even in regions where lower wind speeds are expected would be economically possible. In a typical wind turbine, the power output is limited by Betz's limit; by producing a low-pressure field behind the turbine, this power output can be improved.

The Diffuser Augmented Wind Turbine (DAWT) is a wind power augmentation device that incorporates a diffuser around the turbine. The HAWT (Horizontal axis wind turbine) is constrained by Betz's law, which states that a bare turbine in open wind can convert no more than 16/27 of total wind kinetic energy to electrical energy. In this project, we are aiming to design and analyze the shape of diffusers in horizontal axis wind turbines.

Principle of diffuser augmentation

The concept of a diffuser is to increase the power output of a wind turbine by accelerating the wind velocity that approaches the wind turbine. To increase the wind velocity, a lower pressure would appear at the back of the wind turbine to act as a vacuum to suck the wind and accelerate it towards the blades. The region of areas surrounding or near the vortex would have typically lower pressure where the suction force will be formed by the vortex. Therefore, it will function as an accelerator to accelerate the wind velocity approaching the wind turbine. It was stated that the vortex core will collapse the pressure field flow reversal and therefore no augmentation occurs. This statement showed the alternative approach, where the vortex is used to generate a low-pressure region in the wake of the turbine. Vortex should appear at the wake of the diffuser but as little as possible inside the diffuser [7].

In conventional wind turbines the wind speed served from the location is directly used to generate power. But in DAWT, the available wind speed is increased by the diffuser to generate high power output. Also, the smaller diameter blade in DAWT produces the same power output as of a conventional, bare wind turbine due to the concentration of the wind energy density. Currently very few studies have been reporting the effect of diffuser shape in wind speed using computational simulations.

S.S Gaonkar et al. (2020) focused on the design and analysis of diffuser casing of various with various design parameters. They found the optimum flange angle to be 15 degrees and velocity magnification factor of 2.3 and 27.4% increase in mass flow rate of air [6].

METHODOLOGY

Geometry generation

For our project, we took the length of the diffuser at 50 mm, flange height of 20 mm and D equals to 190 mm as a constant parameter. NACA 4415 airfoil is used for the diffuser cross-section. Hence, optimization of opening angle (**α**) and flange angle (**β**) has been conducted throughout the project.



Author: **Bijay Chhetri**
Co-authors: **Kamal Kunwar, Jayanta Bhattarai, Manoj Poudel**
Final year Students | Mechanical Engineering, IOE, Thapathali Campus, TU
bijayc909@gmail.com

Table: Parameters for Diffuser Geometry

Airfoil shaped diffusers with and without flanges were designed, and simulation was done at different angles of flange. The flange angle varied from 0° to 20°.

Parameters	Value
Inlet Diameter	190 mm
Length of Diffuser	50 mm
Length of Flange	20 mm
Inlet Velocity of air	4 m/s
Density of air	1.225 kg/m3

Power generation by turbine

- Area (swept area) = π/4 ⟦rotor diameter⟧^{2}
- Velocity (V_0) = velocity before augmentation
- Velocity (V_1) = average velocity after diffuser
- Power Output (P)
  = 1/2 density×Area×Velocity^2
- Coefficient of Power (Cp)
  = (power with diffuser)/ (power with open rotor)

  $= \left(\frac{V_1}{V_0}\right)^3$

Table: Post processing solution details

S.N.	Parameters	Selection
1.	Setup Model	Viscous SST (k-**ω** 2 equations)
2.	Number of iterations	1000
3.	Initialization Method	Standard Initialization
4.	Turbulent Kinetic Energy (m2/s2)	0.06
5.	Solution Method	Gradient (least squares cell based)
6.	Specific Dissipation rate (1/s)	410.7522

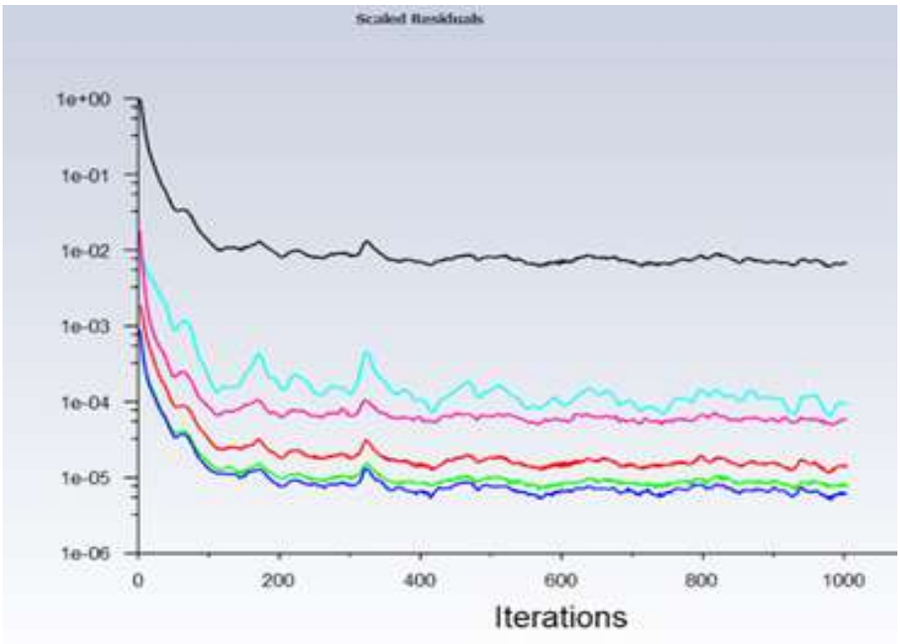


Figure: Convergence Plot

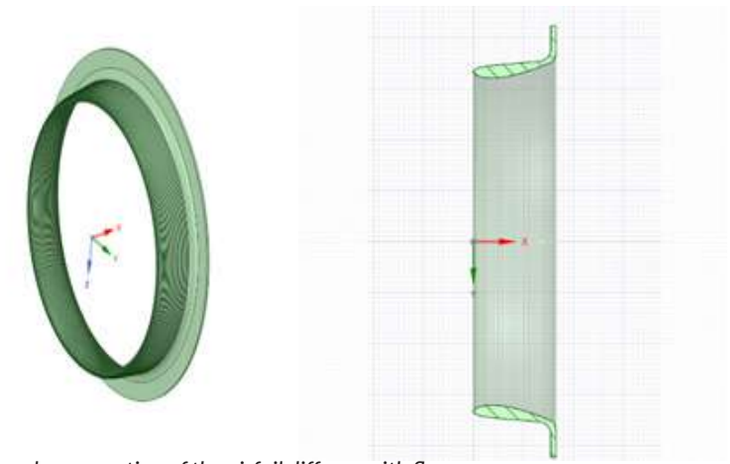


Figure: 3D model and cross section of the airfoil diffuser with flanges

Result analysis

Table: Summary of Airfoil diffuser with flange

Parameters	At β=0°	At β=5°	At β=10°	At β=15°	At β=20°
Angle of Attack (α)	8	8	8	8	8
Diffuser Length (L), mm	50	50	50	50	50
Flange Angle (β)	0	5	10	15	20
Flange Height (h)	20	20	20	20	20
Inlet Velocity (Vo), (m/s)	4	4	4	4	4
Maximum Velocity (Vmax)	8.719	8.330	8.735	8.627	8.179
Average Velocity	5.70	5.75	6.025	5.55	5.50
Coefficient of Power (Cp)	2.8936	2.9705	3.4174	2.6712	2.5996
% Change in velocity	42.5	43.75	50.50	38.75	37.50

Table: Optimization of flange angle

Parameters	At β =8°	At β = 9°	At β=10°	At β=11°	Atβ =12°
Angle of Attack (α)	8	8	8	8	8
Diffuser Length (L), mm	50	50	50	50	50
Flange Angle (β)	0	5	10	15	20
Flange Height (h)	20	20	20	20	20
Inlet Velocity (Vo)	4	4	4	4	4
Maximum Velocity (Vmax)	9.339	9.708	9.431	8.686	8.965
Average Velocity	5.825	5.875	6.025	5.875	5.775
Coefficient of Power (Cp)	3.0882	3.1684	3.4174	3.1684	3.0094
% Change in velocity	45.6	46.8	50.5	46.8	44.3

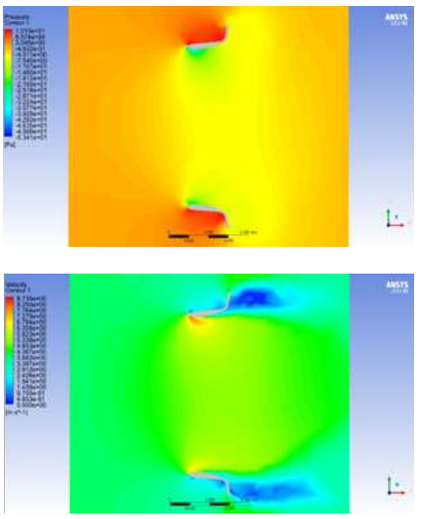


Figure: Pressure and velocity contour for airfoil diffuser with flange at β = 10°

Conclusion

Different shapes of diffuser were designed and analyzed to calculate the velocity of airflow inside the diffuser. RANS (Reynolds Averaged Navier Stokes) equation was used with turbulence Viscous model of k-w (2 equation) was used to analyze in ANSYS FLUENT.

