

INDUSTRIAL VISION

INNOVATION. INDUSTRY. PROSPERITY

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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.

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.

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About us

Society of Industrial Engineering Students - Nepal is a student-driven 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?

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.

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.

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.

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.



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We are grateful to our Well-wishers!



I am overjoyed to learn that Industrial Vision Volume-9.0, 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

Congratulations on the auspicious occasion of releasing the 9th edition of "Industrial Vision"! Your relentless commitment to academic excellence and innovation is truly commendable. This is the matter of pride for Thapathali campus. This milestone reflects your dedication to advancing knowledge and fostering a culture of learning. May this edition be a beacon of inspiration for students, providing valuable insights and contributing to the growth of industrial engineering. Your collective efforts resonate throughout Thapathali Campus and beyond. Best wishes for the entire team of SOIES Nepal, and may "Industrial Vision" continue to illuminate the path of knowledge and discovery.



Dr. Khem Gyanwali

Campus Chief, IOE, Thapathali Campus



Dear Members of the Society of Industrial Engineering Students Nepal (SOIES Nepal) and the Industrial Vision Team, On behalf of the Department of Industrial Engineering, it gives me immense pleasure to extend my heartfelt congratulations to you on the successful publication of the ninth volume of Industrial Vision magazine. Your commitment to promoting industrial engineering principles, sharing insights, and showcasing innovative ideas within the field is truly commendable. Over the past volumes, Industrial Vision has become a valuable resource for students, professionals, and enthusiasts alike, providing a platform for knowledge exchange and networking opportunities. As we celebrate this achievement, I encourage you to continue striving for excellence and pushing the boundaries of what Industrial Vision can offer to its readers.

Er. Sushant Raj Giri

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

I am thrilled to extend my heartfelt congratulations to the SOIES Nepal team on the publication of Industrial Vision- Volume 9.0. Witnessing the continuous innovation and excellence demonstrated by the team brings me immense joy. Watching SOIES Nepal grow and achieve new heights each year is a privilege. May this volume continue to inspire and provide valuable insights to the industrial community. Best wishes for your continued success and impactful contributions!



Er. Prakash Acharya

Founding president of SOIES Nepal,

Co-Founder and COO at Harilo, Founding Chairman at Green Valley Recyclers- GVR Cooperative, Co-Founder/Engineer at Mukti Energy



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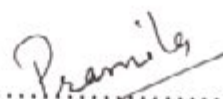
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Date: 2/13/2024



Well-Wishing Message

I am overjoyed to know that "INDUSTRIAL VISION-volume 9" is being published by the entire team of "society of Industrial Engineering Students Nepal" which is instrumental for technological advancement and innovation in the sector of education, the backbone for the development of the country. I would like to extend my best wishes to the entire team of SOIES-Nepal for their dedication and commitment in the annual magazine and taking it to a whole new level. I am hoping for more innovative and informative ideas from the SOIES-Nepal team in the coming years.


.....
Pramila Devi Bajracharya
Secretary



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President's Message

It is with immense pride and a deep sense of honor that I present the ninth edition of our annual publication, Industrial Vision. Reflecting on the journey that began ten years ago in 2014, it is awe-inspiring to consider the foresight and dedication required to initiate such an academic tradition. Today, in 2024, I am incredibly proud to contribute to this legacy, continuing the excellence in the field of education and the advancement of Industrial Engineering. This edition is particularly special as it is brought to you by a team powered by feminine energy, demonstrating our dedication and unity in advancing the field. I hope this edition provides you with valuable insights and enriching reading.

The year 2023-24 has been exceptionally fruitful for SOIES Nepal, marked by a wide range of activities aimed at integrating industries, students, and policy frameworks. These activities included seminars, training sessions, talk shows, workshops, and technical exhibitions both on campus and outside. SOIES Nepal stands as a beacon in Industrial Engineering, committed to elevating the field and addressing its challenges. Our culture embodies responsibility, enthusiasm, and a commitment to continuous improvement. The launch of our flagship project, "Industrial Vision-9," underscores our commitment to promoting academic excellence and fostering intellectual growth among students. Witnessing our institution's growth is deeply satisfying, and I extend heartfelt gratitude to the Department of Industrial Engineering, IE alumni, students, and all our supporters and well-wishers whose constant motivation and encouragement help us remain the most essential and dynamic student society within the campus community and beyond. Leading this dedicated team has truly been a privilege.

Lastly, I would like to express my sincere appreciation and thankfulness to our valuable content providers, generous sponsors, technical supporters, and all the helping hands who made this milestone of Industrial Vision 9.0 possible. On behalf of the entire magazine team and the SOIES Nepal team, I thank you.

Good times ahead!

Shistata Thapaliya

President

SOIES Nepal

16th executive committee



Editor's Note

Welcome to the latest edition of Industrial Vision, where we continue our mission of driving innovation, industrial excellence, and sustainable prosperity. As we navigate through 2024, the world of industrial engineering is more dynamic than ever, with groundbreaking advancements and insightful analysis shaping the future of our field. Our commitment to bringing you the latest and most impactful developments remains steadfast, and this volume is a testament to that promise.

This edition is packed with diverse and compelling content that spans a broad spectrum of topics crucial to modern industry. From shedding light on different facets of AI and its integration into various industrial processes, energy management to the strategic importance of facility layout and location, our articles are designed to provide you with a deep understanding and actionable insights.



Every article, every layout detail, and every visual element in this magazine is crafted with the utmost care and dedication. In this volume, we have endeavored to connect industry, academia, and policy. I extend my deepest gratitude to our incredible team for their relentless hard work and creativity. Special thanks to people around me who kept me motivated throughout this journey.

We value your feedback and suggestions, as they are crucial for our continuous improvement. In this ever-evolving world, there is always room to grow, and your insights help us to better serve our readers.

Thank you for joining us on this exciting journey, we hope this edition of Industrial Vision not only informs but also inspires you to push the boundaries of innovation.

Happy Reading!!

A handwritten signature in black ink, appearing to be 'Sg' or similar, written in a cursive style.

Sadikshya Gautam

Editor-in-Chief

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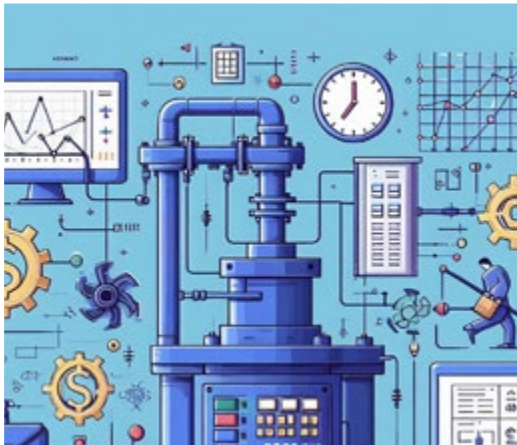
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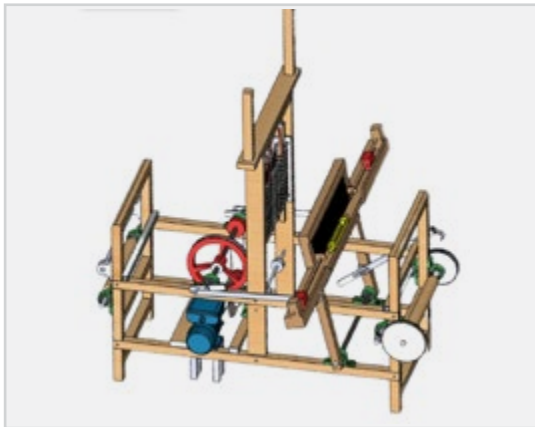
Head of department, Industrial Engineering



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Honorable Minister of Industry, Commerce and Supplies



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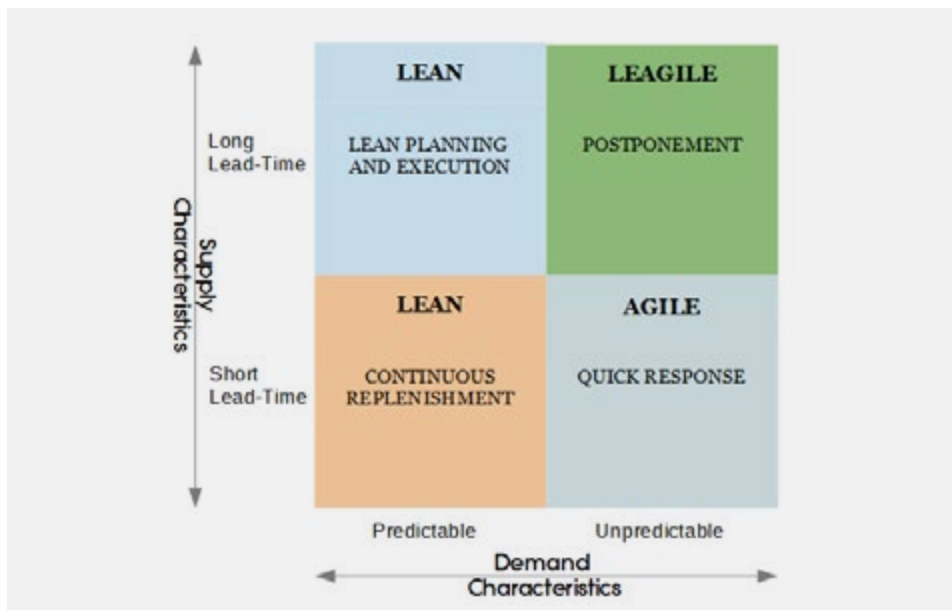
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with adaptability. The supply chain is depicted to enable businesses to respond quickly and effectively to changes in demand and or supply, market conditions, and other internal and external factors. In an agile supply chain, decision-making is decentralized and responsive to real-time data, rather than relying on predetermined plans and forecasts. Key elements of the agile supply chain philosophy include collaboration, transparency, visibility, flexibility, and responsiveness.

Agile is the new Lean.

- Sabin Silwal

Agile is the new Lean and mass customization is the competitive advantage. Any process, sub-process, or action that does not have value to the customer is a waste, Muda, or non-value-adding. Lean Manufacturing experts in Toyota introduced seven wastes widely known as TIMWOOD (Transportation, Inventory, Motion, Waiting, Overproduction, processing, and Defects). The heart of the Lean supply chain is the streamlining and coordinating of information flows, material flows, and cash flows to reduce waste and deliver more value to customers. The key elements of lean supply chain philosophy include Just in Time (JIT) Production, Lean Logistics, Continuous Improvement, Communication, and Co-operation. Lean supply chain framework and tools guide the supply chain to continuously improve, standardize, and sustain the flows. However, too much standardization of

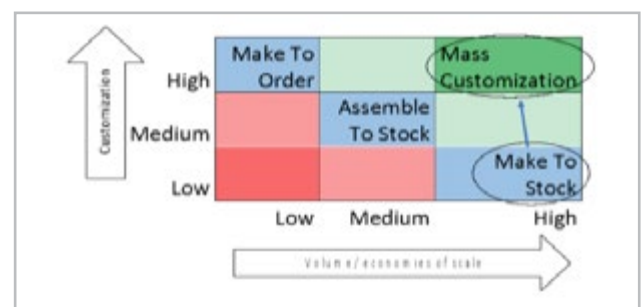
“Companies do not compete with each other, but the supply chain does.”

flows and centralization of decision-making reduces customization possibilities in manufacturing. i.e., ‘one size does not fit all’ in a multi-product environment with a diverse product portfolio lean supply chain philosophy might not be agile enough to adjust and cope with complexities.

Agile supply chain management is an outlook characterized by velocity with vision and acceleration

With huge respect to both Lean and Agile philosophies, for Global Supply Chain Management (GSC) practitioners in multi-product environments, what comes in handy is the type of material replenishment strategy. What does that mean? Simple, the figure at the right is a visual representation of categorizing the product portfolio in terms of volume vs customization.

We can observe that the product portfolio is clustered mostly diagonally and following replenishment strategies:



Make to Stock (MTS) → High volume * Low customization
(e.g., Toyota Innova)

Assemble to Stock (ATS) → Medium volume * Medium customization
(e.g., BMW 6 series and above)

Make to Order (MTO) → Low volume * High customization
(e.g., Ferrari, Rolls Royce)



Sabin Silwal, Regional Upstream Planning Leader (GSC Europe) at Schneider Electric

Supply Chain professionals are currently performing a balanced act to cluster their product portfolio in a diagonal represented as the blue zone in the figure and assigned to the best-fit replenishment strategy.

The red zone behind this blue zone is the less profitable zone. This means that the farther away from the blue zone, where both volume and customization are low, the less profitable it is.

On the other hand, the green zone at the right is known to be the more profitable zone. The same interpretation applies here, the farther away from the blue zone, the better. If the company can offer a high level of customization to high-volume products, that will boost profitability and increase competitive

advantage in the global market.

A couple of decades ago, mass customization embarked on a paradigm shift for material replenishment that is currently offering low customization due to the MTS strategy. This new material replenishment strategy was coined by Stan Davis which was later developed and popularized by Joseph Pine (1993). Mass customization offers customization of products and services best fitting individual customers' needs while keeping near mass production efficiency during the operation. An example is the Advanced driver-assistance systems that car manufacturers offer to some basic car models as optional features to end users. James H. Gilmore and Joseph Pine introduced

four approaches to mass customization: collaborative customization, adaptive customization, transparent customization, and cosmetic customization.

Companies do not compete with each other, but the supply chain does. Supply chain competitive advantage is in manufacturing strategy like Toyota but providing customer perceived value like Ferrari. We all know that since the early 20th century, Lean SC philosophy has been incorporated into several industries and business processes. However, the COVID pandemic guided the global supply chain to unprecedented demand and supply disruptions resulting in highly increased challenges and the need for immediate adaptation, decision-making, and

flexibility which we know as the agile supply chain.

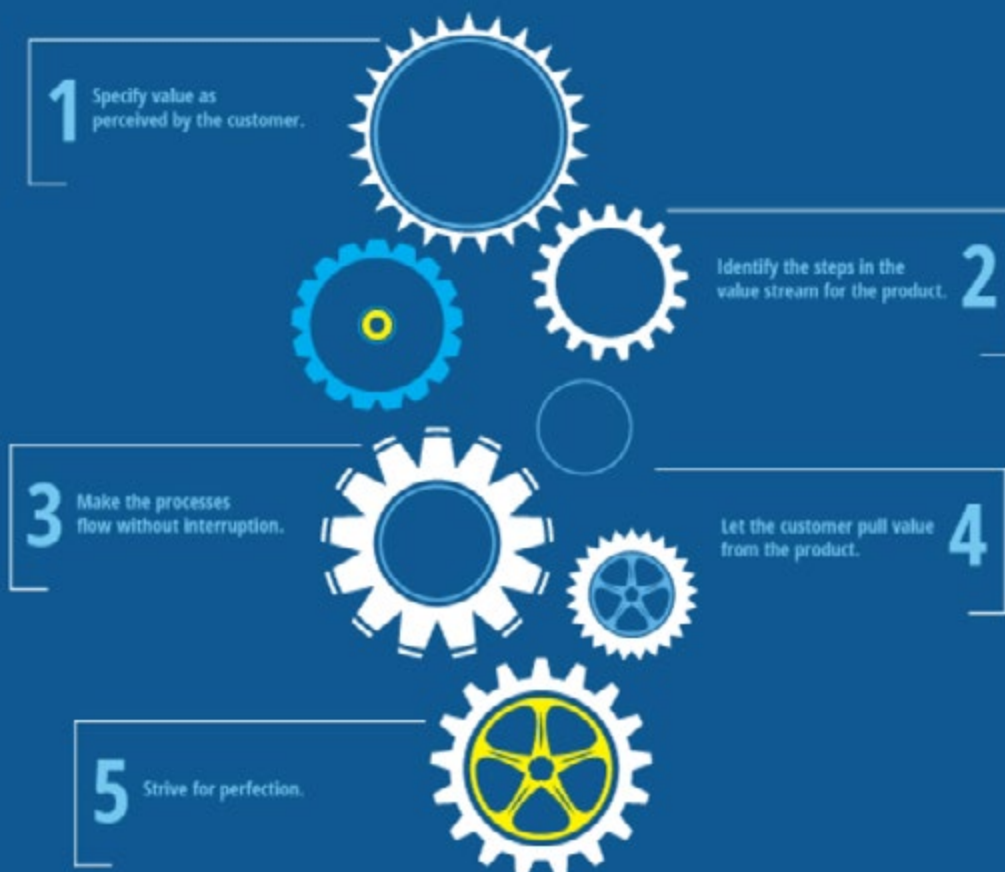
In summary, theoretical understanding of lean supply chain and agile supply chain boils down to material replenishment strategy when it comes to multi-product environments and constantly changing demand market trends. Customizing products where they count, product late differentiation, and LeAgile supply chain management will drive them to reach mass customization for high-runner (high sales volume) products. Make your lean supply chain as agile as possible and navigate your Agile supply chain as leaner as possible.

Therefore, Agile is a new Lean.

5 Key Principles of Lean Manufacturing

Lean manufacturing or lean production is a specific way to eliminate waste. It focuses on adding value by eliminating or reducing aspects that are unnecessary.

The 5 step thought process for implementing lean techniques is as follows:



TEAM SITUATION AWARENESS

- Prameet Ranjan Jha

Introduction

Situation Awareness (SA) refers to the engagement of people or the entire sociotechnical system with the dynamics of their operational environment (Moray, 2004, as cited by Stanton et al., 2017). It is the level of awareness that an individual or a team has of a situation. The past three decades have seen much work in the field of SA, particularly explored in operational contexts of military settings, aviation, transportation, healthcare and medicine, and emergency services. Most of these works are, however, focused on individual SA developed mostly around Endsley's three-level model (Stanton et al., 2017).

Compared to individual SA, relatively fewer studies, so far, have been concerned with determining what is necessary for Team Situation Awareness (TSA). Though the studies have advanced the issue of TSA, a lot remains to be understood about the practices underlying the formation and maintenance of overall TSA in dynamic systems (Garbis and Artman, 2004). Salas et al. (2006) argue that research into the TSA construct is difficult, deficient, and complex because of the complicated cognitive nature of teams. Researchers agree on the fact that the performance of teams rather than individuals is crucial for the success of dynamic systems such as air traffic control, nuclear power plants, industrial plants, etc. In such dynamic systems, the state can change autonomously

or because of the decision maker's actions, and real-time interdependent decisions are required continuously if the system is to be controlled (Brehmer, 1992, as cited by Garbis and Artman, 2004). Because of these characteristics, considerable teamwork is often required for the management of dynamic systems and one of the important aspects of teamwork is TSA. Further, systems continue to become more complicated, technology, and team-driven. So, how best to support awareness across teams and systems is becoming an important question, and today, there is a much stronger and growing focus on TSA. The following section of the paper presents the current status of TSA models and theories.

Team Situation Awareness Teams are distinguishable sets of two or more people interacting dynamically, interdependently, and adaptively toward a common and valued goal with each person having been assigned specific roles to perform (Salas et al., 1992). Thus, shared goals, interdependence of actions, and division of labor are the characteristics of a team. Endsley's (1995) model of TSA is based on this framework of team. TSA is the degree to which every team member possesses the SA required for his or her responsibilities in the team (Endsley, 1995, as cited by Endsley & Robertson, 2000). Each team member will have their own independent **SA** requirements because

of the division of labor. At the same time, team members will also have SA that is shared among team members because of shared goals. Hence, each team member's SA requirements may overlap with other team member's SA requirements. The overlapping occurs when team members have the same SA on shared SA requirements, which Endsley (1995) refers

“There is no unifying theory and commonly agreeable model of TSA, and the research topic is still a work in progress.”

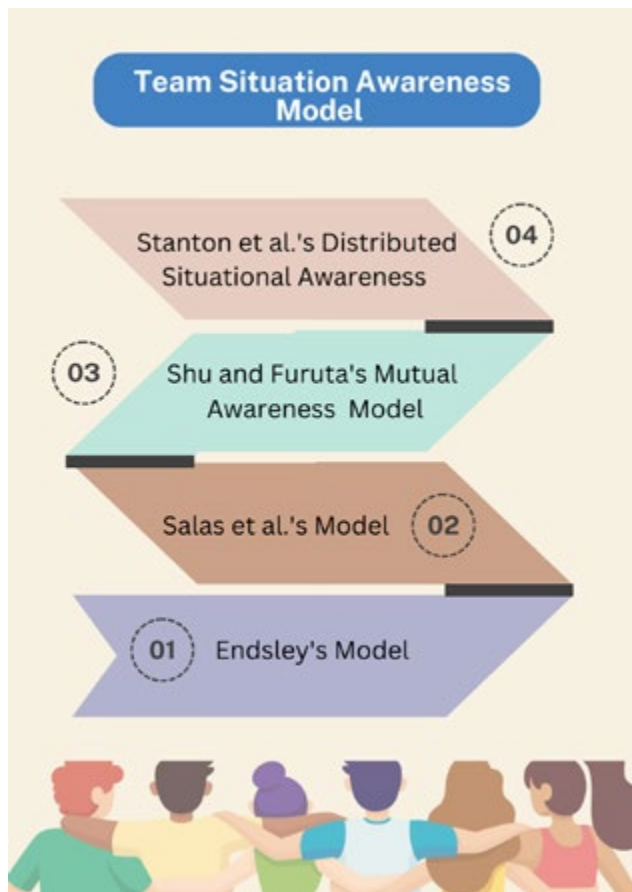
to as shared situation awareness. Therefore, TSA is determined by each team member's responsibilities within a team and the awareness of SA elements about which he or she is concerned. Further, the effectiveness of team coordination is dependent on the quality of team member's SA of shared elements. Successful team performance is dependent on individual team members' SA on their specific elements and the equivalent SA for the necessarily shared elements (Endsley and Robertson, 2000). Team SA suffers when there is a discrepancy between team members' knowledge

of certain pieces of information that they need to know. This discrepancy in SA can be corrected through information transmission which could be through verbal exchange or separate displays. This model has, however, received criticism for only emphasizing Endsley's three-level framework of individual SA and underestimating the importance of team dynamics when addressing SA in team settings.

Unlike the Endsley model, Salas et al. (1995) defined their model of TSA not only from an individual SA perspective but also from the viewpoint of team processes. The model defined TSA as a shared understanding of a situation among team members at one point in time. This understanding is facilitated by team cognitive processes or behaviors that help in developing and maintaining a shared assessment of a situation. According to Salas et al. (1995), communication at various levels in a team influence TSA. Further, the model hypothesizes that the communication of team objectives, individual roles, team capability, and other team performance-shaping factors also influence the perception of SA elements among team members. Any limitations in individual SA can be compensated by information exchange and communication provided by the coordination between the team members (Salmon et al., 2008). Also, the comprehension of this information is impacted by interpretations made by other team members, which in turn is affected by their own individual SA. Thus, cyclical TSA is formed whereby SA (comprehension) leads to new SA and modifies SA of other team members when it is shared. Individual SA and TSA, therefore, evolve because of the interaction and communications at



Prameet Ranjan Jha, Department of Industrial Engineering
University of Louisville



various levels and based on the dynamics of teamwork. Shu and Furuta (2005) introduced the mutual awareness (MA) concept to define the TSA model. The model is very much consistent with Endsley's model of TSA. However, the model also defines TSA from the perspective of "belief" that team members possess in other members' SA to capture the dynamics of team cooperation. Thus, TSA is formed and maintained through interaction within the team members and understanding of the situation which is partly shared and partly distributed among team members. The explicit or implicit interaction among team members is the foundation of mutual understanding and awareness of each other's activities, beliefs, and intentions (Stanton et al., 2017). For example, in a maintenance team, mutual awareness will be achieved when all the team members participating in a

maintenance activity can understand, either explicitly or implicitly, each other's behaviors and motives related to maintenance work. Thus, Shu and Furuta (2005) defined TSA as two or more individuals sharing a common environment, an up-to-the-moment understanding of the situation of the environment, and another person's interaction with the cooperative task.

Stanton et al. (2015) departed from the usual norms and introduced the concept of Distributed Situational Awareness (DSA) which is borne out of distributed cognition theory. In the DSA approach, both human and non-human actors as well as the interaction between the actors are considered. The unit of analysis is not the individual or the teams, it is the entire system under investigation (Hutchins, 1995). The activated knowledge for a specific task at a specific time can be held either by human or non-

human actors in the system. Hence, the system may still perform effectively even if individual human agents do not have knowledge or SA on certain pieces of information. Of course, non-human actors in the system must hold such information to compensate for the discrepancy. DSA approach, thus, contradicts the conventional shared understanding view of TSA. DSA, rather, assumes that non-human collaborative agents can also possess cognitive properties that are not part of individual human cognition (Salmon et al., 2008). Therefore, cognitive processes including SA are considered as emergent properties of collaborative systems. For example, a worker in an industrial plant with degraded SA can update his/her SA by either interacting with other human agents (co-workers) or with a display panel in the control room from where he can receive updated information.

Conclusion

Based on a synthesis of the literature, it is apparent that while there exist many models of TSA, such models view the construct differently. There is no unifying theory and commonly agreeable model of TSA, and the research topic is still a work in progress. From the early Endsley (1995) model which views TSA simply as the extension of a three-level individual SA framework to the recent DSA model which considers the entire system as a cognitive architecture and assumes TSA to be distributed between human and non-human agents of the system, the concept of TSA looks radically different and intriguing when projected through different theoretical frameworks. It can be argued that such a lack of unifying theory could pose a challenge to issues such as the measurement of TSA. However, such

a challenge should not dissuade researchers from continually pursuing this captivating construct. New and emerging constructs of TSA would only add richness to the ongoing debate around TSA.

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Research and Industry: How do they go hand in hand?

-Rajan Kandel

Only industries that embrace continuous innovation through R&D teams can flourish and remain competitive in the market. The powerful technologies we use today, from supercomputers, and AI models to search engines and advanced manufacturing, are all products of a thriving collaboration between academia and industry. This synergy can be extended far beyond the passive exchange of ideas. Industry can become a proactive patron of progress by being involved with academic endeavors in various ways. This can take many forms such as funding for academic prototyping, partnering with academia to conduct trials and studies; industries can provide researchers with invaluable access to real-world scenarios, accelerating the practical application of research findings. Industries can collaborate with universities to identify and prioritize research areas that address the most pressing challenges faced by their specific market segment. Through such a multifaceted approach, the wall between academia and industry crumbles, fostering the environment of cross pollination where theoretical brilliance meets practical ingenuity.

Industry and academic research:

Academic research serves as the intellectual launchpad for innovation and acts as a catalyst for development of technology and society. Although much of the academic literature is simply untrue. The studies are afflicted with small sample sizes, tiny effects, dubious exploratory analysis and inconsequential effects. Despite these shortcomings, academia remains a cornerstone of a robust economy. Transformation of the academic research into a tangible commercial product can be long and arduous. However, through the rigorous peer review, attempts for replication and reproducibility of the methodology, academia lays the groundwork for reliable research and best practices. For instance, the software company RedHat takes open-source technologies, the raw outcomes of academia and transforms them into the enterprise-ready products. Their expertise in packaging, integration, and security adds immense value, just as industry polishes the rough gems unearthed by academic research.

Engineer Entrepreneur:

Bridging the gap between academic research and industry can be a challenging but rewarding endeavor. This begins with identifying the industry pain points and unmet needs, and evaluating the academic research through this lens. Does it address an industry problem? Does it offer a novel solution or significant improvement? In order to translate the research into products consider developing a prototype or minimum viable product as a proof of concept development to showcase feasibility and market potential. Additionally intellectual property management tools such as patent and copyright should be sought to safeguard the innovation. Piloting and market launch, time-

line, team building and clear communication between researchers, industry partners and investors are other crucial considerations. By fostering the collaborative environment, you can effectively transform promising academic research into groundbreaking industry products.

Interdisciplinary Studies

Interdisciplinary study in academia offers a tool to tackle the complex challenges in new ways in a multitude of ways such as breaking down silos; traditional academic disciplines often operate in isolation. Interdisciplinary studies bridge these gaps, encouraging researchers from different fields to collaborate. This cross-pollination of knowledge leads to fresh perspectives and novel solutions for industry problems. By combining different disciplines, interdisciplinary studies can lead to unexpected discoveries and breakthroughs. This fusion of knowledge can spark entirely new ideas and approaches to product development and process improvement. Ultimately, interdisciplinary studies prepares well-rounded talent with a broader skill set and a deeper understanding of how different fields connect, who will lead the industry in the near future. For example, combining engineering with biology can lead to the development of innovative medical devices and diagnostics.

By fostering collaboration and breaking down traditional boundaries, academia can equip industry with the tools and talent needed to tackle complex challenges and drive innovation in the years to come.

“Only industries that embrace continuous innovation through R&D teams can flourish and remain competitive in the market.”



Rajan Kandel

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Sudeep Acharya

Managing Director, Dish Media Network

“Satellite internet is a costly proposition; financial feasibility for residential customers requires government support.”

In your interviews you have mentioned that ‘think globally, act locally’ in terms of media content creation, how can the Nepalese industries adapt to this slogan?

The world has become narrower due to ease of logistics and majorly due to internet connectivity. These days its very easy to communicate using the internet to and from any part of the world. A person living at the remotest part of the world can communicate with anyone through phone or through the internet. Similarly, they can showcase their product and services around the world in matter of minutes.

From the Nepalese perspective, we can produce and sell goods or sell services through these means. We should think in creating and selling high value, low weight (volume) items to the world. Digital Content, tech services seem to fit in this regard. For tangible products, it could probably niche agro products, or something unique from Nepal. In digital content and tech services, it could be online teaching, content creation, call centers, customer service centers (BPOs), data entry etc. For tangible products, it could be Himalayan Honey or Himalayan Tea or something unique to our country.

In the Nepalese market, we give monetary value to tangible goods and services rather than art, creativity and media content. As industrial engineers how can we incorporate production with creativity?

I see an Industrial Engineer as someone who not only optimizes the cost of production but also increase the output (revenue) of the goods or services provided. What we deal with is efficiency, increased output with given resources. For this definitely, creativity is required. Part of being an Industrial Engineer is to analyze data and come out with and optimum solution. This can be utilized in day to day life.

How is the environment for entrepreneurs in Nepal? What suggestions would you like to give to the aspiring entrepreneurs? How can these people monetize a new concept? Is monetization a factor why Nepalese industries shut down in recent years.

I heard about this story where some British shoe company sent two of their people to Africa in the mid 1800s to asses their prospectus business in the continent. One was from Finance, who assessed that there is no business opportunity in Africa as no one wore shoes. The other from Sales, assessed that there was great opportunity in Africa as no one wore shoes but they could in the future.

So I see Nepal as a land of opportunity. Lots of businesses opportunity is there, but people have not been able to tap

them. The downside of this opportunity is that the gestation period is high, so patience is required. Coming up with a new concept is fairly easy for Nepal- as we can see what kind of businesses are successful around the world and specially in India and localize it. I think most of the new concepts that fail or shut down is mainly due to the fact that proper research and planning is not done. Like a said new concepts need a good gestation period, for which we need to pre-plan.

In today's time, we have seen a lot of change in methods of media consumption, shifting cables to various streaming platforms like YouTube or Netflix connected through the internet instead. What has your company's move been to maintain your customer base in terms of services? Are you planning to update your company with the changing times?

As you know with the fast-paced improvements in technologies, it is much easier to dissipate new ideas/ product/service to the market these days. So similarly, with the availability of new technology, market is dynamic. While most of Nepal still gets linear television service via our DTH (DishHome) platform, we are also catering to our customers through internet tv (DishHome ITV), through OTT platform for mobile phone (DishHome GO). Again, we might not be able to compete with Netflix or Amazon Prime or Youtube through global content, however, we can compete with our localized content. For example we are showing the bilateral and tri series of Cricket match on our TV platform and exclusively on our DishHome Go (mobile phone).

You have mentioned trying to find ways to deliver internet to people, even in places where wires can't reach with the help of satellite and wireless internet. How is your company's progress in this regard?

Satellite internet is a costly proposition. While technically it is feasible, financially it is not for residential customers. In the developed world, internet is a basic need and rural customers usually get satellite services through subsidized rate from the government support. If there is support from government is there, we can easily provide these service.

In the recent times of COVID and lockdown, many businesses suffered hardships. As an entrepreneur what measures did you adapt to sustain your business, what suggestions do you have if similar situations arise in the future?

COVID created an opportunity for us to start our DishHome Fibernet business. It was during this time we started our Fibernet services. During difficult times, we need to optimize. I think this is a great time to showcase IE skills. Utilizing limited human resources, we could run the business. We had people sleeping at our Earth Station in bi-weekly rotating basis so that COVID could not spread. Our downtime during COVID was close to zero.

"Dish Home" has an interesting origin story with how two companies who would mostly be considered competition managed to collaborate instead to build a brand that is the most preferred and reliable but also one that strives to keep doing better. What obstacles did you face while finding a middle ground on how you all wanted your brand to represent, and how did you overcome them?

While it was a challenge to merge two companies, but it was the necessity at the time. When companies merge, the major discussion is in the strategic level (board level) rather than in operation level. While there was discussions at the board level for some time, once the decision was made, it was easily carried out in the operational level. Since the companies were fairly new, the merge was not as difficult as it might have seemed.

Striving to do better is something we all inherently have in us. Are there any projects or plans that you are currently allowed to share with us that would help grow your company further? What are your plans for the future?

One of our mottos at DishHome is continuous improvement and creativity. As time passes we understand the change in consumer behavior and expectations and we strive to keep up or sometimes create products and services new to the customers. Moving from traditional DTH services to IPTV (DishHome ITV), DishHome Go (video and linear content on customers mobile phone) are some of the things in the past. DishHome Fibernet (internet service) is also another feat that our valuable customers have liked and made us the 2nd largest provider in about 3 years. Going forward, we will provide more VOD and Sport contents through television platforms and OTT (GO) platforms. We are already providing Data Center (Datalaya) where cloud hosting services and data storage is provided. We are also providing solutions in hospitality sector. We will come up with solutions for smart tvs where no set top box is required. Internet of Things (IOT) will be the next range of products we will be looking at to cater to our customers where they can remotely know who is knocking on their doors and open it with a click.

As industrial engineers, we always appreciate an opportunity to learn from one of our seniors who has been through different experiences. How was your experience studying Industrial Engineering abroad? Is there anything in particular you would like to share about your journey with us aspiring engineers?

Industrial Engineers or IE's are sometimes joked by traditional engineers as Imaginary Engineers, imagination is what differentiates us from traditional engineers. We tend to see the human aspect in engineering which gives us an edge. IE is very vast, OR, which is at the core of IE can be applied to any operations, be it production in a factory or creativity of optimizing in scoring goals in sports. Machine learning, robotics etc. all are part of IE. IE's have managed large corporations like in auto industries to studying and optimizing NFL players to improve their score. So I recommend aspiring IEs to look at this field of study as an engineer who not only understand the technical side but also the management side of business. I see great opportunity for IEs to lead different fields all over the world.