Geometry was modeled in Solidworks and Spaceclaim. Different shapes of diffuser such as normal, airfoil and airfoil with flanges were studied. The free stream velocity of wind was 4 m/s for our analysis. For normal diffuser optimum flange angle was found to be 4° for 15° AOA. Airfoil diffuser was also analyzed as it increases the velocity close to the diffuser which is good for rotor blades as they rotate faster at tips. Flange angle was varied from 0° to 20°. The optimum was found to be 10° flange angle at 8° AOA, where average velocity was 6.025 m/s and corresponding coefficient of power was found to be 3.4174.
The power augmentation increased significantly. Incorporating a diffuser in a wind turbine would improve the performance of wind turbine. It allows the rotor blade to be small to produce the same power that a larger rotor could produce, thus easing the transportation of rotor blades in the country like Nepal where topography is uneven.

Recommendations

1. We performed simulation of diffusers only, simulation and optimization along with rotor blade in wind turbine can be done.
2. Only computational analysis was done, a physical prototype can be simulated in wind tunnel testing to verify the CFD results.
3. Experiments can be done considering mechanical and hydraulic losses.
4. Analysis of force exerted by air on diffuser and structure can be done to improve structural strength.

REFERENCES

[1] Al-Bahadly, I.H., & Petersen, A. (2011). A Ducted Horizontal Wind Turbine for Efficient Generation.

[2] Chaudhari, C.D., Waghmare, S.A., & Kotwal, A. (2013). Numerical Analysis of Venturi Ducted Horizontal Axis Wind Turbine for Efficient Power Generation.

[3] Masukume, P., Makaka, G., & Tinarwo, D. (2014). Technoeconomic Analysis of Ducted Wind Turbines and Their Slow Acceptance on the Market.

[4] McLaren-Gow, S., Jamieson, P., & Graham, J.M. (2014). An inviscid approach to ducted turbine analysis.

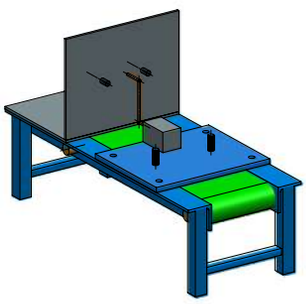
[5] Bagheri-Sadeghi, N., Helenbrook, B.T., & Visser, K.D. (2017). Ducted wind turbine optimization and sensitivity to rotor position.

[6] S, S., Gaonkar, A.A., & R, J. (2020). Design and Analysis of Diffuser Casings for Diffuser Augmented Wind Turbines. 2020 4th International Conference on Green Energy and Applications (ICGEA), 28-31.

[7] Lokesharun, D., Rameshkumar, S., Navaneeth, B.S., & Kirubakaran, R. (2019). Design and Analysis of Diffuser Augmented Wind Turbine using CFD.

Projects Retrospective 2021

By 2074 Batch

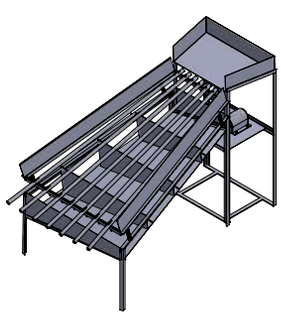


1. Cotton Wick Making Machine

The project titled "Design, Fabrication of Cotton Wick Making Machine" is a final year project by Badri Pandey, Balkrishna Kharal, Bikram Panthee and Sabina Poudel. The project was designed with the aim of replicating the manual method (hand movement) of making cotton wick (batti) which surpasses its existing prototype in terms of efficiency, flexibility and cost. The manual method of making batti is not just time consuming but also causes neck pain and shoulder pain in workers. Thus, the project solves these problems and makes batti in an efficient and effective way. The machine was designed by incorporating mechanisms such as thread turning, thread twisting, clamping, cutting and a conveyor system using different motors (stepper, servo). The core logic for performing those mechanisms was provided by programmed Arduino. After successful fabrication of the project, about 12 wicks per minute were made.

2. Fruit and Vegetable Grading Machine

Mechanical graders grade fruit and vegetables mostly based on size. The project entitled "Design and fabrication of fruit and vegetable grading machines" is a final year project by Anjana Chaulagain, Bikash Neupane, Bishwa Bandhu Rokka, and Shreya Shrestha. In the present scenario, grading is done by human eye judgment. This kind of grading is costly and grading operations are affected due to a shortage of labor in peak seasons. Likewise, commercial fruits and vegetable graders are expensive and beyond the reach of ordinary farmers having small landholding. Hence, the team felt the need for an efficient small capacity mechanical grader at the farm level. The project aims at the development and testing of an adjustable grader. It focuses on grading spherical fruits and vegetables. Adjustability allows the same machine to grade various sizes of inputs. The prototype is based on the divergence rod principle. This divergence allows the escape of spherical inputs from gaps of rods at different distances from input according to their sizes. Along with this, the vibration to this system is given that provides enough flux required for efficient separation. A subgroup size of three including random samples of orange, sweet orange, and onion was taken. Simultaneous tests were done and the polar diameter of samples was measured. The grading capacity of this machine was found to be 225kg/hour for fruits and vegetables.

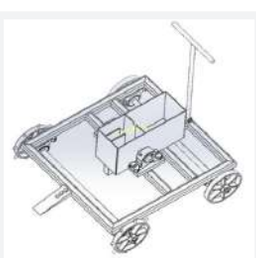




3. Flywheel Kinetic Energy Recovery System

Kinetic Energy Recovery System (KERS) is a system for recovering the moving vehicle's kinetic energy under braking and also converting the usual loss in kinetic energy into gain. Design, Fabrication, and Testing of Flywheel Kinetic Energy Recovery System is a final year project by Prabhat Bhandari , Shambhu Marasini, Sujan Poudel, and Suraj Bhandari. The team aims development and testing of the recovery system installed on a bicycle. In a vehicle, braking is one of the most energy wasteful activities. The system will help to recover the energy lost from braking. The lost energy is in the form of heat by friction. The team uses a flywheel to store the supposedly lost energy. The rotating flywheel is connected to the rear wheel. It gives an extra boost to the bicycle during startup. To facilitate the engagement and disengagement of the flywheel, a chain drive and a clutch-cam mechanism are used. In our country especially, with so many traffic jams and public vehicles, the team believes this will be useful. This system is then likely to reduce emissions by increasing the efficiency of the vehicle. This could reduce the cumulative impact of vehicles on the environment until the time when vehicles using an alternative source of energy are abundant and within reach for the majority of the people in the world.

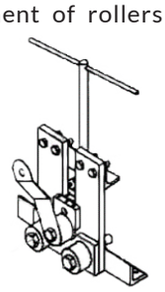
4. Semi-automatic Seed Sowing Machine



A seed sowing machine is a machine that allows the sowing of seeds in the soil at desired depth and spacing. The project titled "Design, fabrication of semi-automatic seed sowing machine" is a final year project by Abhishek Thapa, Pushpa Jha, Rijana Shrestha, and Srijana Rai. Till now, sowing is done with the help of a tractor and manually. The process led to the wastage of seeds. The spacings too are in random order. Also, depths and spacing requirements are different for different varieties of seeds. Available machines in the market do not provide flexibility on those factors. The project aims to develop and test a seed sowing machine that places the seed in proper alignment and distance from each other with appropriate soil compaction. Assembly of the machine consists of mounting the seed hopper on the frame and chassis mounted on the wheel by using nut, bolt, and by welding. The DC motor is connected to the shaft which is powered by a 12V battery that rotates the wooden groove which picks up the seed.

5. Metal Bending Machine

The project "Design, Fabrication, and Testing of metal bending machine" has been planned having studied the difficulties in bending metal encountered during the project visits to smaller workshops of Kathmandu valley. It is a project by Bibek Neupane, Dhiraj Poudel, Dipesh Basnet , and Gaurav Thapa. Metal bending machine is a mechanical device used to bend the metal in a circular shape as per the required dimension. It requires less effort, less time, and a high degree of precision and accuracy than bending it with a hammer and hand. The metal bending machine available in the market is specially designed for bending larger metal. Thus, the prototype can be enhanced to be used in small-scale operations which minimizes cost and is affordable for small-scale users. The project-made machine facilitates the bending of a metal strip of thickness less than 3mm accurately with ease. It uses 3 rollers in a triangular form; two sets of rollers below and one above the mid-plane. The upper roller provides the bending force while the lower roller provides the required driving force, and the front-end roller bends the metal according to the set radius of the bend. After testing, it was concluded that the maximum thickness of the strip that the bending machine can bend is 2mm. The time taken to bend a strip is nearly about 1 and a half minutes. The maximum diameter formed obtained through a bending machine by bending strip is 150mm. The minimum diameter formed was 75mm. Sometimes, the curvature obtained was not symmetric due to misalignment of rollers and operator error.



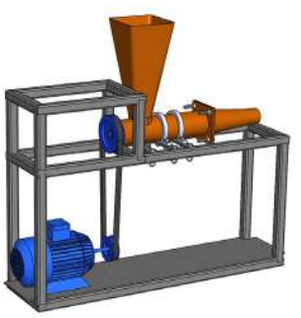


6. Dung Pot Making Machine

The project titled "Design, Fabrication, and Testing of Dung pot Making Machine" is a final year project prepared by Amrit Dhungana, Bisham Bagale, Dibash Pandey, Krishna Gupta, and Nawa Raj Rauniyar.The use of plastic pots and plastic grow bags in nurseries are harmful to both plant and the environment. This problem can be addressed through the replacement of those plastics with dung pots. Pots made of dung, namely dung pots, also would provide nutrition to the plants grown in them. Thus, the project aims to design, fabricate, and test a machine that is capable of producing an eco-friendly pot consisting of dung, clay, and wood dust that surpasses its existing prototypes in terms of efficiency, flexibility, and cost. The design of the prototype is fully based on the molding mechanism. The input power will be supplied by hand which will be connected to a lever which is again connected to the mold key. The power input will result in compression of material thus forming the die-shaped pot. The raw material will be fed manually. Once the lever is released, it returns to its original position (pulled by counterweight).