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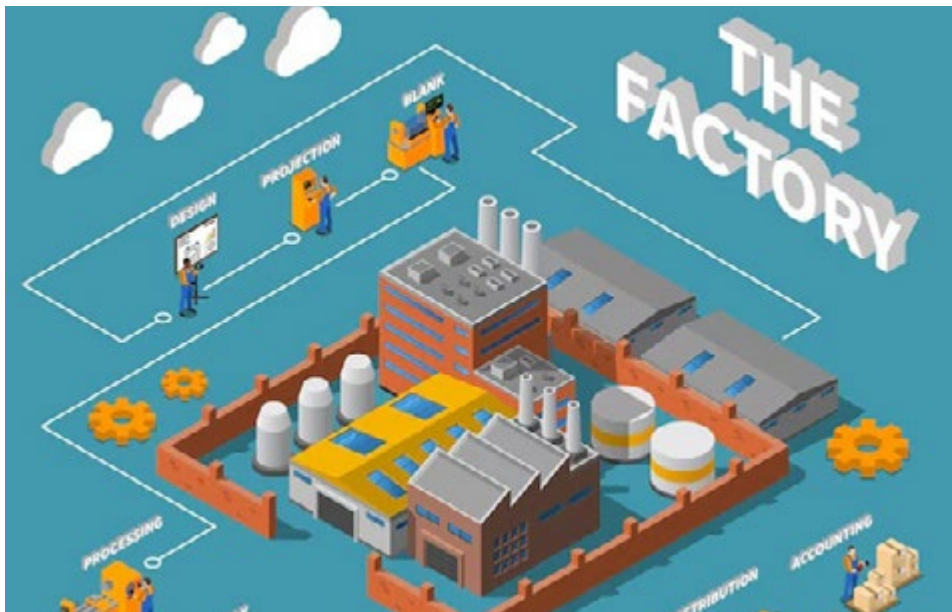
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महाराजगञ्ज, काठमाडौं, नेपाल



FACILITY LAYOUT AND LOCATION

- Aashish Bhandari

Business and company's operations are affected by various factors. Basically, while opening new business many factors / aspects of business should be considered and out of those many factors "Facility Layout and Location" is one of the most important factors while establishing a new business. Facility layout and location are the key factors that impact a company's operations and overall success.

Simply, facility layout refers to the physical arrangement of resources within a company facility which includes raw materials, company's RND and workers. A well-structured facility layout can improve production, reduce waste and ensure safety at its fullest. If we further classify facility layout then there are several types of facility layout such as process-oriented, product-oriented and fixed-position layouts.

On the other hand, location refers to geographical location of a facility (i.e. location of your business). If the facility location is right, it can improve accessibility, reduce transportation cost and provide healthy access to workforce. Companies should consider several factors when choosing location including tax, accessibility, environment, etc.

Facility location selection is considered as one of the biggest challenges for new entrepreneurs or for those who want to extend their production capacity by changing locations and layout. Location selection decision is one of the most difficult things to do as the entrepreneur should consider several other major factors before selecting it. In the past, there have been several debates and discussions where they have tried to figure out the best way to choose facility location. It is very necessary for a company to find the most

suitable facility location as it guides to setup the facility layout. Layout of facility mostly depends on facility location so these things should be considered parallel. A poorly-selected location can cause an increase in production and logistics cost which will surely lead to difficulties in finding many things such as raw materials, government support, human resources, etc. More importantly the wrong choice of facility might be somehow easy to turn back by investing more capital on it but in case of facility location it is not easy to turn back. So, in this article I have tried to explain about pros and cons of selecting good and bad facility layout respectively with some case studies of pre-established business and also a hypothetical example about setting a facility and its location for a chocolate factory.

PROS OF CHOOSING GOOD FACILITY LAYOUT

1. EFFICIENCY ENHANCEMENT

A well-designed facility layout allows for smooth flow of goods and services reducing delays caused due to facility. For example: a factory that has a well-structured production line will have a faster turnaround time with higher production rates.

2. SAFETY

Good facility layout helps in ensuring workers and equipment are placed in safe locations with emergency exits clearly marked. For example: a warehouse which has properly stored goods will reduce the risk of accidents.

3. ENHANCED COLLABORATION

A well-designed facility layout can improve communication and make a healthy relation between employees and departments. For example: A call center with good floor plans and shared workstations can help to

“A well-designed facility layout can add productivity while a best-suited location can improve foot traffic and increase overall customer experience.”



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foster teamwork and improve customer service.

4. BETTER CUSTOMER EXPERIENCE

Good facility layout directly supports for good foot traffic on the company. For example: A good grocery store with organized and clearly marked products can save time and effort of customers which makes it more convenient.

5. COST MINIMIZATION

A well – organized facility can highly reduce operating cost as good layout focuses on space utilization, minimizing waste, etc.

Similarly, the cons are just opposite to pros so it is presented as follows:

- Poor product flow
- Maintenance difficulty
- Increased cost
- Decreased productivity

Now after knowing the pros and cons of facility layout, it is very important to know the ways of selecting good facility location and also a procedure to setup good facility can be helpful too.

FACTORS TO CONSIDER DURING SELECTION OF FACILITY LOCATION:

1. ACCESSIBILITY

The location should be easily accessible to employees and customers with good transportation facility and should be near to highways.

2. RAW MATERIAL AVAILABILITY

Talking specifically about chocolate industry, chocolate factories require a steady supply of raw materials such as coca beans and sugar, so it is also important to consider suppliers while choosing a location.

3. GOVERNMENT RULES

The facility should be located in an area with appropriate regulations for a manufacturing facility and also be within environmental law.

4. SPACE REQUIREMENTS

The facility should have sufficient space for production, storage, and distribution and should also allow for future expansion in case needed.

5. COST

Finally, operating cost, land cost and other expenses should be considered while choosing a location.

6. MARKET DEMAND

Location should meet the demands of your target market such as proximity to suppliers, customers or employees.

And to setup good facility some considerations needs to be done:

- Objectives and goals should be clearly defined if you want to achieve with the facility.
- A site selection analysis should be done in order to evaluate potential locations based on criteria.
- The design that meets the operational and aesthetic needs of facility should be designed of facility and should be revised and discussed with experts.
- A standard operating procedures, policies, and systems that ensure the facility to run smoothly and efficiently should be developed.
- The necessary equipment and technology should be installed such as machinery, computers, and communications systems, to support the operations of the facility.

- The performance of the facility should be continuously monitored and adjustments should be done as needed to improve efficiency and productivity.

CASE STUDIES:

I have shortlisted certain companies which are successful due to their great location and smooth facility layout while those with poor facility location and layout is also shortlisted and studied.

1. BHAT-BHATENI

If we shortlist for biggest retail market in Nepal, Bhat-Bhateni surely comes on top. We might have often visited this particular supermarket at least once. Bhat-Bhateni was founded 38 years ago at Bhatbhateni, Kathmandu and now there are 23 locations of this store all over Nepal.

Bhatbhateni a popular retail chain in Nepal, has been seen in success due to its strategic facility layout and location.

ANALYSIS ON LOCATION

The location of the store is major to its success. They have their branches on major crowded places inside valley.

Let us take an example of Koteswor Bhatbhateni ; due to its suitable location, it is easily accessible to different types of customers. This has helps to increase foot traffic and attracts a larger customer base. Similarly, all other branches of their supermarket are placed strategically in areas with a high density of population and it is very important for retail stores to do that.

ANALYSIS ON FACILITY LAYOUT

Bhatbhateni has well designed facility layout. A well designed facility layout allows for smooth flow of goods and services reducing delays and Bhatbhateni have a well - designed layout as it has smooth flow of goods and services. The customer experience is good as it have proper parking spaces and large choice of products. There are various sections available for various products from which the customers get easy search of desired products also.

As Bhat-Bhateni has been the largest tax payer in the retail sector for the last five consecutive years in Nepal so it can be considered as a successful business.

LOCATIONS OF BHAT-BHATENI STORES INSIDE VALLEY

LOCATION	DISTRICT
Bhat-Bhateni	Kathmandu
Maharajgunj	Kathmandu
Tokha	Kathmandu
Koteswor	Kathmandu
Chuchepati	Kathmandu
Anamnagar	Kathmandu
Balaju	Kathmandu
Kalanki	Kathmandu
Tripureswor	Kathmandu
Krishna Galli	Lalitpur
Satdobato	Lalitpur
Sanagaun	Lalitpur
Radhe Radhe	Bhaktapur

2. AMAZON

Amazon's success is largely attributed to its strategic facility layout and location. The company always keeps their customers ahead in business which has resulted this success in their business.

FACILITY LAYOUT:

Amazon has implemented highly streamlined automated facility layout which helps in minimizing labor costs and increases efficiency. The company uses robots and other automation tools for moving packages from one place to another which generates efficiency. As they use automated technology, a large number of orders are processed quickly which ensures that customer receives their package on a timely manner. Their continuous automation in their layout through new inventions and by adding new technology is key for their success.

LOCATION:

Amazon centers are located near major cities and population centers. This has allowed the company to reach customers quickly and to drastically minimize costs associated with long-distance shipping. For example: In 2019, Amazon opened its first center in France near the city of Bordeaux which was chosen because of its reach to major hubs of transportation allowing them to quickly reach customers in France and major other parts of Europe.

ACHIEVEMENTS:

In 2020, Amazon had 100 fulfillment centers worldwide. According to data from National Retail Federation, Amazon's Prime service had over 200 million members worldwide in 2020, a 40% increase as compared to data from 2019. This demonstrates their focus towards their facility and

location optimization.

In conclusion, Amazon's success can be attributed to its strategic facility layout and location, which has allowed company to reach out customers very fast which results in customer satisfaction.

3. CIRCUIT CITY

The next example of business flop due to its wrong facility and location is the biggest electronics retailer Circuit City. Circuit City was once the largest electronics retailer in the US, with over 800 stores nationwide. But it was not sufficient for its success. The company faced several challenges including competition from other electronics retailer and financial crisis.

The other reason was its poor facility layout and location. There were several stores but the stores were often located in areas with low foot traffic and the electronics market was cluttered as its facility. Circuit's City's facility was not designed to keep up with the changing markets. Unlike other brands they didn't focus on online sales. As a result its sales suffered a lot. According to the data available on internet, in 2005, the company reported \$11.8 billion in sales which dropped to \$7.8 billion by 2008. In 2009, Circuit City declared bankruptcy.

This example clearly shows the importance of considering layout and location of their facilities for businesses. A poor facility as well as location can have significant impact on sales and can ultimately lead to business failure.

Now, let me give an example of hypothetical factory explaining the ways to select facility location and setting its facility layout.

4. EIB SETALOCOCO CHOCOLATES (Nepal)

Chocolate market in Nepal

is not very flourished. When we look at the chocolate market in Nepal, it is not very entertaining as almost 98% chocolate consumed in Nepal is imported which is worth more than 2 billion rupees with an annual growth rate of 6%. As we can see only 2% of demand is fulfilled by Nepali products, this will certainly create a huge opportunity.

FACILITY LOCATION SELECTION

As already mentioned in this article multiple times, there are many factors to be considered while choosing location. Availability of raw materials is must. The raw materials available for producing chocolates are:

- COCOA BEANS
- SUGARS
- COCOA BUTTER
- MILK
- MILK ALTERNATIVES
- EMULSIFIERS

The most important raw material cocoa beans are not available in Nepal. So it is clear that it should be imported. Airways and roadways are the available means of importing it to Nepal. If I prefer roadways my cost will reduce so the possible way of importing through India is through roadways. Now if we screen other raw materials then it can be found easily in Nepal. So for setting my factory location, I am almost ready. Now it is certain that I should choose the area nearer to boarder of India with an easy availability of sugars and milk. The other determining factors for setting my factory location will be government rules and it should be nearer to highways for quick dispatch of produced goods.

FACILITY LAYOUT

Facility layer for chocolate factory includes several layers.

By considering these things for chocolate factory, this business will undoubtedly

not fail due to its facility layout and location.

In conclusion, facility layout and location can be termed as an important aspect to be considered before opening a new business or organization. A well-designed facility layout can add productivity while a best suited location can improve foot traffic and increase overall customer experience. Therefore, it is necessary to consider both of these factors when making business initial decisions. Whether it is a small retail store or a large manufacturing plant, investing on right location and right facility always pays you back and the longevity of the business is secured.



Another Hype or the Key to Unlocking the Future

Exploring the Potential of ChatGPT and DALL-E

- Mahesh Dahal

ChatGPT and Dall-e are the topics most discussed on the internet today. ChatGPT was launched on November 30, 2022, by San Francisco-based OpenAI, the creator of Dall-e and Whisper. Initially, OpenAI was co-founded by Elon Musk and Sam Altman. However, according to some rumors, Microsoft is now expected to fund \$1 billion for further development and research of ChatGPT. The service was initially launched free to the public, with plans to monetize the service later. ChatGPT and DALL-E are both state-of-the-art language models developed by OpenAI. They understand and generate human-like text and realistic rendering of images making them powerful tools for a wide range of applications. There are currently four

models with training data up to 2021. Davinci, Curie, Babbage, and Ada are the models available to the public. The Davinci Model has training data up to June 2021.

One of the most significant ways that ChatGPT and DALL-E can change the future of industrialization in developing countries is through natural language processing (NLP). NLP is the ability of a computer to understand and interpret human language, and both ChatGPT and DALL-E have been trained on vast amounts of text data, making them highly proficient at NLP tasks. One application of this technology in industry is in automating customer service. ChatGPT and DALL-E can be employed to create chatbots that

can get and react to client inquiries and complaints in a usual dialect, liberating human client benefit agents to focus on more complex

“

ChatGPT and DALL-E are state-of-the-art language models developed by OpenAI, proficient at natural language processing (NLP) tasks.

”

issues. It could drastically move forward toward client fulfillment and decrease costs for companies.

Another way that ChatGPT and DALL-E can affect industrialization in creating

nations is through mechanizing information investigation. Both models can extricate experiences from large amounts of content information, such as client audits or news articles. It could be employed to distinguish patterns, anticipate future occasions, and make more educated commerce choices. For instance, a company can use ChatGPT and DALL-E to analyze client criticism and recognize common complaints, permitting them to create changes to progress client fulfillment.

In expansion, ChatGPT and DALL-E can also be employed to make strides in communication and collaboration inside companies. They can be exploit to automatically generate reports, emails, and other composed materials, liberating representatives to center on more imperative errands. They can also be exploit to make language-based collaboration instruments, such as chatbots that offers assistance to workers for exploring inside frameworks or discover data. ChatGPT and DALL-E have the potential to play a critical part in tending to a few of these challenges. For example, ChatGPT can be utilized to produce point-by-point reports on mechanical exercises, counting natural affect appraisals, and social impact evaluations. It appears to offer assistance, distinguish, and relieve negative impacts on the surrounding and communities. Also, ChatGPT can be employed to create point-by-point enlightening for working complex apparatus, making it simpler for laborers to memorize and work modern gear. DALL-E, on the other hand, can be utilized to produce plans for modern mechanical items and processes. This may offer assistance to companies in creating nations to



Mahesh Dahal is an Alumni and Diploma in Computer Engineering Graduate of Thapathali Campus. He has worked in different capacities and agencies on areas like software development, engineering management and technology adoptions in companies like Microsoft Innovation Center, Save the Children, UNDP, UNICEF, KIPUWEX.com etc. Currently he is involved in development of Healthcare IOT device for Finland based company.

move forward their competitiveness by making modern, imaginative items that can be sold on the worldwide showcase. Furthermore, DALL-E can be utilized to optimize existing mechanical forms, making them more productive and feasible.

ChatGPT and DALL-E can also play a part in expanding access to data and instruction for specialists in creating nations. For illustration, ChatGPT can be utilized to produce instructive materials, such as preparing manuals and direction recordings, that can be utilized to educate specialists on new skills. This may offer assistance to companies in creating nations to move forward their competitiveness by making modern, imaginative items that can be sold on the worldwide showcase. DALL-E can also be utilized to create point-by-point specialized details for mechanical items and forms, making it simpler for specialists and engineers to understand and move forward upon them. Moreover, ChatGPT and DALL-E can be connected in different segments, from healthcare to transportation. In healthcare, they can be utilized to analyze medical records, recognize designs, and anticipate illness episodes. In transportation, they can be used to analyze traffic patterns and predict traffic congestion, allowing for more efficient transportation planning.

Overall, ChatGPT and DALL-E have the potential to change the future of industrialization in developing countries in several ways. They can help to improve environmental and social outcomes, increase productivity and efficiency, and increase access to information and education. While these

models are still in the early stages of development, they have the potential to make a significant impact in the years to come.

However, it's worth noting that these models are not a panacea and their impact will depend on how they are used and implemented in the context of the country and its industrial sector. For example, if the infrastructures, policies, and regulations are not in place to support the use of these models, their benefits may not be fully realized. Therefore, it's important to consider the unique context of each country and work closely with local stakeholders to effectively implement these models.

When we talk about Nepal, it is quite obvious to say that there won't be any immediate implementation

of such technologies. Though the adoption of ICT is slightly ahead, we can expect not much but some companies are developing chatbots and flaunting around. Like Blockchains and ride-sharing, there might be hurdles from the policy level in regulating such technologies. Many companies and copywriters are already using ChatGPT for research and content generation.