7. Biomass Briquetting Machine

Briquetting is the process of densification of biomass to produce homogeneous, uniform-sized solid pieces of high bulk density which can be conveniently used as a fuel. A Project Report on "DESIGN, FABRICATION, and TESTING OF BIOMASS BRIQUETTING MACHINE" is prepared by Prakash Upadhyaya, Pranav Acharya, Prashant Thapa, Shishir Gyawali and Yogesh Kant Paudel. Nepal produces abundant biomass wastage. The biomasses being loose, their handling, transportation, and storage are very difficult. Also, while burned, these loose materials will have very low combustion efficiency. So, there is a need to densify these materials so that high calorific value could be obtained and used as fuel and manual machines for briquetting are very time-consuming and laborious. Incorporating the needs, the objective of the project is to design & fabricate an automatic briquetting machine that can be easily afforded by consumers. With the use of a belt drive mechanism, a motor of 1 HP, and a screw press having a pitch of 27 mm and a diameter of 70 mm the team became able to produce a briquette of desired quality. Transported material flux through the screw is 139 kg/h from which the team assumed the production of briquette to be 7 kg/h. This prototype helped to control indoor air quality and increase combustion efficiency by producing briquettes of desired quality.While testing with different raw materials the briquette quality obtained was varying. Tests were done with sawdust and rice husk. For rice husk, the machine is working perfectly and for sawdust, an additional heating mechanism is required as sawdust is highly resistive.



8. Hospital Bed



Hospital beds are designed beds for medical purposes. It is one of the most important medical equipment in hospitals, dispensaries, and rehabilitation centers. Patients, who may have in-patient or ambulatory treatment are the main users of the hospital beds. The project titled "Design, Fabrication, and Testing of hospital bed" is a final year project of the team consisting of Ashesh Parajuli, Dibakar Kafle, and Nabin Ghale. This study and project focus on two aspects: maintaining the comfort and easy transferring of the patient from one bed to another. The main objective of this project is to design, fabricate, and test a hospital bed. After the fabrication, the bed has got the dampers that absorb the vibration as well as shock providing comfort to the patient. It also provides 0 to 35 degrees angle of lift with reference to the horizontal frame. With this, a patient can feel more relaxed while traveling in the ambulance to the hospital. Lift can be done with the help of a screw thread mechanism. There is a stretcher fitted with the bed and contains the green cloth. With the help of the stretcher and cloth, a patient can be transferred from one bed to another.

"Please come here with a dream, and we will assist you in tracing your path and lighting the path to your destination."

Er. Bishworam Parajuli

Head Of Department
Department of Industrial Engineering
Thapathali Campus, IOE, TU



INTERVIEW

You've been working with the industrial engineering department since the beginning. You've seen the industrial department from the ground up as a student, teacher, and HOD. What issues did you encounter, and what expectations did you have for the department during your transition from student to teacher? And now that you've been appointed as the HOD, how do you intend to deal with these issues?

First and foremost, I'd like to thank the SOIES team and the magazine publication committee for giving me the opportunity to share my thoughts here. Yes, I have had the opportunity to experience the department of industrial engineering from its inception in various roles, and I have witnessed many ups and downs in the department's journey. Starting a new course is obviously difficult, and it was both a challenge and a source of pride for the Thapathali campus. The department faced a lack of infrastructure and faculty members in its early stages. When I was a student in the department, my expectations for the department included regular classes, some professional development, and field exposure to allow students to get experience in a real-world work setting. And now, as a teacher and department head, my emphasis is on regular classes and more field exposure for students to practice real fieldwork.

What is the history of the industrial engineering program? The anticipated future direction of the program?

The history of the industrial engineering program in our country began in our department. We started an industrial engineering program at the Thapathali Campus in 2005 A.D., but there were few industrial engineers in Nepal before we started our program who had studied abroad. The program's future direction is to develop sufficient and qualified manpower for Nepal's industrial development, as well as to contribute to the proper utilization of raw materials available in Nepal and to add value to the resources.

What do you think are the most important functions in a Head of Department role? How would you prioritize them?

The most important role of the department head is to properly manage the department's various activities and to properly utilize the department's resources for the betterment of the course.
Aside from managing the department's regular activities, my current priority is to manage on-the-job training (OJT) by signing MOUs with industries and creating an appropriate platform for sharing experiences from our alumni with the department's students.

What makes this industrial engineering program appealing to students?

In addition to course knowledge, students in the program have the opportunity to practice their knowledge, develop skills, and gain professional experience during the course period.

How are you planning to bridge the knowledge and skill sets gained at the academy and required in the industry?

Through our On the Job Training program, it may be possible to create a bridge. However, it can be effectively bridged by establishing a human resource development center with the collaboration of industries and the department

How is the Industrial Department planning to create an environment for R&D and establish a connection with industrial engineering programs of foreign universities?

For now, we are planning to involve our alumni who are studying abroad in our academic program through project work, seminar papers, and a guest lecture on various topics. Similarly, we are also planning for a collaborative program with foreign universities.

Describe a time something didn't go as planned. What did you learn, and how would you address it next time?

Time does not always go according to plan, so plan accordingly. Proper analysis of the environment and proper evaluation of resources makes our plan successful. Prepare for the worst-case scenario as well, so that failure in the work does not lead to frustration, but rather provides you with experience and knowledge that will serve you well in the future in the next task.

Few words to the upcoming students.

Please come here with a dream, and we will assist you in tracing your path and lighting the path to your destination.

8.0

IE SPOTLIGHT

Academics



Bishworam Parajuli
Head Of Department
Industrial Engineering
Thapathali Campus, IOE
bishwo.parajuli@ioe.edu.np

Sushant Raj Giri
Deputy Head of Department
Industrial Engineering
Thapathali Campus, IOE
sushantgiri@ioe.edu.np





Sudan Neupane
Deputy Chief
Examination Control Division
IOE, TU
neupanesudan@ioe.edu.np

Krishna Prasad Pandey
Lecturer
Dept. of Industrial Engineering
Thapathali Campus, IOE
krishnapndey@tcioe.edu.np





Ankit Shrestha
Lecturer
Dept. of Industrial Engineering
Thapathali Campus, IOE
anqitccg@gmail.com

Rajan Sharma
Lecturer
Dept. of Industrial Engineering
Thapathali Campus, IOE
rajan31sharma@gmail.com



In Industry



Spandan Mishra (PhD)
Principle Data Scientist
Palo Alto Network, USA
smishra28@outlook.com

Sabin Silwal
Upstream Planning Manager
Schneider Electric, Germany
silwalsabin@gmail.com





Samir Bhetwal
Operations Research Scientist
FedEx Ground, U.S.A
bhetwalsamir@gmail.com

Prakash JamarKattel
Supply Chain Modeler,
Consultant, and Statistician
Quetica, LLC, U.S.A
p.jamarkattel@gmail.com





Yushef Shrestha
Business Intelligence Analyst
NCELL Axiata Ltd.
yushefshrestha@gmail.com



Shekhar Ghimire
Sr. Business Analyst
Hitachi Energy
shekhar.ghimire@hitachienergy.com



Suyog Jha
Sr. Software Engineer
Lis Nepal Pvt. Ltd.
suyog.k.jha@gmail.com



Bishnu Parajuli
Head of Strategy and Planning
Daraz Nepal | Alibaba Group
bishnu.parajuli@daraz.com.np

Government Sector



Tapendra Chand
Consultant
Investment Board Nepal
tapendra.chand@ibn.gov.np



Rajan Panthi
Inspector
Ministry of Education, Science and Technology
rajanpanthi98@gmail.com



Geeta Basyal
Mechanical Engineer
Ministry of Education, Science and Technology
gta5711@gmail.com



Shuveksha Sapkota
Mechanical Engineer
Department of Mines & Geology
(Ministry of Industry, Commerce and Supply)
suvu2071@gmail.com



Sudin Bhuju Shrestha
Mechanical Engineer
Department of Customs,
Ministry of Finance
sudien.21@gmail.com



Bishal Jirel
Metrologist
Nepal Bureau of Standards and Metrology
elitebishal@gmail.com



Prashant Bhattarai
Assistance Manager,
Industrial Engineer
Nepal Oil Corporation
er.prashant49@gmail.com



Sulav Shrestha
Factory Inspector
Labour and Employment Office
Teku, Kathmandu
sulavshrestha015@gmail.com

They are the pioneers unlocking the gateway to the vast realms of industrial engineering, guiding and inspiring us on our journey throughout and beyond.

Essential Lean

How wasteful is your office?

The Seven Wastes



Defects/Rework
Inputting the same data into two places or missing information off a form

Overproduction
Producing too much, such as multiple versions of the same document

Waiting
Waiting for a meeting to start, a computer to start up or for customer information you need

Transport
Walking to meetings or travelling around the building to collect goods or meet with others

Over-processing
Printing out documents you could read on screen or sending reports to people that never get looked at

Inventory
Holding too much stock, such as stationary or equipment that is never used or out of date brochures

Motion
Getting up to go to the printer, look for files or heading to another area to complete a task

The Eighth Waste

Employee talent
Spending time on menial tasks that can be outsourced, or failing to appreciate how their skills could be best utilised

The Eighth Waste

100% Effective

The Seven Wastes are an essential tool when it comes to implementing Lean in your organisation. They form part of an essential Lean toolkit. For more information about Lean tools and how they can help you, visit 100pceffectivetraining.com/lean

100PCEFFECTIVE.COM
PIKTOCHART.COM



Public Enterprises

- Er. Amar Upreti

INTRODUCTION

Public Enterprises were established on the considerations of the country, the success of the project, and people's participation in the process. Public Enterprises are considered a driver of development and grants. Between the periods of 1950s and 70s, such an idea towards Public Enterprises became successful in most of the world whether it's developed or less developed nations. Nepal adopted this idea into implementation in its industrial policy of 1957 AD.