In conclusion, ChatGPT and DALL-E are powerful tools that could change the future of industrialization in developing countries in several ways. They can help to improve environmental and social outcomes, increase productivity and efficiency, and increase access to information and education. While these models are still in the early stages of development,

they have the potential to make a significant impact in the years to come, but their implementation must be done carefully and strategically. ChatGPT and DALL-E are advanced language processing models that have the potential to revolutionize the way industries operate in developing countries. They can be used for automating customer service, data analysis, and communication within companies. However, the successful implementation of these models in developing countries will require addressing challenges such as data availability and job displacement.





INTERVIEW

ROJESH MAN SHIKHRAKAR

Sr. Manager Tech Talent Development

fuse | machines

About Fuse Machines

Founded in 2013, Fusemachines is a global provider of enterprise AI products and solutions on a mission to democratize AI. Leveraging proprietary AI Studio and AI Engines, the company helps drive the clients' AI Enterprise Transformation, regardless of where they are in their Digital AI journeys. Under the leadership of chief executive officer and founder Dr. Sameer Maskey, Ph.D., Adjunct Associate Professor at Columbia University, Fusemachines continues to actively pursue the mission of democratizing AI for the masses by providing high-quality AI education in underserved communities and helping organizations achieve their full potential with AI. Fusemachines is headquartered in New York, with operations across Asia, Canada, the USA, and Latin America.

About Rojesh Man Shikhrakar

Rojesh Man Shikhrakar is the Sr. Manager of Tech Talent Development and leads Fusemachines' AI Academics function. He has extensive hands-on experience in machine learning, deep learning, artificial intelligence, designing algorithms, and application development. Mr. Shikhrakar oversees the development and deployment of Fusemachines' comprehensive AI curriculum and manages an elite team of AI Instructors. He is also a member of the academic subject committee and a visiting faculty at Kathmandu University Computer Science Department, where he teaches Data Science to undergraduate students and Data Acquisition Management Systems to grad students.

Mr. Shikhrakar holds a Bachelor of Technology degree and a Master of Science in Mechanical System Design. He holds 100+ certifications from different organizations. He has extensive expertise and experience in Robotics, design and development of unmanned aerial vehicles (UAV) for medical deliveries, topography surveys, 3D reconstruction, urban planning, and more.

What do you consider the most challenging and rewarding project you have worked on at Fuse Machines Nepal?

The most challenging project was a CSR internal Drone Project. We believe that this project could impact the remote landscape of our country. We designed the AI algorithm to deliver packages to different locations automatically, we could not continue the project due to inadequate funding and realized that such projects required a separate organization.

The most rewarding project is our AI fellowship course. The course design included interviewing engineers and asking them about the acquired skills that became relevant in their professional careers. We have compressed mathematical concepts like optimization, numerical methods, linear

programming, statistics, and information methods into a single program and solved them using computer programming. We also included programming, data structures, and algorithms in our course. We converted these ideas into learning objectives and designed a course "Foundation in AI". Our program is a 6-month rigorous program, and I believe its impact is more than a four-year bachelor's course we find this rewarding in the sense that students get to learn more in a short time.

The trend is something we all seek to give attention to. What is the current trend in AI that you are excited about and are following through?

Generative AI is trending, and foundation models are getting attention in the current context. Since my background is in physical science, I am more inclined and excited about theory-guided AI learning. I think this dual network is trending. It is a design architecture that incorporates physical principles or equations into the learning process.

Regarding the societal impacts of Artificial intelligence, particularly the efforts to democratize AI and make it accessible to audiences. Can you share your insights on the democratization of AI? How does your organization approach the challenges of making AI technologies more accessible to diverse users and communities?

Democratization of AI is expanding artificial intelligence research and development to a large user base, including those without specialist expertise in AI. We have been providing AI services and solutions in different countries, but education was the purpose of starting Fuse Machine, and education remains our focus. We educate graduate students so that they can develop AI solutions in the market, and this is how we see the democratization of AI.

How can AI be used in Engineering?

One aspect in which AI is widely beneficial is Preventive maintenance by helping system designers identify potential downtime. AI is used in airplanes for generative foundational models. The other aspects are material forecasting, material prediction, supply chain, and auto desk.

In Nepal, we say we have limited access to data in every aspect. While we move towards a data-driven world, how can countries like ours work on data mining and benefit from adopting a data culture and investing in data infrastructure and innovation?

Believing that we have access to limited data is a misconception. There are two different domains: engineers who use data and people who have data. Lack of collaboration among these two parties is the problem, not the limitation of data. The collected data are written on files and not digitalized. Hence, we face problems accessing them. If the data are computerized we could build modeling data systems, data mining, and building data in fracture.

Nepal ranked 150th in the Government AI readiness index, which indicated a lack of enough infrastructure to develop AI. Digitalization of available data, developing infrastructure and policies, and collaboration among various parties involved in data collection can solve this problem this issue.

When it comes to collaboration among different domains, it should start from the base, for now, we students can collaborate with students of other faculties to develop projects conduct research, and develop a culture.

In what ways do you see democratized AI impacting small and medium-sized enterprises (SMEs)? What opportunities or challenges might arise for these businesses in adopting AI technologies?

One major problem with (SMEs) when it comes to adopting AI technology is the lack of a link between their business goals and the impacts of AI. Intensive research is required to bridge this gap. In most cases, businesses need to build AI solutions themselves, but due to the increasing effects of brain drain, they find it difficult to hire potential manpower.

What do you think can be the real-time use of AI in Nepal? What sectors or areas can benefit from the proper utilization of AI in Nepal?

There is a lot to do. Nepal is just becoming familiar with the concept of digital Nepal. One of the main projects could be conversational AI: creating chat bots for the Nepali language. AI can create a huge impact on the agriculture sector by using Satellite-based images can be used to predict production. AI can also be used to know when crops rip to solve problems during harvesting and storing. AI can protect national parks by tracing and counting endangered animals and plant species.

AI is equally important in the government sector, but we have faced difficulties in performing legal tasks in government offices. The government can use an autoresponder to answer questions related to legal processes and government offices.

How can AI help in retail and manufacturing? Can you provide examples in other domains in which you have worked?

While we talk about manufacturing let me highlight the production and retail sector. AI can facilitate production through demand forecasting, and support effective production through system optimization and overall scheduling of machines to support preventive maintenance. For the retail AI can help group customers bring market basket analysis. It can also play a huge role in fraud detection. AI can be used to create a supply chain network between the manufacturers and the buyers. Fuse machines have worked in the fields of healthcare, insurance and finance, technology, healthcare, and retail and manufacturing.



AI learning is getting quite popular among youths in Nepal. Are there any experience-based advice you want to give to the students or youths who want to pursue their careers in this field?

Let us not limit our education to the curriculum set by the government. Students should not focus on application-based education and study with the mindset to apply their knowledge rather than just pass their exams. There should be a mindset for research-based learning, and to learn and understand rather than solve past papers to ace a paper. To use AI it is not necessary to learn programming, however, it is not efficient. Learning to program is essential for AI engineers. The basics would be to learn a programming language develop skills to build a system in a computer, and make a strong base in mathematics. Learn algorithms, and data structure and learn to implement mathematical skills in programming. Learn to build a system on the computer.

To what extent do Fuse machines collaborate with other companies, research institutions, or industry associations to foster innovation and advancement in AI for manufacturing and engineering?

We collaborate with industries and businesses and develop systems according to their demand. We can collaborate with IE through training, the main focus is the train AI engineers through fellowship and training, we have seen that those people who come from other domains than BCE have become better AI engineers. We do partner with colleges. We are open to suggestions if you have any.

How does Air Conditioning System Work?



Condenser

Releases the heat absorbed from inside the house to the outdoor air, cooling the refrigerant before it recirculates.

Compressor

Circulates the refrigerant throughout the air conditioning system, facilitating heat exchange and ensuring continuous cooling.

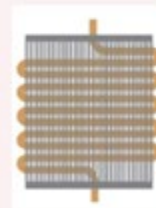


Blower motor

Moves warm air from inside the house through the air ducts, pushing it across the evaporator coil for cooling.

Evaporator coil

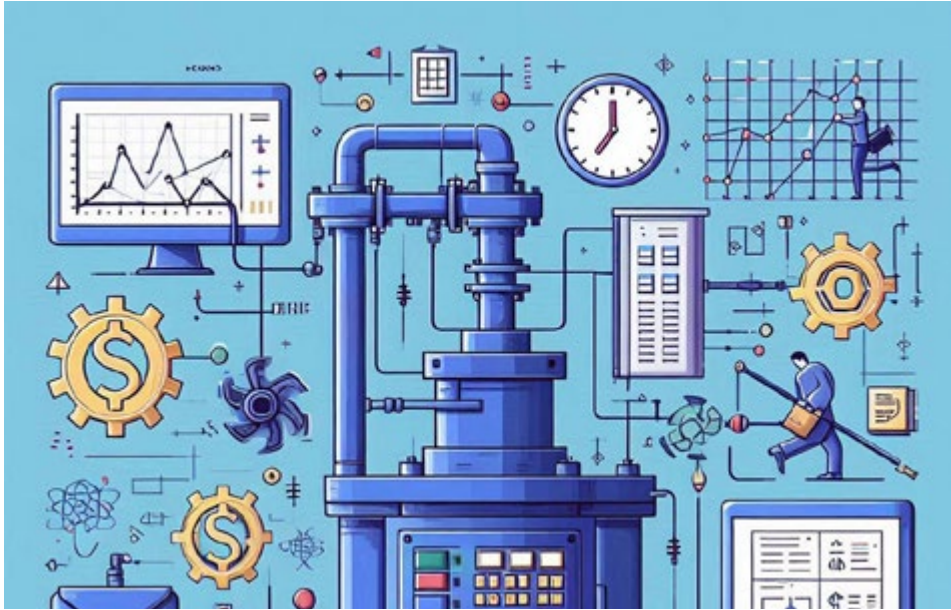
Absorbs heat from the indoor air, cooling it down before it is recirculated back into the house through the supply vents.



Thermostat



Controls the operation of the air conditioning system by activating it based on the desired temperature set by the homeowner.



Improving the Feasibility Pump Heuristic for solving Integer Programming Optimization problems with the help of Machine Learning

- PhD Candidate Ashim Khanal

Abstract

Finding a feasible solution to mixed integer programming problems (MIPs) is critical for many practical applications and can be very difficult at times. In this regard, we focus on improving the performance of Feasibility Pump (FP), which is one of the most influential heuristics for finding feasible solutions to MIPs. An integer programming problem is a mathematical optimization or feasibility program in which some or all the variables are restricted to be integers. If some decision variables are not integers, the problem is known as a mixed-integer programming problem. Some notable applications of MIPs are Production Planning, Scheduling, Territorial partitioning, Energy systems Optimization, Transportation Networks, Smart and sustainable infrastructures etc. Feasibility pump is a methodology to solve such

problems mathematically and computationally. For the FP algorithm, choosing the appropriate number k , number of variables to be flipped (change the value of 0 or 1), is very important for its performance. So, in this work, we propose a learning-based scheme to determine the best value of k for a specific class of instances to be solved.

Introduction and Problem Definition

Overview

Mixed integer programming problems (MIPs) are those whose goal is to minimize a linear objective subject to linear constraints, where some or all variables are integers (Wolsey, 1998). Finding a feasible solution to mixed integer programming problems (MIPs) can be difficult (NP hard) (Nair et al., 2020). Feasibility Pump (FP) (Fischetti and Lodi, 2005) has been con-

sidered as one of the most influential heuristics for finding feasible solutions of MIPs. The basic idea of feasibility pump is to perform rounding to the LP relaxed solution and then make the distance between the so obtained integer point and any feasible integer point to be zero through iterations. However, the main obstacle for this method is stalling through cycling, meaning that after some iterations, the procedure gets into a loop, and variables keep on visiting the previous values repeatedly. In the original FP, this issue is handled by a random perturbation: a random number, k variables are flipped (change the value of 0 or 1 for binary var.) (Fischetti and Lodi, 2005). For the test instances mentioned in Fischetti's work, k was set to 20, and perturbation frequency parameter R was set to be 100. They were determined randomly. Considering the potential pattern between the value k and features of the MIPs instances, we wish to develop a framework aiming to find the optimal value of k with the assistance of machine learning.



Feasibility pump (FP) has been considered as one of the most influential heuristics for finding feasible solutions of MIPs.



Literature Review

The Feasibility Pump, (Fischetti and Lodi, 2005), talks about the methodology of finding a feasible solution for a generic MIP which is a NP-hard problem. Despite simple foundation of this heuristic, it is competitive with commercial solver in terms of quality and speed for first solution delivered. Revisiting local branching with a machine learning lens, (Liu and Lodi, 2022), talks about finding high-quality solutions to mixed-integer linear programming problems. Here the paper computationally shows that the size of neighborhood in local branching heuristics can be learned and can be generalized across instances.



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Integer Programming, (Wolsey, 1998) includes detailed mathematical models, methodologies, and theories for Mixed Integer Linear Programming.

Introduction to Data Science, (Shah, 2020) explains in detail about the various statistical and machine learning theories and methods with applications.

Machine Learning for Integer Programming, (Khalil, 2016) applied machine learning approaches to making decisions

in branch and bound search. Features that characterize variables at each node of the tree have been collected, to predict the branching decision variables as target.

Learning to branch in mixed integer programming, (Khalil et al., 2016) proposed an instancespecific learning framework to pattern the strategy-making by Strong Branching which can determine the variable gives the best improvement to the objective function before branching.

Feasibility Pump

The process of Feasibility pump algorithm was introduced in detailed in (Fischetti and Lodi, 2005). Generic MIP problem can be written as model 1|

$$\begin{aligned} \text{(MIP)} \quad & \text{minimize} \quad c^T x \\ & Ax \leq b \\ & x_j \text{ integer } \forall j \in I \end{aligned} \quad (1)$$

After solving the LP relaxation and rounding the results. The algorithm updates the objective to the L1 norm distance between a generic point x and given integer point $\tilde{x}$ (equation 2): $\Delta(x, \tilde{x}) =$

$$\sum_{j \in I} |x_j - \tilde{x}_j| \quad (2)$$

Given an integer point $\tilde{x}$, the closest optimal point is given by:

$$\min \Delta(x, \tilde{x}) : Ax \leq b \quad (3)$$

For 0-1 instances we minimize the following function:

$$\Delta(x, \tilde{x}) := \sum_{j \in I: \tilde{x}_j = 0} x_j + \sum_{j \in I: \tilde{x}_j = 1} (1 - x_j) \quad (4)$$

Integrating the machine learning, we modified the original feasibility pump algorithm:

Algorithm 1: Feasibility Pump with Machine Learning

```

Input: instance dataset  $P = \{p_i\}_{i=1}^M$ 
for instance  $p_i$  in  $P$  do Initialize  $nIT := 0$ 
     $\bar{x}^* := \operatorname{argmin}(c^T x : Ax \geq b)$  // Solve the LP relaxation if  $x$  is integer
    then
        return  $\bar{x}^*$ 
    else
        Rounding:  $\tilde{x} := \lfloor \bar{x}^* \rfloor$  // Rounding
        while time < TL and  $nIT \leq s$  do  $nIT++ = nIT$ 
             $\hat{x}^* := \operatorname{argmin}_{\Delta}(\bar{x}, \tilde{x}) : Ax \geq b$  // Linear projection if  $x$  is Integer
            then return  $\hat{x}^*$ 
            else
                if  $\exists j \in I : [\bar{x}^*] \neq [\tilde{x}]$  then  $\tilde{x} :=$ 
                     $[\bar{x}^*]$ 
                else
                    Flip  $k := f_{\theta}(\beta)$  variables // Perturbation with the result of machine learning

```

Machine Learning

First, we generate the labels for regression model. To do so, we define the cost of solving an instance using FP as function 5 (Liu and Lodi, 2022), where t denotes the solving time for finding a feasible solution with FP, o indicates the objective value for the minimize problem. So in this case, the cost is a trade-off of the computational time and the solution quality. In the practice, we scaled both t and o to the range $[0,1]$ to make them comparable.

Then the label for learning can be determined by equation Then we train our machine learning model to find the best model parameters:

$$c^k = \alpha * t_{scaled}^k + (1 - \alpha) * o_{scaled}^k \quad (5)$$

In equation 7, s means the flipping frequency, i.e., after how many iterations we need to start to flip. We repeat solving

$$k^* = \operatorname{argmin}_{k \in \mathbb{Z}^+} c^k \quad (6)$$

the same instance with different values of k (numbers of variables to be flipped) and s (flipping perturbation frequency) and select the k value which minimizes the cost as our learning target.

Experiments and Results

We generated 100 instances. The number of variables is selected randomly from the integer set ranging from 300 to 1000, by 100. The number of constraints is determined to be twice the number of variables. While generating the instances, we also considered the following things. We set the sparsity of matrix A to 50%, i.e., $SA := 0.5$.

The entries of matrix A belonging to 'binary' variables are randomly drawn from the discrete uniform distribution $[1, 30]$.

The entries of matrix A belonging to 'continuous' variables are randomly drawn from the discrete uniform distribution $[30, 30]$ The components of vector b are randomly drawn from the discrete uniform distribution $[nsA, 10 nsA]$, where nsA is the expected number of non-zero elements in each row of matrix A .

For each instance, we ran 25 times, with different combinations of k and s , for all $k \in \{1,2,3,4,5\}$ and $s \in \{0,1,2,4,6\}$.