The main motto of public enterprise in Nepal is to produce daily needs and social needs service to any or all the citizens at a low cost and simply the maximum amount as possible. The goals are to make employment at the local level, build up the body for social and cultural development, and a self-reliant economy. It helps to extend the assembly of local goods and increase the sustainable ecosystem. The government of Nepal is focusing on the establishment and management of public enterprise service, industrial revolutions, global trade, and so on. The most important role of the state to extend public enterprise and state owned business started from the first five-year periodic plan and establishment of Biratnagar Jute Mill in 1993BS. The general public enterprise gained a huge advantage and their number increased rapidly and reached up to 62 by the end of the seventh five-year periodic plan (2042-2047BS).

Currently, there are 31 public enterprises fully owned by the government among them 21 public enterprises are owned by the government with major capital investment. Among all the general public enterprises, 10 are industrial sector, 10 service sector, 5 social sector, and 5 utility and 9 financial institutes. In step with the Ministry of Finance, only 33 public enterprises are in operation and 5 public enterprises don't seem to be in operation as of 2077 (Ministry of Finance, 2020). As of 2077, 30 corporations are transferring to the non-public entity after the government follows the liberalized free enterprise.

> ***"To adopt a disinvestment policy to release resources locked in those public Enterprises where the government's involvement is deemed now not necessary and/or its presence renders them uncompetitive."***

The financial activities of those public enterprises are questionable as many of those public enterprises are in negative records and negative income. Also, 26 public corporations are in profit and 5 public enterprises have zero turnovers. Also, these public enterprise's expenses increased by 306.58 percent in 2020 in step with the previous minister of finance Yubaraj Katiwada.

From loss to the highest profit-making public enterprise, Nepal electricity Authority earned about 9.1 billion in the fiscal year 2075/076. This clearly shows how public enterprises can concentrate on the tiny administrative change and their result and their activities to market the local development.

The industrial policy of 1957 AD recognized the responsibility of the government in "promoting, assisting and regulating" industrial revolutions and development within the border of the country and promoting local goods and development. The first Plan targets to work on the removal of monopolies within the business and service sector to promote effective market and market share among all stakeholders. The major monopolies markets were transportation and telecommunications and other mineral-based industries like textiles, iron, and steel production are out of our context, and hydropower generation is the country's major responsibility.

As Public Enterprises are owned by the government or major shareholders in government, they often follow the policy of the government as their tools to reach a higher market. Public enterprise in Nepal is established with the different acts of government or special acts to increase national productivity and socio-economic goals set by the ministry of finance. Some government-owned businesses are established solely for the fulfillment of political goals.

Not all state's public organizations indeed have economic value but they follow other goals like social justice and social-economic empowerment. These public enterprises set new goals for the community and communicable justice and these organizations are often funded by donor agencies like US Aid, China, JICA, and so on.

The debate about whether the government or the market should lead the process of economic empowerment has occurred in several phases in Nepal. Government-owned enterprises (or public enterprises) prove their worth within the seventies and eighties by citing 'the infancy state of the private sector' argument. However, a poor



Er. Amar Upreti
MBA, York St. John University
amarupreti119@gmail.com

review of these enterprises distributed within the Fifth Five Year Plan period (1975-80) presented a question.

The growth of the operating income of these public enterprises, dividends provided to the government, and the tax paid by these enterprises show that they are reformative work in the past few years, and their overall financial position has been positive in the last fiscal year 2075/76. The major role of public enterprise is to provide the government with basic pieces of information about the GDP and provide essential products in the GDP. The average GDP contribution of public enterprise in the national GDP is 12.5 percent and the average contribution of the business sector public enterprise is 6.5 percent (Anon., 2021).

The share of income tax received from public enterprise is increasing in the last five years from 2.36 percent in 2070 to 9.04 percent in 2077. The financial sector is the highest contributor to income tax and the industrial sector is the lowest in the public enterprises (Anon., 2021).

The question of whether these public-owned industries are capable of running smoothly without causing the state burden or they can uplift the market and social life of the people is a major issue in Nepal.

1.1 Analysis of Overall Performance

Public enterprise is established to provide essential goods and services to the people but their failure to provide these services raise many questions about their performance. As of 2020, 26 of our public enterprises are in profit but the dividend provided to the government by these public enterprises is in the form of loss. When the profit of these enterprises increased by 17 percent in the current fiscal year, the loss of non-profit public enterprises increased by 306.58 percent. The main profit-making public enterprises are Nepal Electricity Authority and Nepal Telecom along with Nepal Oil Corporation, Rastriya Banijya Bank, and Nepal Civil Aviation Authority.

Also, the service-providing sector of public enterprise is at a huge loss along with the industrial sector due to a lack of proper management and the system. According to the Ministry of Finance, Nepal airlines was at a huge loss in the fiscal year 2075/76. Here are a few public enterprises that have a very huge loss in the fiscal year 2075/76. These enterprises are mainly focused on the service sector like Nepal Television and Nepal Drinking Water Corporation.

Table 1: Top 5 profit-making Public enterprises (Source: MOF)

S.N	Public Enterprise	Profit Amount (Rs.)
1	Nepal Electricity Authority	9.81 billion
2	Nepal Telecom	9.76 billion
3	Nepal Oil Corporations	8.75 billion
4	Rastirya Banijya Bank	5.04 billion
5	Nepal Civil Aviation Authority	4.31 Billion

Table 2: Top 5 losing Public Enterprise (Source: MOF)

S.N	Public enterprises	Loss Amount
1	Nepal Airlines Corporations	1.97 billion
2	Udaypur Cement factory	196.3 Million
3	Nepal Television	126.20 Million
4	Nepal Drinking Water Corporations	125.50 Million
5	Nepal Orient Magnesite	108 Million

The welfare objective of the Nepalese Public enterprise is based on its performance and its working mechanism. Due to heavy losses in industrial sector public enterprise, the government must focus on the welfare of these enterprises. If this public enterprise fails to operate, it could be a huge problem in developing countries like Nepal as these industries are based on the taxpayer and their taxes.

CHALLENGES/PROBLEMS

The public enterprises are failing to compete in the market and their performance is weak which is due to the lack of an economic plan, lack of autonomy of the public enterprises, poor accounting method, and accountability, poor performance from the managerial level, lack of technical manpower and overstaffing of the unskilled manpower, dependency of the enterprises towards government and their policy, lack of uniform framework, corruptions, misutilizations of available resources and manpower and negligence of the staff towards public enterprises and management. These cause a major economic burden on the government. The major reason for the poor performance is the political intrusion on the management and appointment of managerial positions based on political biases rather than competitive analysis. This causes a major problem in the service and ongoing projects of the public enterprises. The sad reality is that major problems related to public enterprises have not been answered as they are structural and institutional problems. The basic problem faced by the public enterprise is maintaining the balance between the profit-oriented business and service-oriented business which is a major task for these public enterprises. We are now focusing on the basic problems faced by these industries which can be solved with a few system changes and basic bureaucratic manpower to increase the efficiency of these public enterprises. The welfare program conducted by these public enterprises is also accountable for the great service by this sector and their accountability must be taken into account. We must take two sides of these industries to measure their performance and their management. However, we must focus on the question, is public enterprise a burden to the taxpayer? Can public enterprises compete in the competitive market where private organizations are seeking profit? and how can these public enterprises focus on the major issue of privatization and the competitive market with commercial and social activities at the same time?

2.1 The balance between autonomy and accountability

The major challenge in the operations is due to the political intrusion inside and outside the public enterprise operations sector. Political intrusion is usually seen while investment decision-making and appointment in managerial positions. The financial return of the project, recruitment, and service of these sector-major affected by this intrusion. The Asian Development Bank, Department of International Development from UK aid, and International Labor organization cited in their paper about Nepal's Critical development constraints, "Public Enterprises are instruments of political patronage for rewarding political supporters and for providing employment. These practices have undermined the standard of management and accountability of the public enterprises and saddled them with huge labor costs and

low productivity." Autonomy will increase the productivity of these enterprises if we can combine them with accountability. Being a public enterprise and government having the authoritative power, the final decision of these organizations depends upon the government. But if these public enterprises become accountable and autonomous for the investment decision and the service enhancement this will affect the performance as they don't need to rely on the long procedure for any decisions. During the privatization of these organizations or holding investment, autonomy will help but this could lead to problems as the government and their bureaucratic structure need to finalize the decision about their performance. Overall, due to the structure of the public enterprise, it becomes the ground for political performance and it is held responsible for the autonomy of these organizations and accountability of these organizations.