Features we collected for learning includes:

The instance size	• Number of iterations • Number of constraints • Number of variables • Number of non-zero items in objective
Stat. of Coefficients	For the coefficient matrix A, each column, compute min, max, standard deviation, then calculate: • Min(min), min(max), min(std) • Max(min), max(max), max(std) • Std(min), std(max), std(std) For the RHS b: • Min(b), max(b), std(b) For the coefficient of the objective function: • Min(c), max(c), std(c)
The result of subproblem	• LP relaxation objective value • LP relaxation solving time

Figure 1: Features for machine learning

Overall, we have 100 observations of 21 features. The values of target k are in the set $\{1,2,3,4,5\}$ for our case, and the frequency of the five classes are: {"5" : 46, "4" : 23, "3" : 23, "2" : 5, "1" : 3}. Then we tried both multi-class classification and regression models to make predictions. The models we used were MLP (Multi-layer Perceptron) and RF (Random Forest). Following are the results

		Fold1	Fold2	Fold3	Fold4	Fold5
MLP_clf	accuracy	0.15	0.25	0.45	0.45	0.4
RF_clf	accuracy	0.4	0.5	0.45	0.35	0.35
MLP_reg	neg-MSE	-5.69733209	-8.13448746	-4.93337479	-3.0350729	-5.37760519
RF_reg	neg-MSE	1.69707625	-1.23977625	-0.68804149	-0.86898986	-0.86472125

Figure 2: Results of machine learning

Random forest showed better results, so we fine-tuned it with grid search and conducted feature selection, it turned out that the best score showed when we select 16 features: ['LP objective', 'LP solve time', 'bMax', 'bMin', 'bStd', 'coefMaxMax', 'coefMaxMin', 'coefMinStd', 'coefStdMax', 'coefStdMin', 'coefStdStd', 'costStd', 'nIT list', 'nonZeroCost', 'numConstraints', 'numVariables']. After that, we re-fit the random forest model with 16 features, the new neg-MSE results are:

[-1.68317875, -1.21939, -0.70543262, -0.84601076, -0.86247811].

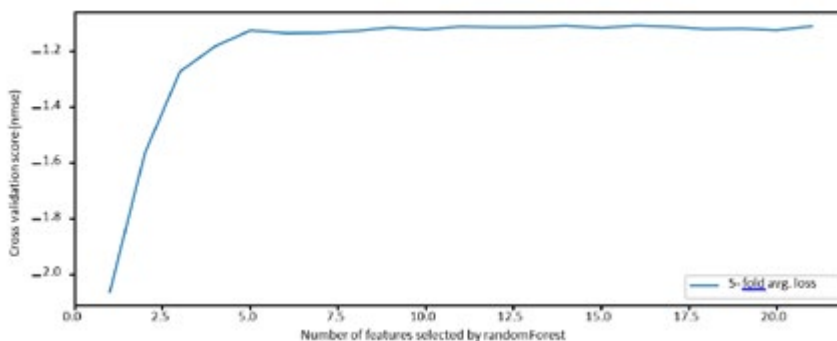


Figure 3: Random forest feature selection

Result Test

To test the regressing result, we generated 4 instances for testing, with 300, 500, 700, 900 variables respectively. k values predicted by the model:

instance	k	cost	k_pred
1	1	1	5
	2	0.928335	
	3	0.730788	
	4	0.690865	
	5	0.685714	
2	1	0.905118	5
	2	0.688557	
	3	0.691076	
	4	0.785714	
	5	0.685714	
3	1	0.9	4
	2	0.688158	
	3	0.736058	
	4	0.785714	
	5	0.734712	
4	1	0.999115	5
	2	0.688418	
	3	0.685714	
	4	0.785714	
	5	0.686325	

Figure 4: Testing results

The table above shows the predicted k values for the 4 new instances. We displayed the cost values corresponding to 5 different k values and the model has correctly predicted 3 decisions based on the costs in the second column.

Conclusion

In this research, we made decisions for the originally random step in Feasibility Pump with the assistant of machine learning. The result of multi-class classification are not good.

In this research, we applied machine learning to making decisions in the flipping step of Feasibility Pump. It shows that machine learning can provide references for determining the number of variables to be flipped for a better trade-off benefit considering both the computational time and the solution quality.

We tried multi-class classification and regression models for learning the target, but the classification model didn't perform well. The reason maybe that we have set a relatively narrow range for k because of the small scale of instances. This leads to the values of each class are very close to each other. In this case, a classification model cannot perform its ability.

To improve our work or as a planning of future work, we can dig more into feature engineering, including feature extraction, processing and selection. Besides, we have an assumption that the k value is a constant for each iteration. Making the learning sequential and dynamic with the help of reinforcement learning can be one of the future works.

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डिजिटल वित्तीय सेवाको प्रयोग गर्दा के प्रयोजनको लागि कसलाई भुक्तानी गरेको हो सोमा सावधानी पुर्याउनुपर्ने दायित्व सम्बन्धित व्यक्तिको नै हुने भएकोले बैंकको नाम, खाताको नाम, खाता नम्बर, मोबाइल नम्बर, भुक्तानीको प्रयोजनलगायतका विवरण यकिन गरेर मात्र कारोबार गर्नुपर्दछ ।

सजग भई डिजिटल वित्तीय सेवा प्रयोग गरौं ।

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CLEARING
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लेखाल राइट बैंकबाट "लुक्काली प्रणाली सञ्चालक" को
कार्य गर्न अखण्डिपञ्चाल सेवा



State-of-the-Art and Emerging Techniques for Defect Detection Using Deep Learning

- Dr. Sinan Onal

Defect detection is the process of identifying and addressing defects in products or materials before they cause problems, such as reduced performance or safety issues. In recent years, there has been a growing interest in the development of new defect detection methods, particularly those that are more efficient and reliable than traditional approaches. However, detecting defects can be a challenging task, particularly in industries where products are complex or produced at high volumes. Traditional methods of defect detection, such as visual inspection or manual testing, can be time-consuming and prone to human error. As a result, there is a need for more efficient and reliable methods of defect detection that can be used to identify and address defects in a timely and accurate manner. There are several problems associated with the current

approaches to defect detection:

1. Inefficiency: Traditional methods of defect detection, such as visual inspection or manual testing, can be slow and labor-intensive, making it difficult to keep up with the demand for high-volume production.

2. Inaccuracy: Human error is a common problem with traditional methods of defect detection, leading to missed defects or false positives.

3. Limited scope: Traditional methods are often limited in their ability to detect defects, particularly in complex or hidden areas of the product.

Overall, the defect detection problem is one of finding a more efficient and reliable method for identifying and addressing defects in products or materials. This requires the development

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In recent years, there has been a growing interest in the use of machine learning and artificial intelligence (AI) techniques for defect detection, as these approaches have the potential to significantly improve the efficiency and reliability of the process.

”

of new approaches that can accurately and quickly detect defects, regardless of their location or complexity. In recent years, there has been a growing interest in the use of machine learning and artificial intelligence (AI) techniques for defect detection, as these approaches have the potential to significantly improve the efficiency and reliability of the process.

One of the most widely used machine learning techniques for defect detection is deep learning, which involves the use of artificial neural networks to process large amounts of data and perform tasks such as pattern recognition, image and speech recognition, and language translation. Deep learning has been applied to a variety of defect detection tasks, including the identification of defects in images and videos (Chen et al., 2018; Zhang et al., 2018), the analysis of sensor readings (Chen et al., 2018), and the analysis of audio signals (Zhang et al., 2018). In some cases, deep learning models have been shown to outperform traditional machine learning techniques, such as support vector machines, in defect detection tasks (Zhang et al., 2020).

In addition to deep learning, other machine learning techniques, such as support vector machines and random forests, have also been applied to defect detection tasks (Zhang et al., 2020). These methods have been used to analyze a variety of data types, including images, sensor readings, and audio signals. For example, a study published in the journal *Measurement* (Li et al., 2019) used a deep learning model to detect defects in the laser cutting process based on sensor readings, achieving an accuracy rate



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of 95.8%. Another study published in the journal *Measurement* (Rao et al., 2017) applied image processing techniques to the detection of defects in textile fabrics, achieving an accuracy rate of 97.6%.

Other approaches to defect detection using machine learning have been proposed in the scientific literature, including the use of ultrasonic testing (Zhou et al., 2016) and online monitoring systems (Li et al., 2019). These approaches have the potential to improve the efficiency and accuracy of defect detection by automating the process of identifying defects and providing real-time feedback. For example, an online monitoring system can continuously monitor the production process and alert operators to potential defects as they occur, allowing for timely and accurate detection and correction.

In summary, the use of machine learning and AI techniques for defect detection has shown great promise in a variety of industries, including manufacturing, construction, and agriculture. These techniques have been applied to a range of data types, including images, sensor readings, and audio signals, and have been shown to be effective at identifying defects with high accuracy. While there are challenges to the adoption of these techniques, such as the need for large amounts

of labeled data and the potential for bias in the data and models, the potential benefits of improved efficiency and reliability make it an active area of research in the scientific community. Overall, the use of machine learning and AI techniques for defect detection has the potential to significantly improve the efficiency and reliability of the process, leading to improved product quality and reduced costs associated with repairs and replacements.

Steps for our defect detection model, which uses deep learning to find defects on PVC profiles includes:

1. Data collection: The first step in the methodology is to collect a sufficient amount of data for training and testing the deep learning model. This data includes images of PVC profiles with and without defects, as well as the corresponding labels indicating the presence or absence of defects. It is important to have a balanced dataset with a similar number of images with and without defects to avoid bias in the model.

2. Data preprocessing: The collected data is preprocessed to ensure that it is ready for use in training the deep learning model. This includes tasks such as resizing the images to a consistent size, converting the images to a suitable format (e.g., grayscale or RGB), and splitting the data into training, validation, and testing sets.

3. Model training: The next step is to train the deep learning model using the prepared data. This involves selecting a suitable deep learning architecture (e.g., convolutional neural network, autoencoder) and optimizing the model's hyperparameters (e.g., learning rate, batch size). The model should be trained using the training and validation data, with the performance monitored using the validation data.

4. Model evaluation: Once the model has been trained, it is evaluated using the testing data to assess its performance on unseen data. This involves calculating metrics such as accuracy, precision, and recall to measure the model's ability to correctly identify defects.

5. Model deployment: If the model performs well on the testing data, it can be deployed for use in detecting defects in real-world PVC profiles. This involves integrating the model into a production line or using it to manually inspect samples.

The early results of our autoencoder based deep learning model have shown great promise in the detection of defects in PVC profiles. Our model is able to analyze large amounts of data and identify patterns and features that may indicate the presence of defects. Our model has been shown to be effective at detecting defects with high accuracy and can

outperform traditional machine learning techniques in some cases. One advantage of using the proposed is that it can be automated and integrated into the production process, allowing for real-time detection of defects. This can significantly improve the efficiency of the defect detection process and reduce the need for manual inspection, which can be time-consuming and prone to human error.

However, there are also challenges to the use of the model, including the need for large amounts of labeled data for training and the potential for bias in the data and models. It is important to carefully consider these challenges and take steps to mitigate them, such as using a balanced dataset and evaluating the model's performance on a diverse set of data.

Overall, the use of deep learning for defect detection has the potential to significantly improve the efficiency and reliability of the process, leading to improved product quality and reduced costs associated with repairs and replacements. However, it is important to carefully consider the specific needs and constraints of the task and choose an appropriate deep learning approach to ensure optimal performance.

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- ✦ इनर्जी इन्फर्मेशन सेन्टर प्रा.लि. अन्तर्गत विगत ७ वर्षदेखि ऊर्जा खबर अनलाइन पत्रिका (www.urjakhabar.com) सञ्चालन हुँदै आएको छ ।
- ✦ विगत ३ वर्षदेखि ऊर्जा खबरको छापा संस्करण खोज अनुसन्धानमूलक अर्धवार्षिक म्यागजिन समेत प्रकाशित हुने गरेको छ ।



अनलाइन तथा छापा संस्करणमा आफ्ना महत्वपूर्ण लेख प्रकाशनका लागि पठाउनु हुन इच्छुक विद्यार्थी, प्राध्यापक तथा अनुसन्धाताहरूमा अनुरोध छ ।



ER. SUSHANT RAJ GIRI

Head of Department, Industrial Engineering
Thapathali Campus, IOE.



“Our vision for the Industrial Engineering Department is to create a renowned center of academic excellence, innovation, and industry collaboration.”

Mr. Sushant Raj Giri is the Head of the Department of Industrial Engineering at Thapathali Campus, IOE, TU. He holds a Bachelor in Industrial Engineering, an MBA, and an M.Sc. in Mechanical Design and Manufacturing. Mr. Giri is known for his innovative and energetic activities and is actively working to bridge the gap between academia and industry.

You’ve seen the industrial department from ground up as a student, teacher, and Head of Department (HOD). How did you experience the transition from being a student to taking on the responsibilities of an educator? What emotions and insights did you gain during this transformative journey?

Starting my journey in industrial engineering back in 2005 as a student marked the beginning of a fulfilling path that eventually led me to become a faculty member in 2011. Over time, I embraced the role of Head of Department (HoD) about a year ago, a responsibility that has been both challenging and rewarding. Reflecting on this journey, it has truly been a wonderful experience. We were the pioneer batch, laying the foundation for subsequent students on our campus. Despite encountering numerous gaps, we viewed them as opportunities for growth and improvement. Throughout this journey, the support and guidance of our teachers were invaluable. Drawing from these learning experiences, both as a teacher and now as HoD, I have been able to contribute to the enhancement and organization of our department, ensuring a better academic environment for all involved.

Throughout the years, our department has undergone significant positive transformations. From its inception as the first batch of industrial engineering students on campus to its current state, we have continuously evolved and improved. The gaps we initially encountered were seen as opportunities for innovation and enhancement. With the support of dedicated teachers, we implemented changes that not only addressed these gaps but also elevated the overall quality of our department. As a result, we have witnessed a remarkable improvement in various aspects, including curriculum development, student engagement, research initiatives, and administrative efficiency. By leveraging our

collective experiences as both students and educators, we have cultivated a more dynamic and well-organized department that is better equipped to meet the evolving needs of our students and the industry. This positive change is a testament to our commitment to excellence and continuous improvement.

What do you think are the most important roles to perform as the Head Of Department, What issues did you encounter, and what expectations did you have for the department, And as the HOD, How have you been prioritizing them?

As the Head of Department (HoD), the primary focus revolves around leadership, academic excellence, faculty and staff management, student engagement, research promotion, administrative efficiency, and stakeholder engagement. Challenges such as budget constraints, faculty turnover, curriculum alignment, and administrative hurdles have been encountered. To prioritize these responsibilities, We’ve implemented strategic and operational planning which will be helpful in achieving our short and long term goals towards our focus stakeholder engagement strategies. Activities like Stakeholders Engagement which includes students, faculties and job providers have borne fruit in form of good teaching learning environment, MoUs regarding student’s entrance to the job market different stakeholder’s sessions have pinned this department on the broader map. By proactively addressing these areas and challenges, we aim to lead the department towards fulfilling its mission of academic excellence and innovation, while also strengthening relationships with industry partners, alumni, and other stakeholders.

What is your vision for the Industrial Engineering Department, and how do you plan to align it with the broader goals of the institution?

Our vision for the Industrial Engineering Department is to create a renowned center of academic excellence, innovation, and industry collaboration. We aspire to produce graduates who possess cutting-edge knowledge and practical skills, empowering them to excel in various industrial sectors while contributing to societal advancement through impactful research and problem-solving. To align with the institution’s broader goals, we plan to cultivate strategic partnerships

with industry leaders, enhance academic programs to meet evolving industry needs, promote a culture of research and innovation, support student success through mentorship and career development initiatives, foster diversity and inclusion, and ensure continuous improvement through ongoing assessment and evaluation. By pursuing these objectives, the department will not only strengthen its reputation but also contribute significantly to the institution's mission, impact, and relevance in the field of higher education and industrial engineering.

IOE has recently undergone revisions and modifications on BE syllabus after a considerable period, and you were also involved as an expert in this change. How do you anticipate these course changes will prepare students for the future career in industry?

The recent revisions and modifications to the Bachelor of Engineering (BE) syllabus at the Institute of Engineering (IOE), with our involvement, hold significant potential in preparing students for future careers in the industry. The updated syllabus is designed to be more market and student-friendly, aligning closely with industry demands and contemporary trends. By streamlining and optimizing the course workload, students are provided with more flexibility to engage in extracurricular activities, internships, and research opportunities that complement their academic journey. However, the effectiveness of these changes ultimately depends on the students' initiative and dedication to making the best use of their time. It is essential for students to actively seek out meaningful experiences, apply theoretical knowledge in practical settings, and develop relevant skills that will enhance their employability and readiness for the dynamic challenges of the industry. Thus, while the revised syllabus sets the foundation, it is the proactive engagement and initiative of students that will truly shape their future career prospects in the industry.

How do you envision the role of industrial engineering evolving in the next 5-10 years, and how are you preparing your department for these changes?

In the upcoming 5-10 years, we foresee industrial engineering evolving to encompass a wider spectrum, integrating traditional principles with emerging technologies and interdisciplinary approaches. Industrial engineers will play a crucial role in optimizing complex systems across various industries, leveraging advancements in automation, artificial intelligence, data analytics, and sustainability practices. To prepare the department for these changes, we're enhancing our curriculum with interdisciplinary coursework and real-world case studies, emphasizing smart manufacturing, supply chain optimization, and sustainability. We're fostering a friendly environment, strengthening industry collaborations for relevance, and offering experiential learning opportunities through internships and industry-sponsored projects. Additionally, we're investing in faculty development to ensure they remain updated with the latest trends. Through these initiatives, we aim to equip our graduates with the skills and knowledge to excel in the dynamic landscape of industrial engineering, contributing to innovation and efficiency across diverse sectors.