2.2 The balance between commercial and bureaucratic orientation

Since the financial constraint of public enterprise is to use government-funded means this account is largely responsible for the taxpayers and their taxes. Since not all public enterprises are set for financial constraints, the social public enterprises must ensure the social outcomes of the investment. The legal constraints and legal analysis of the project that public enterprises invest in must be loyal to the public and open-source data which is mainly lacking in Nepal. The fundamental commercial market for these projects is failing due to the failure of the system and analysis. The data show that more than 100 million worth of properties from public enterprises have been damaged in the last 10 fiscal years according to the ministry of finance in their report about the conditions of public enterprise 2020. Public enterprise is an instrument for the political means to reward political parties and their supporters in Nepal due to which the commercial outcomes of these projects seem very lacking in Nepal. The bureaucratic problems always remain the major issue in the public enterprise as many enterprises fall under the different acts and different ministries and these enterprises need to answer to different ministries about their project and their financial outcomes. The bureaucratic culture damages the productivity of the public enterprise as well as the political appointment due to this culture remains a major issue for the project.

2.3 Overall incentive structure

Although an incentive system is not possible under the bureaucratic structure of public enterprises, it plays a vital role in the failure of public enterprises. Due to political interest in the public enterprise, every decision by public enterprises is taken under their influence. In the context of Nepal, the incentive structure of these enterprises is maximum as the unskilled manpower of these organizations is often the part of governing bodies. No matter the performance of the public enterprise, they are getting funds from the governing authority but we need to understand that continuous financing of these organizations is not going to increase the profitability and financial constraints within the enterprises. The incentive structure of enterprises makes it possible for poor management of resources available and creates huge employment for the political appointee and their followers. Alan Water mentions that "Economic theory is quite explicit and clear that thanks to the character of ownership and hence incentive, a state entity cannot be as efficient as a private entity within the production of identical output." This mentions that lack of skilled manpower and continuous funding is a major problem inside public enterprises no matter their financial performance and their overall commercial outcomes.

2.4 Institutional Challenges

Due to the lack of a uniform system to form any public enterprise, there are many legal formations and many special acts which govern the public enterprise. Among the 44 public enterprises which are currently in Nepal, 33 of them were formed by the company act and 7 by the special act of government and 2 public enterprises were established by the communications act, and 1 public enterprise responsible for cooperating and corporations act each (Ministry of Finance, 2020). Due to this, these companies need to answer to different ministries and different acts which cause a major issue for the public enterprise. There are many issues about public enterprise as this public enterprise doesn't answer to the Ministry of Finance, so there is a clear issue with the public manner. According to the Ministry of Finance, there is a lack of clear policy and a lack of an exact mechanism to evaluate the financial performance of the public enterprise. The ministry of finance is mainly responsible for observing and evaluating the financial issue of public enterprises but due to the lack of a proper system and proper management, the economic performance of the organizations is lacking. Also, due to employment issues and service issues for the public enterprise, their performance is lacking. With the improper management and lack of uniform institutional framework for the public enterprise and their formations, there is a lack in their economic performance. The Public enterprise doesn't fall into the priority functions of the ministry of finance and since there is an economic burden in the ministry of finance they are not being able to pay due to a lack of administrative and evaluation framework.

RECOMMENDATIONS

The report by the Asian development bank (ADB) suggests that the success of the public enterprise depends upon the infusion of public enterprise with the discipline of the private sector and competitive market analysis. The report suggests that public enterprises can focus on a competitive market and their productiveness which increase their commercial value and norms. If the ownership of public enterprise remains under the public domain, the increment system is effective and their commercial performance can be dull but if they follow the infused method of operations their operations can be optimized and effective inside the market. Although the privatization of public enterprise is not suggested, their commercial domain must be increased to increase the financial burden for the taxpayer and their money. The main concern about the privatization of the public enterprise has many questions about ownership and benefits of the enterprise which could be solved by a public-private partnership to improve the effectiveness of the system.

3.1 Autonomy of Public Enterprises

The eleventh five-year plan of the government, given the dismal performance of public enterprises, had addressed the fact that now it is time "to adopt a disinvestment policy to release resources locked in those public Enterprises where the government's involvement is deemed now not necessary and/or its presence renders them uncompetitive." The analysis of five out of six sectors namely, Industry, Service, Public-Service Corporation, Social, and Trading, demonstrates that resources are indeed locked in public enterprises.

Government own industries inside the industrial societies and trading sector are not effective as that as a private entity. So we can suggest the implementation of the government plan to create a public-private

partnership or transfer of ownership towards private forms. This needs to be done on a priority basis where government owned enterprises are facing lots of issues, as many of them are in a negative cash balance, hence privatizations of those industries will increase their efficiency and economic constraints. The autonomous public enterprise would control its monitoring and evaluations of its financial and economic strain which increases its efficiency. As these industries are facing problems due to the lack of a uniform system of governing authorities, an increase in autonomy for enterprises will help them to increase their mechanism and judicial power to increase their competitive value.

3.2 Commercial Orientation: Competition and hard budget constraints

The success of public enterprises depends upon their modal economic activities and how their economic plan works out. The public enterprises working for the government and their decision-making ideas play a major role in the competitive market. This includes the competition of public enterprises with private organizations and how their budget will help uplift the overall incentive organizations. It includes the bureaucratic system of the public enterprises and how their commercial entity works for the budget constraints. The budget of these public enterprises is hard and followed by the taxpayer money so these organizations focus mainly on profitability and economic sustainability. The government must address the issue and provide decision-making authority to the public enterprise where there is large competition with private organizations like cigarettes, cement and other products as the decision-making for commercial outcomes is a major delay in public enterprises. The delay of these decisions comes at a vulnerable price tag and this will slow down the functioning of the public enterprises.

3.3 Alternative policy for social welfare

One of the major problems behind the poor performances of the public enterprises is that it is hard to manage between dual functions of the public enterprises that are commercial and non-commercial goals. But there is a major issue with this as many policies of the public enterprises fail within their boundaries. The case study of AICL shows that it provides huge benefits to the farmer in the name of agricultural goods and services but despite this AICL is not productive and its mechanism fails. So despite providing subsidies through AICL, if we provide direct benefits to the farmer, its non-commercial benefits can be achieved. Currently the private market can not compete with subsidized organizations but it is not a sustainable system. So this method needs to be updated and commercial benefits need to focus on the alternative policy for the sustainable welfare of these organizations. We can take the example of Fiji as their private companies provided both subsidized shipping and transport services through the central contract of the government which allowed the government to reduce the allowances over time and increase the mass of civilians. So non-commercial goals of these enterprises should be maximized through alternative methods of working and alternative policies so that the subsidy can be reduced for the organizations.

3.4 Umbrella Organization

As we already discussed, there is no uniform method for the formation of public enterprises, there are lots of issues with the method. Many public enterprises fall under several ministries and several acts of the government, which create an enormous bureaucracy and bureaucratic problems. This is the time for the government to create a uniform mechanism for the umbrella organizations which will run the public enterprises. This umbrella organization will run the public enterprises and create the solutions-making mechanisms for the organizations. These institutions need to be autonomous and free from political intrusions and appointments which helps to increase productivity. Since the Ministry of Finance is already facing major problems with financial constraints of the public enterprise and their financial problems. The major issue with public enterprises is the lack of policy reform initiatives, unmanaged hiring of human resources, and lack of resolving the negotiations and labor issues within the organization. So we need to create a global framework for the organizations which will help public enterprises to increase their productivity and financial constraints. The public enterprises directive board that has been given the responsibility of operating public enterprises with coordination and promoting competition and professionalism has been a positive initiation of the government that must be strengthened and will be developed because the potential of umbrella organizations can bring positive aspects to the public enterprises.

3.5 Classifications of Public enterprises

When public enterprises were established, the private sector was underdeveloped and some sectors were free from competition. The main motto of the government behind this was to provide ease of service and goods to its citizens and also create a huge employment market. It was justified until the competitive market was established and the private sector started to invest heavily in these sectors. Today, the private sector is developed and they are creating huge employment opportunities as more than 80 percent of employment in Nepal is due to the private sector and self-employed. Although some essential services like electricity production distributions and management fall under the public enterprise Nepal electricity Authority, most of the other public enterprises face a competitive market. The government must classify the public enterprise within the product and service sector along with their importance to create a balance between the market and demand for these services. The major responsibility of the government is to ensure an efficient marketplace which needs the presence of public enterprises. Important products like cement, cigarettes, and services like air transportation are effectively provided by the private entities while the government-owned public enterprise is failing, so government must think about the reform of these organizations and their operation.

CONCLUSION

Public enterprise is a key to implementing government policy and strategic outcomes inside the public easily and effectively. But, due to the lack of proper management and political intrusion in the working mechanism of the public enterprise, many questions have been raised about their effectiveness and mechanism. Although many people and researchers cited the privatizations of public enterprises as solutions to their effective working, it needs to rethink as of now. However, there are many steps required to complete the privatizations of the public enterprises as there are lots of issues with ownership of the organizations and unilateral working mechanisms. These organizations are facing issues with financial and autonomy of the organization due to the lack of a uniform formation mechanism for the public enterprise and they have to answer to different governing bodies of the government. The attempt to improve the performance without the help of major stakeholders could destroy these organizations and we need a complete

analysis of these organizations to work for better efficiency in the national interest. The increasing autonomy of the project and financial advantage for the top-tier management somehow help these issues to resolve at the local level. The issue of overstaffing, lack of service and social security, and political intrusion in the public enterprise are major human resource problems faced by these organizations so these issues need to be addressed and human resources should be managed for the proper management of these organizations.

The public enterprise is a wealth of the public and is responsible to the public. For the proper management of the market and for decreasing the monopoly of the market, we need to reform its operations and increase its profitability as well as social responsibility. Government, as well as all the stakeholders, need to think twice about the localization of public enterprise and deep research into how these companies can be better and better in the context of Nepal.

References

Anon., 2021. Enotes World. [Online]
Available at: https://enotesworld.com/public-enterprises-in-nepal/
[Accessed 12 6 2021].

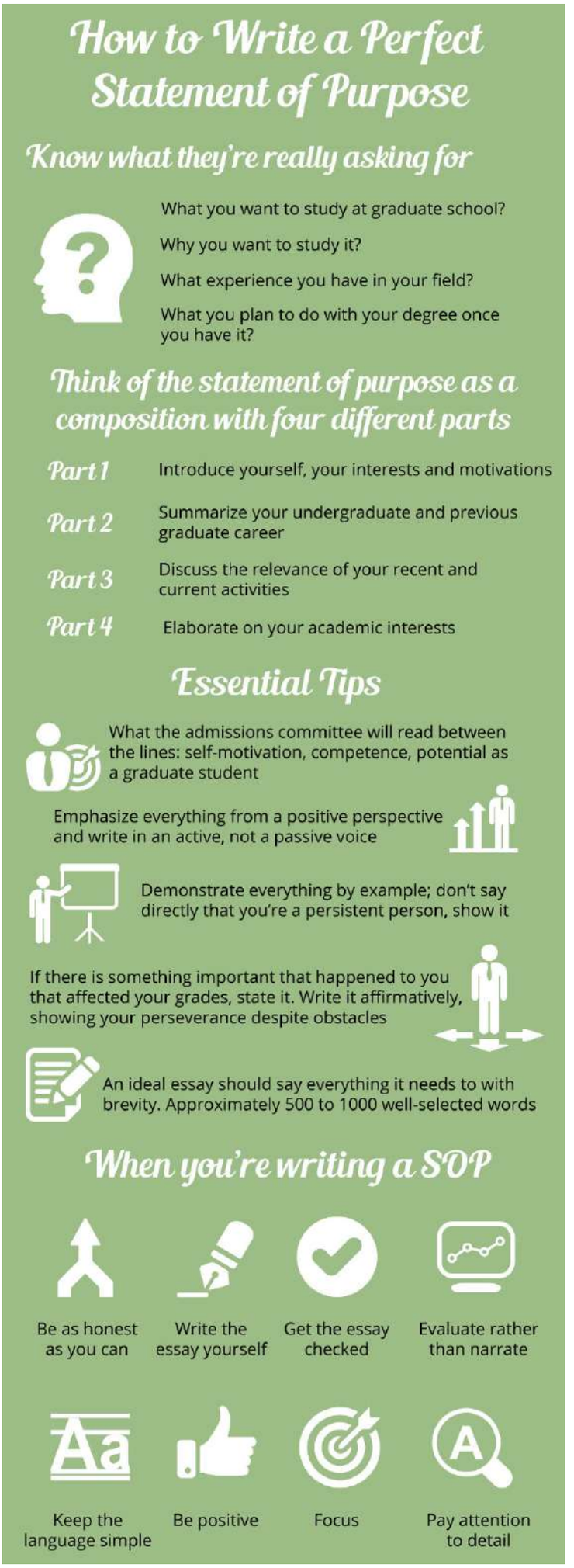
Anon., 2021. Investopaper. [Online]
Available at: https://www.investopaper.com/news/public-enterprises-in-nepal/
[Accessed 12 6 2021].

Asian Development Bank, 2009. Reforming Public Enterprises, s.l.: Asian Development Bank .

Ministry of Finance , 2020. Economic Survey 2019/2020, s.l.: Ministry of Finance .

Ministry of Finance, 2015. NPRR 2015-Presentations by Energy sector, Kathmandu : MoF.

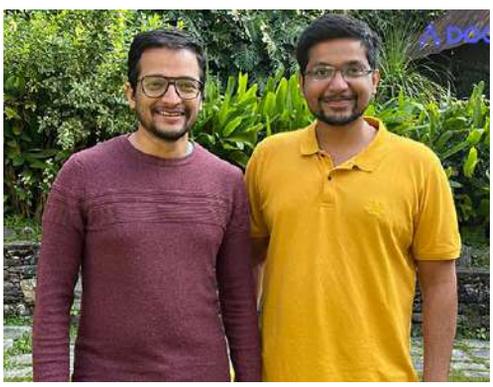
Ministry of Finance, 2020. Annual Status Review of Public Enterprises, s.l.: Ministry of Finance.





Alumni News

It is great to hear that Docsumo, the company co-founded by a Young Nepali Industrial Engineer who turned into data scientist to entrepreneur, **Er. Bikram Dahal** along with his Indian counterpart Mr. Rushabh Sheth in 2019, raised $3.5 Million in Seed Capital. Docsumo is a document AI startup that helps enterprises make automated decisions from customer documents. We industrial engineering family are proud of him, and we wish for the successful journey of Docsumo.





Er. Milan Adhikari, Chairperson of Nepal Cableways Company Pvt. Ltd., is someone who many people would adore to get to know. In 2018, he started his own venture after working as a mechanical design engineer at Ropeway Nepal. The survey, design, consulting, installation, operation, and maintenance of ropeways and cable cars in Nepal are all done by Nepal Cableways Business (NCC) Pvt. Ltd., a company with legal authorization.

Er. Rojesh Man Bajracharya, a project engineer at JGC Corporation, founded RDX Moto Private Limited in 2019 with the goal of promoting motorsports and manufacturing automobiles and automobile parts in Nepal. In Nepal, RDX is a "REVOLUTION" in automotive paints, cleaning, customization, part production, and assembly.





Hypothesis Study on the Effect of Two-Day Public Holiday on Petrol Consumption

- Er. Bikash Neupane

During the time of the global pandemic COVID-19, the import of goods from foreign has nearly stopped. After COVID-19, due to the high import of goods and commodities, the foreign currency reserve of Nepal is decreasing rapidly and only lasts for around six months. After analyzing the import commodities of Nepal, petroleum products are found to be the major ones. Along with the starting of the Russia-Ukraine war, the global supply chain of petroleum products has been unstable. So, the price of petroleum products in the global market is at its peak level. Due to this, high oil prices, the large amount of foreign currency reserves of Nepal is decreasing to buy petroleum products So, by the suggestion of Nepal Oil Corporation and the Central Bank of Nepal, the Nepal government had decided to give a two-day public holiday in the preliminary phase. Due to this, a large number of government office vehicles and the people's movement to the government office has been reduced for at least one day.

As the government decides to give a two-day public holiday thinking that people's movement to the workplace will be decreased for an extra one day, which reduces the consumption of petroleum to maintain foreign currency reserves. But as per the report by the ministry of tourism in 2019, tourism activities will be increased if provided by a two-day public holiday. So, there will be an increase in movement of the people to recreational centers, parks, etc. So, this study on the effect of a two-day public holiday on petroleum usage could be a great way to analyze whether petrol consumption will decline or not.

For this study, the data are collected from various sources. The Community Mobility Reports by google show movement trends by region, across different categories of places. For each category in a region, reports show the changes in the trend of people in Recreation Centers, Parks, Grocery stores, Transit, Workstation, and residential. The data shows how visitors to categorized places change compared to baseline days. A baseline day represents a normal value for that day of the week. The baseline day is the median value from the five weeks Jan 3 – Feb 6, 2020. So, the mobility of people comes from this community mobility report. For the daily sales of petrol, Nepal Oil Corporation provided the data. Now for the preparation of a model for this available data a model of multiple linear regression on python was prepared and analyzed the fitting of the data to the linear pattern. As we don't have the mobility data of people on Saturday and Sunday after a two-day public holiday, we must prepare the hypothetical scenario of the mobility of the people when there is a two-day holiday as per historical trends and verify it through the null hypothesis method. Then the outcome from the hypothesis is entered into the regression model to find out the consumption of petrol on Saturday and Sunday which was used for the result.

> ***"The aim of the government to reduce the consumption of petrol by giving the two-day public holiday will not be achieved."***

For two years and three months of data, the models were trained and tested using people's mobility data, with 95 percent of the data being used for training and the remaining 5% for testing. The statistics for sales of petrol, MSE, RMSE, MAPE, and R2 are,

MSE	29561.09
RMSE	171.9334
MAPE	9.583989
R2	0.819919

This shows the performance evaluation statistics. The Mean Squared Error was found 29561.09, the Root Mean Squared Error was found to be 171.9334, the Mean Absolute Percentage Error was found to be 9.583989 and The R2 value was found to be 0.819919.