What steps can be taken to promote diversity and inclusion within the field of industrial engineering, ensuring that it is accessible and welcoming to individuals from all backgrounds?

Promoting diversity and inclusion within industrial engineering necessitates deliberate actions to ensure accessibility and a welcoming atmosphere for individuals from diverse backgrounds. To achieve this, efforts must focus on diverse representation among faculty, staff, and students, actively recruiting and retaining individuals from underrepresented groups. The curriculum should be inclusive, incorporating diverse perspectives and examples to reflect the experiences of all individuals. Cultural competency training for faculty, staff, and students is essential to create an environment free from biases and conducive to learning. Support services, including mentorship programs and counseling services, should be available to support students from underrepresented backgrounds and foster a sense of belonging. Outreach and recruitment initiatives should target diverse groups, and scholarships and financial aid opportunities should be provided to support their academic pursuits. Additionally, promoting diversity in leadership roles within the department and industry organizations can serve as a model for students and contribute to a more inclusive environment. By implementing these measures, industrial engineering can become a more diverse, inclusive, and vibrant field, benefiting from a wide range of perspectives to drive innovation and excellence.

As we navigate the changing educational landscape, have you observed any shifts in student preferences when it comes to join engineering programs in general? How do you envision rekindling interest in engineering among students?

In navigating the evolving educational landscape, there has been a noticeable shift in student preferences regarding engineering programs. While traditional engineering disciplines such as mechanical, computer, and civil engineering continue to attract students, there has been a growing interest in interdisciplinary fields such as environmental engineering, biomedical engineering, and data science. Additionally, there has been an increased emphasis on programs that integrate engineering with other disciplines such as business, healthcare, and sustainability. To rekindle interest in engineering among students, it is crucial to highlight the relevance and impact of engineering in addressing global challenges, promoting innovation, and improving quality of life. This can be achieved through targeted outreach efforts, including interactive workshops, hands-on projects, and guest lectures from industry professionals. Furthermore, showcasing the diverse career opportunities available to engineering graduates, from traditional engineering roles to emerging fields such as renewable energy, artificial intelligence, and sustainable development, can inspire students to pursue engineering as a rewarding and impactful career path. Additionally, emphasizing the importance of creativity, problem-solving, and teamwork in engineering education can appeal to students' interests and aspirations, fostering a renewed enthusiasm for the field.

In recent trends, a growing number of Industrial Engineering (IE) graduates are pursuing further studies abroad. Do you believe this scenario will lead to a shortage of IE professionals in the local market, or is it providing valuable exposure to the international market?

The growing trend of Industrial Engineering (IE) graduates pursuing further studies abroad presents a dual perspective regarding its impact on the local market.

On one hand, the migration of IE graduates for further studies abroad can lead to a temporary shortage of professionals in the local market, especially if a significant number of talented individuals choose to pursue opportunities overseas. This shortage could potentially impact local industries and organizations that rely on IE professionals for optimizing processes, improving efficiency, and driving innovation.

On the other hand, the exposure gained by IE graduates through international education can be immensely beneficial for the local market in the long term. Studying abroad exposes students to diverse perspectives, innovative practices, and advanced technologies that may not be readily available in the local market. This exposure can enhance their skills, knowledge, and global network, making them more competitive and valuable assets when they return to the local market or contribute remotely from abroad. Additionally, these graduates may bring back new ideas, best practices, and international connections that can stimulate innovation and growth in the local IE sector.

In summary, while the trend of IE graduates pursuing further studies abroad may lead to a temporary shortage of professionals in the local market, it also provides valuable exposure to the international market, ultimately benefiting the local market through enhanced skills, knowledge, and global perspectives brought back by returning graduates. Therefore, it is essential for local industries, educational institutions, and policymakers to support and leverage this trend by creating opportunities for international collaboration, knowledge exchange, and talent retention.

The Industrial Engineering department deserves applause for its proactive approach in establishing valuable connections with stakeholders, industries, research organizations. Could you shed light on the department's strategic plan to leverage these connections for the benefit of students, encompassing opportunities such as internships, jobs, trainings, and orientations? How can SOIES Nepal aid department on this regard.

The Industrial Engineering department has implemented a strategic plan to leverage its valuable connections with stakeholders, industries, and research organizations for the benefit of students. This plan encompasses various opportunities such as internships, jobs, trainings, and orientations to enhance students' academic and professional development. The department actively collaborates with industry partners to offer internship opportunities that provide students with hands-on experience and exposure to real-world industrial engineering challenges. Additionally, the department facilitates job placements by connecting students with industry professionals through networking events, career fairs, and alumni networks. Furthermore, the department organizes training sessions and orientations conducted by

industry experts to supplement students' academic learning with practical insights and skills relevant to the industry.

In this regard, the Society of Industrial Engineering Students (SOIES) Nepal can aid the department by providing support in several ways. Firstly, SOIES can facilitate partnerships and collaborations between the department and industry stakeholders, leveraging its network and expertise to identify potential opportunities for students. Secondly, SOIES can assist in organizing industry-focused events, workshops, and seminars that bring together students, faculty, and industry professionals to exchange knowledge and explore collaboration opportunities. Thirdly, SOIES can support the department in implementing mentorship programs that pair students with industry mentors to provide guidance and support throughout their academic and professional journey. Overall, the collaboration between the Industrial Engineering department and SOIES Nepal can create a conducive environment for students to access valuable opportunities, develop relevant skills, and establish meaningful connections that enhance their career prospects in the field of industrial engineering.

Lastly, Do you want to say something to SOIES Nepal and the magazine team?

I would like to express my sincere gratitude for your dedication and commitment to promoting excellence in the field of industrial engineering. Your efforts in fostering collaboration, knowledge exchange, and professional development opportunities are invaluable in shaping the future of our industry and empowering the next generation of industrial engineers. I am inspired by your passion and vision for advancing the field and am honored to be a part of this vibrant community. Together, let us continue to innovate, collaborate, and inspire positive change in the field of industrial engineering. Thank you for your tireless efforts and dedication.

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Industry 4.0

Technologies

IoT (Internet of Things)

The Internet of Things (IoT) refers to a network of interconnected physical devices and objects that can communicate and share data through the Internet. These devices, equipped with sensors and actuators, collect and exchange information in real-time, enabling them to make intelligent decisions without human intervention. It enhances efficiency, automation, and decision-making by providing valuable insights based on the data generated by these connected devices. IoT aims to create a more interconnected and efficient world by seamlessly integrating the digital and physical realms.



Big Data Analytics

Big Data Analytics involves the examination and interpretation of large, complex datasets to uncover patterns, trends, and insights that can inform decision-making. It goes beyond traditional data processing methods, utilizing advanced algorithms, statistical models, and machine learning to extract valuable information from massive volumes of data. In essence, transforming raw data into actionable knowledge enables a more informed and strategic approach to problem-solving and planning.

Artificial Intelligence

In Industry 4.0, Artificial Intelligence (AI) is the tech powerhouse that brings intelligent decision-making, learning capabilities, and automation to manufacturing processes. It optimizes production, enhances efficiency, and enables smart, adaptive systems through machine learning and predictive analytics, marking a significant leap in the evolution of industrial technology.



Autonomous Robots

Autonomous robots are cutting-edge technology designed to perform tasks without direct human intervention. These robots are equipped with advanced sensors, AI, and machine learning, allowing them to navigate and adapt to their environment. It contributes to the smart factory concept by enabling flexible and adaptive production lines, reducing the need for manual labor, and increasing productivity. This technology exemplifies the transformative impact of Industry 4.0 by ushering in a new era of intelligent, self-guided machines in industrial settings.



Cloud Computing

Cloud computing in Industry 4.0 facilitates efficient data management, analysis, and sharing among interconnected devices, contributing to enhanced decision-making, agility, and cost-effectiveness. It forms the backbone for the digital transformation of manufacturing, allowing businesses to leverage the benefits of smart, interconnected systems in the modern industrial landscape.

Blockchain Technology

Blockchain technology is a revolutionary tool that ensures secure, transparent, and tamper-resistant transactions and data sharing across interconnected devices and systems. It operates as a decentralized and distributed ledger, where information is stored in a chain of blocks, each containing a timestamp and a link to the previous block. This technology enhances the integrity and trustworthiness of data exchanges in supply chains, logistics, and manufacturing processes. By providing a decentralized and immutable record, blockchain fosters transparency, reduces fraud, and streamlines complex transactions, making it a key enabler of trust in the digital era of smart manufacturing.

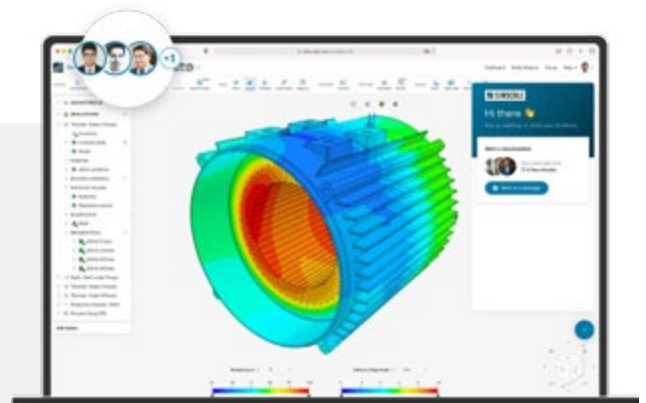


5G connectivity

5G technology is the next generation of mobile connectivity, providing faster speeds and lower latency than 4G. Although it is a reality in some countries, we still consider it as the next generation, because it is currently in the process of being adopted by nations around the planet. In Industry 4.0, 5G is used to connect devices and equipment in real-time, enabling faster and more reliable communication between machines and people, which can be essential to increasing results and the competitiveness of a business.

Simulation Systems

Simulation is a technology that allows you to create a virtual model of a process or system to test and optimize it before it is implemented in real life. In Industry 4.0, simulation systems are used to test new production processes, train employees, and improve the efficiency and quality of products before they go to market.





Early Development

In the 1990s, a team of engineers from NASA's Marshall Space Flight Center developed a revolutionary rocket known as the DC-X, which performed the world's first successful vertical takeoff and landing of a reusable rocket. Despite a relatively small team of 100 engineers and a budget of only \$60 million, the DC-X program demonstrated the feasibility of reusable rockets. Unfortunately, NASA ended funding for the program in 1996. However, the engineers behind DC-X did not give up on their vision of reusable rockets. They continued to develop new technologies, which



eventually gave rise to modern reusable rockets such as SpaceX's Falcon 9 and Blue Origin's New Shepard. Today, these reusable rockets are heavily utilized in launching commercial satellites, transporting astronauts to and from the International Space Station, and even promoting space tourism. The cost-effectiveness and sustainability of reusable rockets have greatly benefited the space industry, providing nations with the opportunity to establish their space programs and allowing small companies and students to launch satellites for research and commercial purposes.

Reusable Rocket

Have you ever seen a rocket launch and marveled at the engineering behind it?

- Dhan Prasad Pradhan

Have you ever seen a rocket launch and marveled at the engineering behind it? It's no wonder they're considered marvels - it takes a lot of precision and high-quality components to safely launch a payload into orbit. But all that top-notch technology comes with a hefty price tag. The recent Artemis-I mission cost around \$4.8 billion, which is about 14% of Nepal's GDP in 2021. And that's just for a successful mission - the cost only goes up if something goes wrong. It's no wonder that for many countries, rockets and space programs are financially out of reach. But there's another problem with traditional rockets: once the payload or spacecraft is sent into orbit, the most expensive parts of the rocket, the boosters, are just left to crash back down to Earth. It's like throwing away a jumbo jet after every flight. This wasteful approach to space

travel has led some brilliant engineers to come up with a solution: reusable rockets. Reusable rockets have the potential to change the way we explore space by significantly reducing the cost of launches. They can be used multiple times, meaning the cost is spread out over multiple missions instead of being incurred all at once. Plus, they're designed with reliability in mind and can be tested and refined over multiple launches. While there are still challenges to overcome, like wear and tear on the rocket's components and the initial cost of building and maintaining reusable rockets, they represent an exciting step forward in space exploration. By lowering the cost and increasing the reliability of launches, reusable rockets could make it possible for more people to reach for the stars.

“With a staggering number of launches, a low cost per kg, short intervals between consecutive launches, and operational efficiency made possible by the use of reusable rockets.”



Dhan Prasad Pradhan, Mechanical design engineer, Yatri Motorcycles

Economics Of Reusing

In 1968, NASA introduced the space shuttle program to regularly visit the International Space Station (ISS) for maintenance and resupply. The program consisted of four different space shuttles - Columbia, Challenger, Discovery, and Atlantis - which were essentially spaceplanes attached to rockets and were only recovered and reused. These spaceplanes were responsible for a total of 138 successful missions, but unfortunately, two of them also failed. Despite their reliability, the cost of the space shuttle program remained high due to its complex design. Each launch cost around \$450 million, and the entire program cost a staggering \$211 billion. Later, NASA dropped the space shuttle program due to financial and other reasons.

In the early days of space exploration, launch vehicles such as Vanguard had a high cost per kilogram of payload, at around \$1 million. The Space Shuttle program was able to decrease this cost to around \$55,000 per kg. However, despite advancements in technology, the cost of launching payloads into space remained relatively unchanged. This began to change in 2013, with the advent of SpaceX's reusable rockets. According to SpaceX, the cost per kg of payload for launching with the Falcon Heavy and Falcon 9 rockets is \$1,400 and \$2,700 respectively, which is significantly lower than previous launch costs. This cost reduction is largely due to the reusability of the rocket boosters. As a result of SpaceX's success, other private companies and national space agencies have begun to focus on reusable rocket technology. The trend of decreasing launch costs per kg of

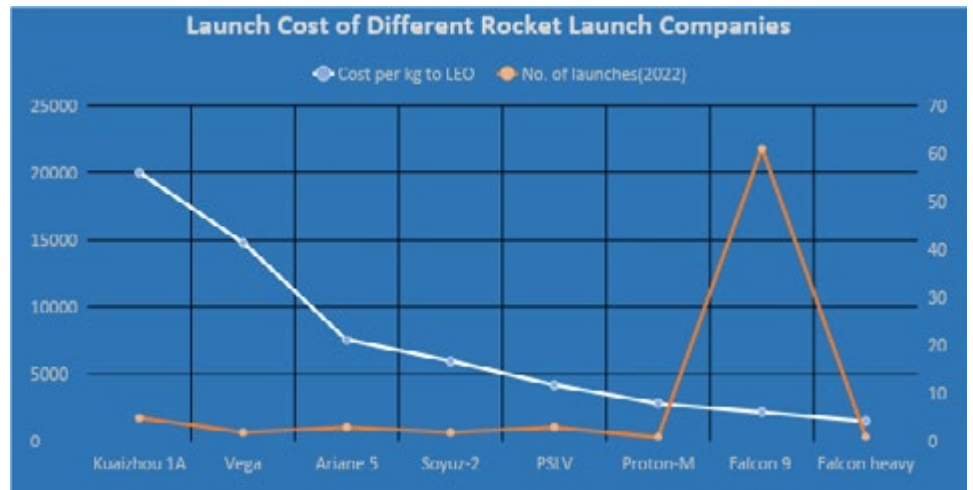


Fig: Graph

payload can be visualized in the accompanying graph. This graph illustrates the current state of the space industry, and it's clear to see that SpaceX is leading the charge in the race to make space accessible and affordable for all. With a staggering number of launches, a low cost per kg, short intervals between consecutive launches, and operational efficiency made possible by the use of reusable rockets.

It is important to note that while SpaceX's Falcon 9 rocket has been successful in many launches and has played a major role in the company's success, it is not the only player in the space industry. Other private companies like Blue Origin, Virgin Galactic, and Rocketlab, as well as national agencies in countries like China, Russia, the European Union, and India, are also working on reusable launch systems and making strides in the industry. The space industry is expected to see even more advancements and innovations in the future with reusable rockets, as the number of players in the field increases. This is likely to lead to more frequent launches, lower costs, and greater accessibility to space for a wider range of customers.

In conclusion, reusable rockets are revolutionizing the space industry and changing the way we access space. With companies like SpaceX leading the way, and others following suit, the future of space travel is looking bright, as reusable rockets make space travel more frequent, affordable, and accessible to all.



Top Manufacturing Companies

in Nepal

Business Haunt 2023

Nepal Lever Ltd

Nepal Lever Ltd., the Nepalese subsidiary of the British consumer products company Unilever, was established in 1992 and operated in Nepal for over 20 years, providing a variety of products such as food, beverages, personal care items, and household cleaning supplies. The company continues to be a significant player in the Nepalese consumer products industry, supplying popular names like Lipton, Surf, and Pepsodent, among others. Its transportation method is efficient, and a significant presence in both urban and rural areas of the country.



Chaudhary Group



Chaudhary Group, a global conglomerate headquartered in Nepal, operates in various sectors including banking, finance, hospitality, real estate, energy, and education. Established by Lunkaran Das Chaudhary, who passed away in 1933, it is now managed by his son, Binod Chaudhary. The company has significant operations in Nepal, India, Sri Lanka, Bangladesh, and the Middle East, and is present in over 30 countries. With over 15,000 employees, it is one of Nepal's largest private companies.

Himalayan Snacks Pvt. Ltd.

Founded in 2015 by Nepali businesspeople, Himalayan Snacks Pvt. Ltd. aims to promote healthful snacking in Nepal. The company produces snacks using traditional Nepali recipes and locally sourced ingredients, without artificial flavors, additives, or gluten. Their goal is to offer delicious, wholesome, and eco-friendly food choices. Popular products include roasted legumes, roasted peanuts, and baked lentil snacks.