Now for the hypothesis, data was taken from the month of Phalguna 2078 to Baisakh 2079 which makes the sample size Fourteen days each Saturday and Sunday. During the hypothesis, as per the report by the Tourism Ministry, we increase the people's mobility to Recreation places, parks, etc. during a two-day holiday. Under the confidence level of 95 %, the null hypothesis of Saturday and Sunday was done by keeping the Z score value to the acceptable level which was found to be:



Er. Bikash Neupane
Associate Business Analyst
Hitachi Energy
bikash.neupane@hitachienergy.com

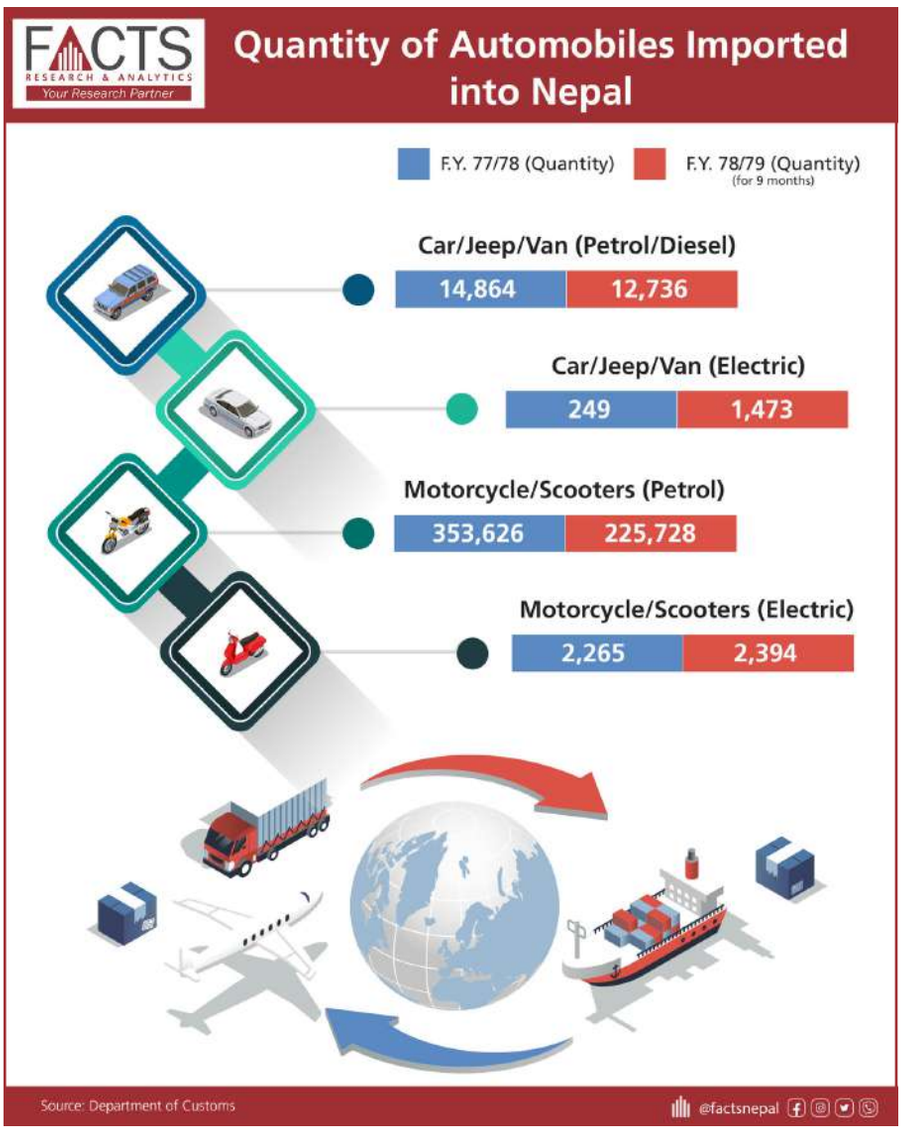
Saturday	Recreation	Grocery	Parks	Transit Station	Workplace	Residential
MEAN ($\bar{X}$)	38.71429	97.21429	117.2143	76.3571	36.71429	4.428571
Estimated (μ)	42	100	127	81	33	4
Sunday						
MEAN ($\bar{X}$)	46.5	102.5714	122.3571	80	34.85714	4.785714
Estimated (μ)	49	105	133	84	28	4

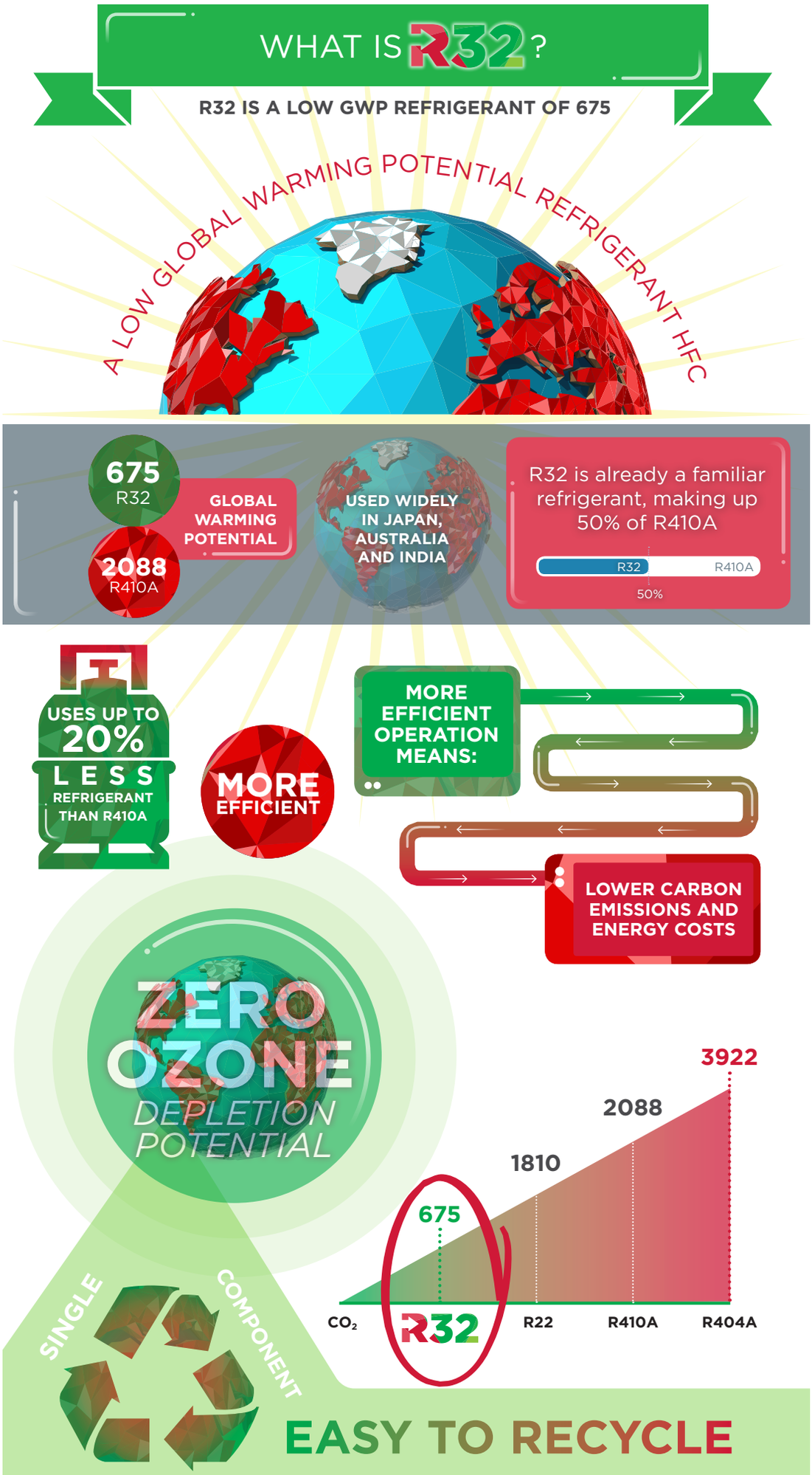
By keeping these estimated values to the regression model, we get the consumption of petrol.

Day	Recreation	Grocery	Parks	Transit stations	Work places	Residential	Petrol Usages
Mean (Saturday)	38.714	97.214	117.2	76.357	36.71	4.4286	2117.980
Hypothesis (Saturday)	42	100	127	81	33	4	2161.182
Mean Sunday	46.5	102.571	122.4	80	34.86	4.7857	2103.180
Hypothesis (Sunday)	49	105	133	84	28	4	2161.161

From the output of the regression model, we can see that the mean petrol usage for Saturday is about 2117.980 kiloliter and the hypothesis petrol usage on Saturday is about 2161.182 kiloliter. Also, for Sunday the mean petrol usage is about 2103.180 kiloliter and the hypothesis petrol usage is about 2161.161 kiloliter. As per the above table, we can see that the consumption of petrol increases by 43.202 kiloliters on Saturday and the consumption increases by 57.981 kiloliters on Sunday.

By the result of the hypothesis scenario after a two-day public holiday, 101.183 kiloliters of petrol will be consumed per week. It was found that the aim of the government to reduce the consumption of petrol by giving the two-day public holiday will not be achieved. So, the government should focus on the things which can decrease the import of fuels and other commodities to maintain the foreign currency reserve of the country. Also, there were certain limitations to the research, so more research should be done on this topic for the exact result.




WHAT IS R32?
R32 IS A LOW GWP REFRIGERANT OF 675
A LOW GLOBAL WARMING POTENTIAL REFRIGERANT HFC
675
R32
2088
R410A
GLOBAL WARMING POTENTIAL
USED WIDELY IN JAPAN, AUSTRALIA AND INDIA
R32 is already a familiar refrigerant, making up 50% of R410A
R32
R410A
50%
USES UP TO 20% LESS REFRIGERANT THAN R410A
MORE EFFICIENT
MORE EFFICIENT OPERATION MEANS:
LOWER CARBON EMISSIONS AND ENERGY COSTS
ZERO OZONE DEPLETION POTENTIAL
3922
2088
1810
675
CO2
R32
R22
R410A
R404A
SINGLE COMPONENT
EASY TO RECYCLE

Why Choose Jamboree for GRE Test Prep?