Himalayan Snax & Noodles (P) Ltd.



Nepal Distillery Pvt. Ltd.

Nepal Distillery Pvt. Ltd. specializes in the production of alcoholic beverages, particularly whiskey and rum. It is renowned for its traditional and high-quality brewing techniques.



Unitech Nepal Pvt. Ltd.

A Nepal-based information technology (IT) company called Unitech Nepal Pvt. Ltd. offers a variety of IT services and solutions to businesses and organizations. The business was established in 2002, and it has its headquarters in Kathmandu, Nepal. Unitech Nepal Pvt. Ltd. offers a variety of products and services, some of which are software development, web development, mobile application development, e-commerce development, digital marketing, and IT consulting.

Shree Pashupati Steel Industries Pvt. Ltd.

Shree Pashupati Steel Industries Pvt. Ltd. is a business with headquarters in Nepal that focusing the manufacture and sale of steel goods. Shree Pashupati Steel Industries Pvt. Ltd. manufactures a wide array of steel products, including steel ingots, steel sheets, steel pipelines, and wire rods. The company prides itself on crafting high-quality steel goods that meet global standards, employing state-of-the-art machinery and technology in its production processes.



Jagdamba Steel Industries Pvt. Ltd.

Situated in Nepal, Jagadamba Steel Industries Pvt. Ltd. specializes in steel manufacturing. Established in 2001, the company has established itself as one of Nepal's leading steel producers. Jagadamba Steel Industries Pvt. Ltd. manufactures a wide range of steel products, including TMT bars, wire rods, angles, channels, and billets. Utilizing modern tools and technology, the company ensures the highest standards for its products.

Star Chemicals and Catalysts Pvt. Ltd.

Star Chemicals and Catalysts Pvt. Ltd. produces a range of chemical products, including industrial and laboratory chemicals. It is known for its innovation and commitment to quality in the chemical industry.



Gorkha Brewery Pvt. Ltd.

Gorkha Brewery Pvt. Ltd. is known for producing popular beer brands such as Tuborg and Carlsberg. It maintains high standards in brewing quality beverages, making it a leader in the Nepalese beer market.

Surya Nepal Pvt. Ltd.

Surya Nepal Pvt. Ltd., part of ITC Limited, manufactures and markets cigarettes and has diversified into garments and safety matches. The company plays a significant role in Nepal's tobacco and garment industries.





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Manufacturing process:

1. Collecting raw material:

The fallen leaves are gathered by farmers and sheaths are separated from the leaf. After separating, the farmers deliver the sheaths to merchants who deal in Areca leaves.

2. Drying the areca sheath:

As the following phase in the procedure, areca sheaths are to be dried. The sheaths are further dried by the merchants once they gather them from the farmers and stacked in bundles.

Cleaning the areca sheath
After coming into the factory, the manufacturers soak the sheath in freshwater for 20 minutes making them pliable. In order to get rid of the dust and sand particles, the sheaths are also washed with a soft brush.

3. Heat press and plate forming:

The Areca leaf plate making machine has two pressing heads: the upper pressing head and a lower pressing head. The upper head is fixed to a channel and the lower head of the machine moves up and down. The up and down movement of the machine helps in pressing the areca leaf sheaths. Both the pressing heads have a heating coil. After turning on

LEAF PLATES: AN ECOFRIENDLY DINING

- Prajita Ghimire

Sustainable, Biodegradable, and eco-friendly are the age-old words used to define the quality factors of Areca Palm Leaf Plates (Supaari ko paat). It's astounding to see how minutely they affect the environment in all the good ways. Areca leaf plates are a sustainable alternative to single-use plastic tableware, manufactured from the fallen sheaths of areca or betel palm trees.

Areca palm plants (scientifically known as Areca catechu) are extensively cultivated in the lower belt of Terai. There are 38 million areca nut trees in Eastern Nepal. Areca plant takes seven years to fully establish itself and can last up to eighty years in the field and even beyond. Throughout its life cycle, areca plant not only produces the primary product (Betel nut) but also yields by-products (leaf sheath and areca nut husk). Each areca palm produces on an average 10 leaf sheaths per year which is either burned for cooking or basically wasted. Thus, every

year around 380 million leaves are getting wasted as an agro waste. Due to the advances in technology, it has now been possible to utilize the leaf sheaths for manufacturing of plates, bowl or spoons of variety of shapes and sizes. Each leaf can be utilized to produce an average of 3 plates. Thus, there is a potential to produce up to 1.2 Billion areca leaf plates in Nepal by utilizing those leaves. [1]

Unique features of areca leaves plates:

- Microwaveable and safe for oven use
- Holds liquid both hot and cold
- Compostable and Biodegradable
- Strong and light weighted
- Versatile
- Natural, wood-like appearance with its beautiful grains and textures
- Hygienic and food safe
- Cultural and traditional appeal

“ Each leaf can be utilized to produce an average of 3 plates. Thus, there is a potential to produce up to 1.2 Billion areca leaf plates in Nepal by utilizing those leaves. ”



the machine, the pressing heads start heating. The heat of these heads is controlled by a thermostat.



Prajita Ghimire, Batch of 2076, Bachelors in Industrial Engineering
Prajita.076bie030@tcioe.edu.np



After the heating of the sheaths with the Areca leaf plates making machine, the next step is the pressing of the plates. We place the sheath between the hot-pressing heads and press them tightly. The heads are tightly pressed against each other to get the desired shape.

The pressing heads also contain cutting blades in the edge with which you can easily cut the sheath into a proper shape.

4. Grading and Surface finishing:

The last step is to grade the Areca Leaf Plates which is done manually.

After the grading, the Areca leaf plate's edges are smoothed with the help of sandpaper. This process provides the plates with a beautiful finishing and a clean surface and edges. Additionally, the process also helps in removing all the dust and debris from the leaf plates.

5. Packaging:

In the end, the leaf plates are left to dry. Before packaging, it is made sure that there is no moisture in the plates. [2]

Case study of Leaf plus

Areca leaf plates are produced by a number of manufacturers in Nepal, Leaf Plus Private Limited being one of the examples.

LeafPlus is a socio-economic enterprise that aims to impact the environment & society by producing and promoting areca leaf products manufactured with direct engagement of women, marginalized & farmer groups in the production chain. Registered in 2017, the venture is expanding in the Nepalese market as we can find these products across the nation from profound online stores like Daraz to the street market.

On a very informal conversation between three high school friends Kobit Singh Baniya (Graduate of Electronics and Communication Engineering), Swaviman Acharya (Mechanical Engineer from Pulchowk Engineering campus) and Bidhan Pokhrel (Graduate of Electrical and Electronics Engineering from KU) at a local momo shop, the idea of making those leaf plates better, reliable and leakage proof inspired them towards establishing a company, Hence Leaf plates.

The manufacturing industry is based in Jhapa where they discovered that a significant amount of these leaves was wasted and there would not be any shortage of the raw material. With 19 employees, 2000+ farmers benefited and 4 million+ plastic plates replaced, Leaf Plus has been making an impressive move in the Nepalese market.

In the early stages of the company's establishment, the company's production capacity was 15,000 to 20,000 pieces month. It is now producing between 200,000 and 250,000 pieces each month. They have been getting impressive attention in B2B sales- Bhatbhateni Supermarket to Soaltee Hotel. Leaf plus has signed an agreement with BuyEcoGreen, a company based in Australia to ship their products and is expanding their business into other countries as well. [3]

Not always, your academic line reflects your business move but A multidisciplinary Field as Engineering teaches students engineering management skills such as accounting, leadership, international relations, quality management, and research all vital skills for being an entrepreneur and establishing and running your own business. With its upside there are downfalls, but a sustainable vision always works. Leaf plus and the engineering alumnis founding it certainly reflect upon that.



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An overview on Industrial Hemp

Reviving an ancient crop.

- Kusum Raj Tamang

Introduction:

Begun in Central Asia, hemp, experimentally named *Cannabis sativa* L. has been developed for fibre, nourishment, and therapeutic properties. (Vasanth Rupasinghe et al., 2020). In 2018, the USA passed The Farming Change Act, which authorized the generation of hemp and its subsidiary items. It moreover characterized mechanical hemp as any hemp propagules seeds, takes off, fibre, and CBD having delta nine THC substance of less than 0.3 percent.



Fig. Marijuana

Difference between hemp and marijuana

Even though there are huge genome-wide contrasts between cannabis and hemp, it is outwardly troublesome to foresee whether it is pot or mechanical hemp. (Sawler et al., 2015). Chemically pot contains more than 0.3 delta 9 THC, but we cannot say based on field perception. Not one or the other such progressed commercial gear has been created for testing THC at a field level. But a few key perceptions might be made to guess the contrasts. For case, mechanical hemp plants are tall, a few cultivars like Jinma, Yuma, and Panther indeed surpass 12 ft. in tallness (LU trial). However, marijuana plants are brief and bushy. Bushiness is additionally a vital characteristic of the pot. Since most of the mechanical hemp uncommonly developed for seeds does not have

auxiliary branching, even though ready to visually tell the contrast between fibre and seed hemp. To distinguish between CBD hemp and pot is indeed more challenging.



Nepal has excellent conditions for hemp cultivation, but legal restrictions currently limit its production.



Importance of Hemp:

Although hemp has colossal potential as an elective source of protein, they have been utilized exceptionally small and the hemp inquiry has fairly started. Hemp contains a great sum of protein, specifically edestin, vicilin, and egg whites which

can be utilized as an elective to animal-based protein nourishment (Liu et al., 2022 Shen et al., 2021) In expansion, the hydrolyzed peptides have a few positive wellbeing impacts, counting antioxidant, antihypertensive, and hypoglycaemic activity. (Shen et al., 2021) Terpenes dependable for the fragrant character of hemp are the fundamental oils that have synergic or escort impacts (making you feel great but not tall) on the consumers. (Sommano et al., 2020). Hemp incorporates terpenophenolic components counting cannabidiol (CBD) and cannabigerol (CBG), which are associated with cannabinoid receptors to emphatically control a run of physiological, immunological, and metabolic forms in people. Due to CBD and CBG's effect on the cytokine digestion system, cannabinoids are being explored for their potential role in the treatment of viral maladies like COVID-19. (Deguchi et al., 2020).

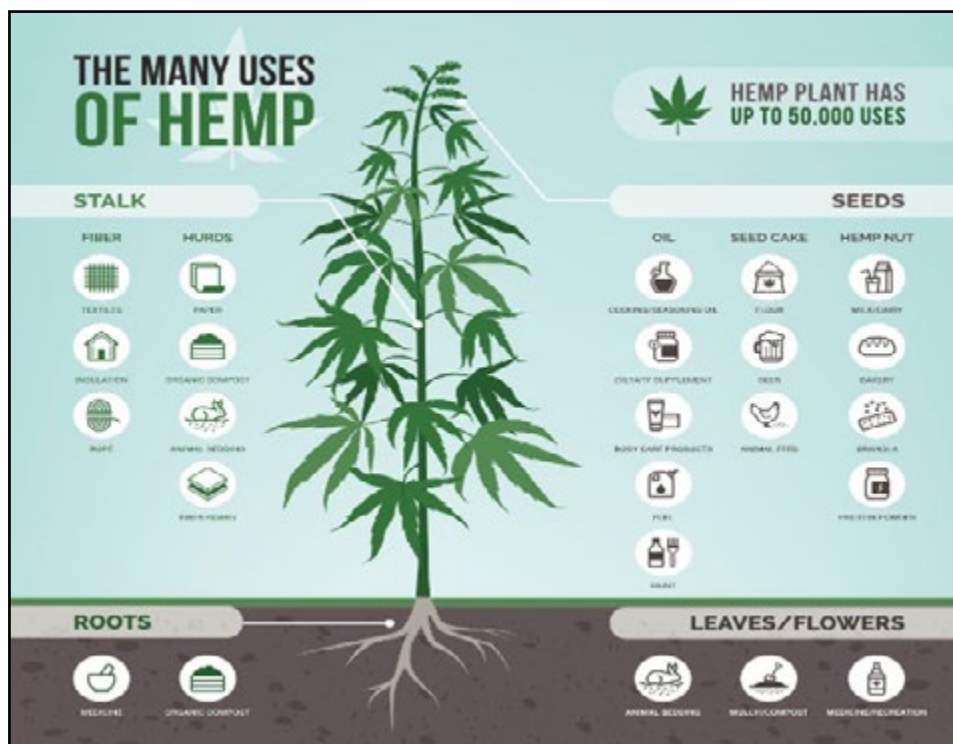
In expansion to cannabinoids and nutritive values, mechanical hemp has been plan utilized in fibre and its subordinate items. The thermoplastic bundling and paper businesses can advantage of the more noteworthy quality of hemp filaments, which are composed of cellulose derivatives. (Promhuad et al., 2022). Hemp-based articles of clothing are becoming even more popular within the



Fig. Hemp



Kusum Raj Tamang is a graduate research assistant and industrial hemp researcher at Lincoln University Hemp Institute, US. He completed his bachelor's from the Institute of Agriculture and Animal Science (IAAS), and he was the founder of The Narke Rabbit and Meat Production Farm, one of the pioneering rabbit farms in Nepal.



Joined Together States and all parts of the globe. Indeed, well-known companies like Nike, Patagonia, and Levi's have begun to utilize hemp-based materials in their materials, giving amateur business visionaries positive thinking. In addition, hemp woods and hemp concrete can be made from hemp filaments which are maintainable choices for wood and ordinary concretes.

Current research trend in Industrial Hemp:

The Marihuana Tax Act, of 1937, passed by Congress began the boycott on hemp within the USA. Harry Anslinger, the Charge Act's primary advocate, began progressing anti-marijuana legislation globally. This brought about the worldwide prohibition of hemp development and handling. Hemp cultivars were burnt down, and all the hemp processing plants were shut down. This was driven by the misfortune of all the information base of hemp hereditary qualities and agronomic hones.

In 2014, President Obama marked the Cultivate Charge, empowering

scholarly teachers to dispatch test industrial hemp programs. Ever since, researchers have been attempting to think about and revive this antiquated trim. The inquiry about mechanical hemp is still within the fledgling organized investigative being centric on hemp generation, preparation, and therapeutic utilization. Cornell College is investigating the microbiome, hemp atomic hereditary qualities, and stressors on THC in hemp. Additionally, Oregon State College is investigating the potential of hemp seeds as a ruminant count calorie. Too, they have been researching the vegetative proliferation of hemp, hemp seed preparation, and restorative utilization. Similarly, the College of California, Davis is working on translating the hemp genome. Similarly, they are testing by concocting the finest water system hones and agronomic hones for developing hemp. Lincoln College of Missouri as of late gotten a whopping 5 million give for inquiries about hemp. It has been investigating the varietal screening

of mechanical hemp for Missouri. Additionally, it is also working on agronomic investigations and the atomic perspective of hemp hereditary qualities.

Hemp in Nepal

Nepal is one of the roots of industrial hemp and offers a long history of hemp generation. In any case, with the US undertaking on war against drugs, the generation of mechanical hemp was confined in Nepal. Nepal possesses excellent physiographic conditions for hemp development. Hemp adores sloppy arrive and abhors outright water stagnation which makes most of the arrive appropriate for hemp generation. Able to witness this prove from the wild hemp inclining within the Western portion of Nepal. As of now, offering hemp-based items is permitted in Nepal. Be that as it may, developing mechanical hemp is still denied. In 2019, Nepal imported hemp strands for \$46,900 (Danielle, Hemp, and Trust). Envision how numerous work openings it would have created had it been developed in Nepal. In 2020 the law was ordered stating

that it would be lawful to resume the generation of hemp. In any case, the law has not been implemented as of presently. The great portion of this proposed law is that there would not be a necessity to authorize hemp developed for foods as licensing has been one of the major issues within the USA. Nowadays hemp has still been edited at a juvenile arrange. And each nation is investigating acing this edit and developing patents. In this way, Nepal ought to too inquire about standards with its worldwide partners and create valuable products and breeds that might elevate the national economy.

Challenges of Hemp and potential for entrepreneurs:

One of the essential challenges of hemp generation is the lack of information base. The worldwide forbidding of hemp has driven the annihilation of all the information base and hemp cultivars. Therefore, there's a need for appropriate hemp cultivars for a given agroclimatic locale. In expansion, the nonappearance of a gifted workforce has thwarted the development of this industry.

Another challenge is the ambiguity in-laws and arrangements. Even though the law has been ordered permitting hemp cultivation, they are shapeless because of the insufficient specialized information in cannabis science.

There's a need to create an economical advertising channel and expand the product. Hemp may well be easily grown, but without the correct development of the showcase and coordination, an increment in grounds would not be beneficial.

On 9th November 2022, Lincoln College Hemp

Established with the Jointed Together State Department of Farming (USDA) gave a workshop to agriculturists related to Hemp cultivators permitting. One of the essential issues indicated was the need for THC testing labs. So, establishing a THC testing lab would be an entrepreneurial opportunity.

Lincoln College is conducting varietal screening of hemp cultivars for Missouri. Amid its inquiry about mechanical hemp, a few of the challenges watched were seed diffusing, unsteady genetics, and weeds.

Hemp filaments are troublesome to prepare as per the co-founder of Midwest common filaments working in fibre preparation in Missouri. Amid LU Hemp Day 2022, he recommended that the thickly stuffed filaments within the hemp biomass made it troublesome to extricate the fibre strings for advanced preparation.