Smart Analytics help you track and evaluate your performance



Targeted study plan & exhaustive Full-Length tests to maximize speed and accuracy



Personalized attention through Unlimited Doubt Clearing Sessions



Mentoring and Coaching by the best and most experienced faculty



Unmatched Scores on the GRE since 1993



Powerful adaptive technology platform streamlines your preparation

Jamboree™

nepal@jamboreeeducation.com

01-5913013, 01-5913014

6th & 7th Floor, Simkhada Plaza, New Plaza Road, Putalisadak, Kathmandu

Jamboree's Training is Designed to Help you Improve in 3 Key Areas

Concepts

Accuracy & Speed

Stamina & Strategy

Strategize your GRE prep journey with customized study plans

8 full-length tests, which are like the actual GRE test



Jamboree™



Circular Economy

A New System for Sustainable Economy

- Er. Subin K.C.

Circular Economy is a new term used highly in the developed or those pioneers' industrialized countries around Europe which offers a systematic response to the climate crisis as the climate is a hot topic nowadays. The circular economy is rethinking how we use our raw materials and resources to create a sustainable economy free of waste and emissions. It is the shifting from the current linear model of 'take, make, waste' to an economy where we 'reduce, reuse, recycle'. It acts as fundamental to help achieve global climate goals where companies Need to change the way they produce and consume. A company needs to design differently, sell differently and value differently.

The origins of the concept

The notion of circularity has deep historical and philosophical origins. The idea of feedback, of cycles in real-world systems, is ancient and has echoes in various schools of philosophy. It enjoyed a revival in industrialized countries after World War II when the advent of computer-based studies of non-linear systems unambiguously revealed the complex, interrelated, and therefore unpredictable nature of the world we live in – more akin to metabolism than a machine. With current advances, digital technology has the power to support the transition to a circular economy by radically increasing virtualization, de-materialization, transparency, and feedback-driven intelligence.

There are some principles of this circular economy which are restorative and regenerative by design. The principles include: *Design out waste and pollution; keep products and materials in use; Regenerate natural systems.*

> ***"By designing out waste and pollution, keeping products and materials in use, and regenerating rather than degrading natural systems, the circular economy represents a powerful contribution to achieving global climate targets."***

—Design Out Waste and pollution

This principle generally questions, what if waste and pollution were never created in the first place? This principle reveals and designs out negative impacts of economic activity that cause damage to human health and natural systems which include the release of greenhouse gases and hazardous substances, the pollution of air, land, and water, as well as structural waste such as traffic congestion.

—Keep products and materials in use

This principle questions, what if we could build an economy that 'uses things' rather than 'use them up'? Here both terms look alike but there is a certain distinction in the meaning they convey. A circular Economy favors activities that preserve value in form of energy, labor, and materials. This means designing for durability, reuse, remanufacturing, and recycling to keep products, components, and materials circulating in the economy.

—Regenerate Natural Systems

What if we could not only protect but actively improve the environment? A circular Economy avoids the use of non-renewable resources and preserves or enhances renewable ones, by returning valuable nutrients to the soil to support regeneration, or using renewable energy as opposed to relying on fossil fuels.

The Economic Benefits

The macroeconomic impacts of shifting to a new economic model of circular economy are discussed here. The circular economy has been gaining traction with business and government leaders alike. Imagination is captured by the opportunity to gradually decouple economic growth from unused resource inputs, encourage innovation, increase growth and create more robust employment. The economic benefits can be summarized in the following points:

—Economic Growth: GDP would increase through a combination of increased revenues from emerging circular activities, and lower cost of production through productive utilization of the inputs. These changes in the input and output of economic production activities affect the economy-wide supply, demand, and prices. Its effect ripples through all sectors of the economy adding to overall growth.

—Material Cost Savings: Based on detailed product-level modeling, it is estimated that, in the sectors of complex medium-lived products (such as mobile phones and washing machines) in the EU, the annual net material cost savings opportunity amounts up to USD 630 billion. For fast-moving consumer goods (such as household cleaning), there is a material cost savings potential of up to USD 700 billion.

—Job Creation: This impact on employment is largely due to increased spending fueled by lower prices; high-quality, labor-intensive recycling activities, and higher-



Er. Subin K.C.
MA 2nd semester, Central Department of Economics
subinkc123@gmail.com



skilled jobs in remanufacturing. New jobs are created across industrial sectors, within small and medium enterprises, through increased innovation and entrepreneurship, and a new service-based economy.

—**Innovation:** The aspiration to replace linear products and systems with circular ones is an enormous creative opportunity. The benefit of a more innovative economy includes higher rates of technological development, improved materials, labor, energy efficiency, and more profit opportunities for companies.

Environmental and System-Wide Benefits
The potential benefits of shifting to a circular economy extend beyond the economy and into the natural environment. By designing out waste and pollution, keeping products and materials in use, and regenerating rather than degrading natural systems, the circular economy represents a powerful contribution to achieving global climate targets.

—**Carbon Dioxide Emissions:** For Europe, a circular economy development path could halve carbon dioxide emissions by 2030, relative to today's levels across mobility, food systems, and the built environment. In addition, sector-specific analysis indicates that the UK could reduce greenhouse gas emissions by 7.4 million tons per annum by keeping organic wastes out of landfills.

—Primary Material Consumption: The circular economy results in the reduction of primary material consumption (i.e. car and construction materials, real estate land, synthetic fertilizers, pesticides, agricultural water use, fuels, and non-renewable electricity) by 32% by 2030.

—Land Productivity and Soil Health: Higher land productivity, less waste in the food value chain, and the return of nutrients to the soil will enhance the value of land and soil as assets. Returning the biological materials to the soil will reduce the need for replenishment with additional nutrients.

Opportunity for Company
Businesses would benefit significantly by shifting their operations in line with the principles of the circular economy. These benefits include the creation of new profit opportunities, reduced costs due to lower virgin-material requirements, and stronger relationships with customers.

—**Improved Customers interaction and loyalty:** This system offers new ways to creatively engage customers. New business models, such as rentals or leasing contracts, establish longer-term relations, as the number of touch points increases over the lifetime of the product. These business models offer companies the chance to gain unique insights into usage patterns that can lead to a virtuous circle of Improved products, better service, and greater customer satisfaction.

—**Profit opportunities:** This system will lower the cost of new goods and create new profit streams. The cost of remanufacturing is lowered. For example, if a high-end washing machine could be leased instead of sold, then customers can save more, and manufacturers would also earn more.

—Reduced Volatility and Greater security of supply by using less new raw material and more recycled inputs

—**New demand for business services:** This system has potential to create demand for new business services such as, Collection and reverse logistics companies that support end-of-use products being reintroduced into the system; Product marketers and sales platforms that facilitate longer use or high utilization of products; Parts and components remanufacturing and product refurbishment offering specialized knowledge and services.

—**Opportunity for individuals:** The circular economy will not only benefit businesses, the environment, and the economy at large, but also the individual. Ranging from increased disposable income to improved living conditions and associated health impacts, the benefits for individuals of a system based on the principles of circularity are significant.

Conclusion
The Circular Economy is embodied in Sustainable Development Goals (SDG) 8, 9, and 12. SDG 8 promotes sustained, inclusive and sustainable growth, within others, through the improvement of global resource efficiency in consumption and production. SDG 9, on sustainable infrastructure and industrialization, urges industries to adopt resource-efficient and environmentally sound technologies. SDG 12 addresses sustainable consumption and production emphasizing resource efficiency and waste reduction.

Our economy is currently locked into a system that favors the linear model of production and consumption. However, this lock-in is weakening under the pressure of several powerful disruptive trends. We must take advantage of this favorable alignment of economic, technological, and social factors to accelerate the transition to a circular economy. Circularity is making inroads into the linear economy and has moved beyond the proof of concept; the challenge we face now is to mainstream the circular economy and bring it to scale.

8.0

References
Circular, T. (2022). What is Circular Economy? Retrieved from Think Circular: https://thinkcircular.io/what-is-circular-economy/

Foundation, E. M. (2022). The Circular Economy In Detail. Retrieved from Ellen Macarthur Foundation | Archive: https://archive.ellenmacarthurfoundation.org/explore/the-circular-economy-in-detail

ERMC (P.) Ltd.

(Environmental & Resource Management Consultant)

Phone : 01-4483064, 4465863 Fax:01-4479361
E-mail: info@ermcnepal.com,
ermc@ermcnepal.com
Website : www.ermcnepal.com

Services

- Engineering Projects;
- Architectural Projects;
- Planning and Management;
- EIAs (Environmental Impact Assessments);
- Initial Environmental Examination
- Socio-economic and Social Distribution studies;
- Rural Community Development Enterventions;
- Program/Project Identification, Appraisals and Design;
- Program/Project Implementation;
- Evaluation and Monitoring of Development Endeavours;
- Project Management Service;
- Training and Human Resource Development;
- Research if any of the above

AREA OF SPECIALIZATION

- Environment
- Water Resource
- Transportation
- Energy
- Water Supply and sanitation
- Irrigation
- Geotechnical/Geology
- Bio-Engineering
- Hydropower
- Housing and Building
- Urban/Rural Development
- Community Development
- Agriculture and forestry
- GIS(Geographic Information System)and Mapping
- Capital Investment
- Computer Software Development and Training
- Human Resource Development









SUSTAINABLE DEVELOPMENT GOALS





Bachelor Degree Programs

- Architecture
- Automobile Engineering
- Civil Engineering
- Computer Engineering
- Electronics and Communication Engineering
- Industrial Engineering
- Mechanical Engineering

Masters Degree Programs

- M.Sc. Engg. in Mechanical Design and Manufacturing
- M.Sc. in Earthquake Engineering
- M.Sc. in Informatics and Intelligent Systems Engineering

Tribhuvan University
Institute of Engineering
Thapathali Campus
Department of Industrial Engineering

Society of Industrial Engineering Students
SOIES
Nepal