The public's conclusion on mechanical hemp is another issue we have right now. Numerous individuals continue to see hemp as a sedate with no clear positive uses.

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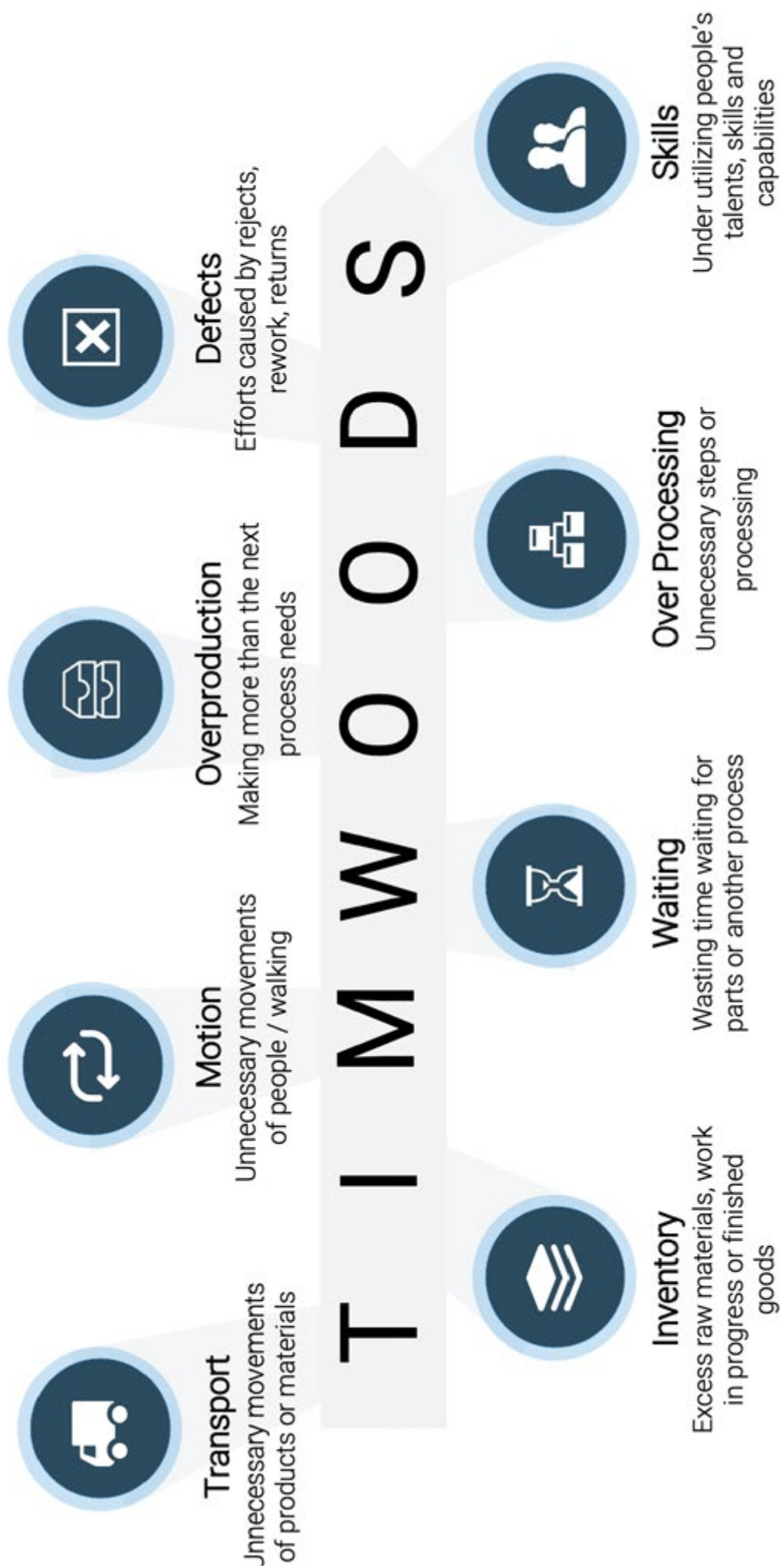
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A Comprehensive Analysis Of Emerging Additive Manufacturing In The Aerospace Sector

- Subash Dhakal

Abstract- Additive manufacturing is a fast-emerging technology that is extensively used all over the world. The purpose of this comprehensive Additive Manufacturing or 3D printing technology analysis is to identify the roles and applications of various 3D printing materials, types, and processes in the design and development of fabrication in the aerospace industry. 3D printing technology allows you to create complex shapes with fewer materials than conventional methods. It has been used for the mass customization and production of any type of design and development in the fields of the aerospace industry, aviation industry, and automobile sector as well. One of the methods of additive manufacturing, which is rapid prototyping, is a time-saving 3D printing process applied in the aviation and aerospace sectors. It is a fast and

cost-effective solution in whichever field it is used. In this paper, we will look at how the 3D printing process has impacted the aerospace industry. The applications of AM or 3D printing technology are expanding all the time in the field of aerospace, and it's proving to be a very exciting technology for today's manufacturing industries.

I. INTRODUCTION

3D printing technology, also known as additive manufacturing (AM) is a process that uses a digital design to create three-dimensional solid objects layer by layer[1]. Additive manufacturing (AM) enables unrivalled flexibility in component design and production in comparison to traditional methods of production therefore the difficulties during manufacturing are easily attained[2].

Nowadays, advanced manufacturing processes like rapid prototyping process have a wide range of applications in various fields of human activity: research, engineering, aerospace engineering, aviation, military, construction, architecture, and many others. Using 3D printers for these purposes is called rapid prototyping. Rapid prototyping is the fast fabrication of a physical part, model, or assembly using 3D computer-aided design (CAD). This is due to the simplicity of the use of 3D printing technology, which requires only sketching and setting the data in the machine-printed so that 3D things can be manufactured [3].

Aside from rapid prototyping, 3D printing is also applied for rapid manufacturing. Rapid manufacturing is a new manufacturing approach in which businesses employ 3D printers for short-run or small-batch custom manufacture [4]. It has evolved into a fully developed process for fabricating end-user products in a variety of industries. The creation of the part, model, or assembly is usually completed using additive manufacturing commonly known as 3D printing. To summarize, 3D printing technology has developed as a versatile and strong tool in the advanced manufacturing business in recent years. This technique has been widely used in many nations, particularly in the industrial sector. As a result, this article provides an overview of the many types of 3D printing technologies, their applications, and, finally, the materials utilized for 3D printing technology in the manufacturing business.

“Engineers can also utilize a 3D printer to create repair parts, sophisticated engine structures, and complex engine components on demand for individual aircraft.”



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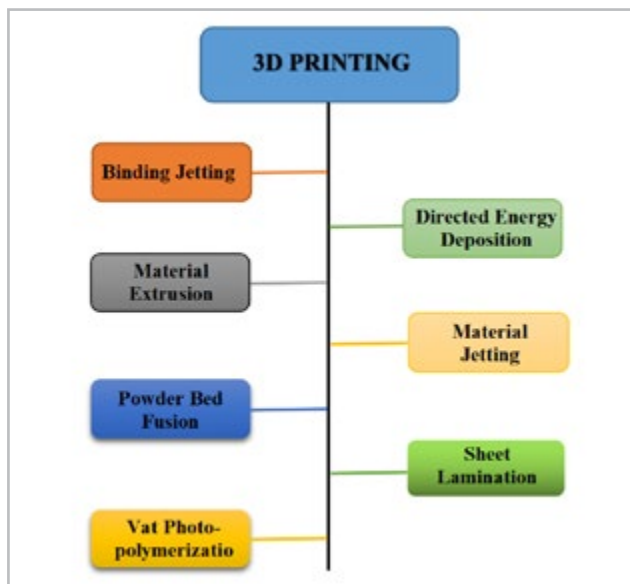


Figure 1. Types of 3D Printing Technology

II. TYPES OF 3D PRINTING TECHNOLOGY

The term 3D printing refers to a series of manufacturing technologies that manufacture parts layer by layer. There are several types of 3D printing methods with distinct functions that have been accessible.

According to ASTM Standard F2792 [5], 3D printing technologies are classified into seven categories, which include binding jetting, directed energy deposition, material extrusion, material jetting, powder bed fusion, sheet lamination, and vat photo-polymerization. 3D printing technologies are no longer restricted to prototypes nowadays[6]. They are most widely used in the aerospace and aviation industries for development and research.

1.1 Binding Jetting

Binder Jetting (BJ) is one of seven additive manufacturing processes that involves selectively deploying a binding liquid to combine powdered material to make a 3D component. Binder jetting commonly employs granular materials such as metals, composites, sand, stainless steel, nickel-based alloys, and ceramics. It is unique among today's additive manufacturing technologies because it does not require heat to fuse the material like other additive manufacturing processes[7]. Binder jetting is widely used in areas like aerospace and heavy industry, where thermally stable and wear-resistant parts are required. It can be suitable for producing low-cost, complex metal parts that do not require extremely high mechanical properties.

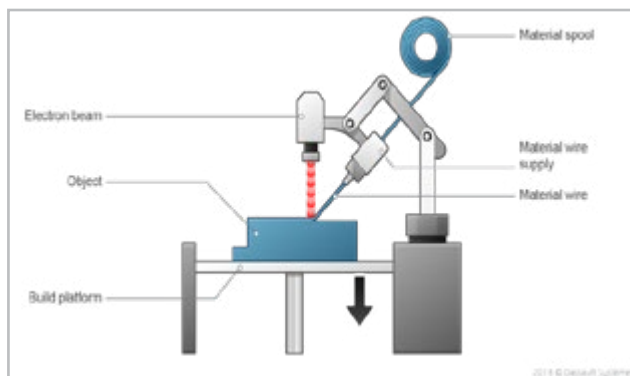


Figure 2. Binding Jetting process

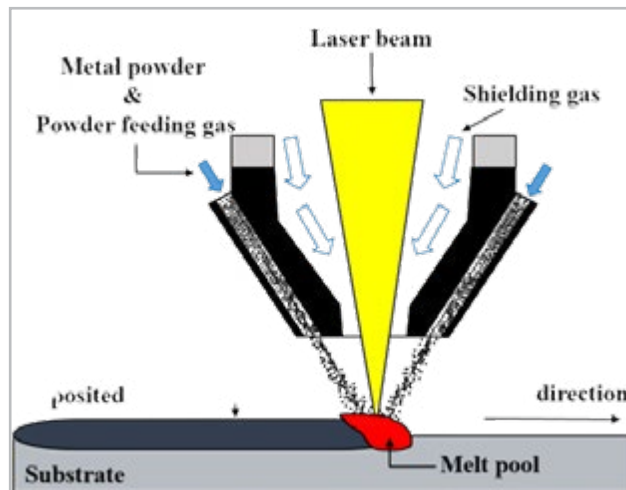


Figure 3. Directed Energy Deposition process

1.2 Directed Energy Deposition

DED is a 3D printing technique that uses a directed energy source such as a plasma arc, laser, or electron beam, to melt a material that is deposited by a nozzle [8]. A typical DED machine is made up of a nozzle mounted on a multi-axis arm that drops melted material onto the desired surface, where it sets. The process is similar in principle to material extrusion, except that the nozzle is not bound to a certain axis and can travel in any direction. This method is mostly applied to ceramics or polymers, but it is most commonly applied to metals and metal-based hybrids in the form of wire or powder.

Laser deposition and laser net shaping (LENS) are two examples of this technology[9]. Directed energy deposition is used in aerospace manufacturing to remove the layer from solid metals and specific compounds, making them more suitable for industrial processes. The advantage of directed energy deposition is the ability to control the grain structure, which allows the method to be used for the repair of high-quality functional parts.

1.3 Material Extrusion

The Material extrusion technique deposits the material through the nozzle, where it is heated to build 3D parts layer by layer[5]. It offers a wide selection of printing materials such as Polymers, ABS plastics, and Nylon, with low set-up and running

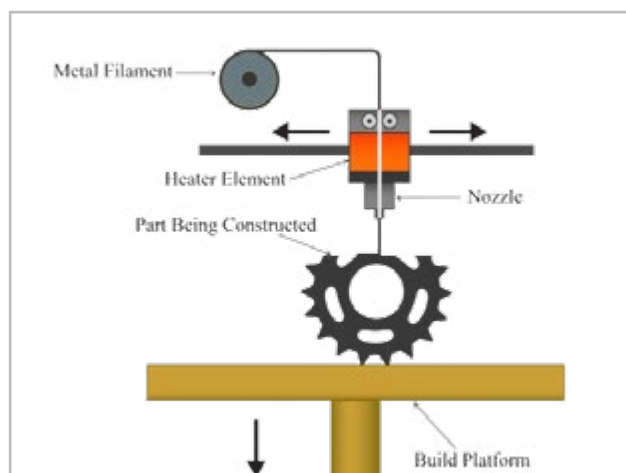


Figure 4. Material Extrusion Process

costs. Fused filament fabrication (FFF) and fused deposition modeling (FDM) are two significant examples of material extrusion technology. Materials extrusion is widely used in research and by hobbyists because of its low complexity, ease of implementation, and commercially available materials. Applications include the development of functional engineering prototypes and systems, including those for aerospace applications.

1.4 Material Jetting

Material jetting (MJ) is one of the seven types of Additive Manufacturing (AM) technologies in which drop by drop of build material is selectively deposited onto the build platform and cured by UV light or heat to produce a 3D object. MJ uses thermoset photopolymers (acrylics) as a material that comes in liquid and is dispensable from a print head [10]. Material jetting 3D printing produces high-dimensional-accuracy products with a very smooth surface finish for models of aerospace design. It is ideal for visual prototypes and industrial tooling useful in the fabrication of anatomical medical models for pre-surgical and suitable for casting patterns.

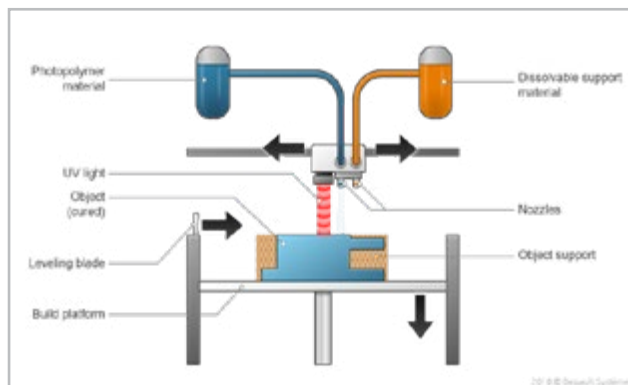


Figure 5. Material Jetting Process

1.5 Powder Bed Fusion

The Powder bed fusion technique in laser-based additive manufacturing has gained significant interest in the research and development of innovative engineered materials due to their greater cooling rate and superior surface smoothness when compared to other additive manufacturing processes [11].

The Powder bed fusion process uses any powder-based material, although the most typically used metals and polymers include Nylon DMLS, Stainless Steel, Titanium, Aluminium, Cobalt Chrome, Copper, and so on [12]. In comparison to other AM processes, it can integrate technology into small-scale, office-sized machines and a wide variety of material alternatives. The aerospace sector, which was an early adopter of powder bed fusion for metal components, works at the cutting edge of material science and engineering technology to push the boundaries of what is feasible. Powder bed fusion is employed to combine the numerous elements of a rocket engine combustion chamber into a single component, decreasing part complexity significantly.

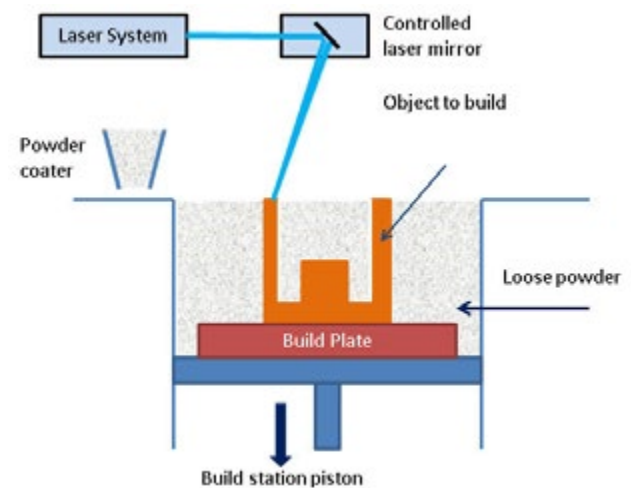


Figure 6. Powder Bed Fusion Process

1.6 Sheet Lamination

According to ASTM definition, sheet lamination is the 3D printing process in which sheets of materials are bonded together to produce a part of an object. Sheet lamination processes include bonding, ultrasonic welding, and brazing, with the final form created by laser cutting or CNC machining. As compared to the other seven AM processes, sheet laminate creates the product with the least additive resolution [13]. However, because of its low cost and shorter manufacturing time, it allows product designers to make low-fidelity prototypes using common, readily accessible low-cost materials.

Although sheet lamination may be done with a broad range of materials, including paper, polymer, ceramic, and metal, each material

has a unique binding process. The most common sheet lamination material is paper with pre-applied adhesive, which is activated by heat and pressure. Sheet lamination techniques are employed for a variety of applications, each of which is closely related to the unique procedure. For full-color printing, paper-based processes such as LOM and SDL are employed, whereas metal-based sheet lamination is used in hybrid production.

1.7 Vat Photo-polymerization

The most common 3D printing technology is photo-polymerization, which generally refers to the curing of photo-reactive polymers with a laser, light, or ultraviolet light (UV) [14]. It uses a vat of liquid photopolymer resin, out of which the model is fabricated layer by layer. The

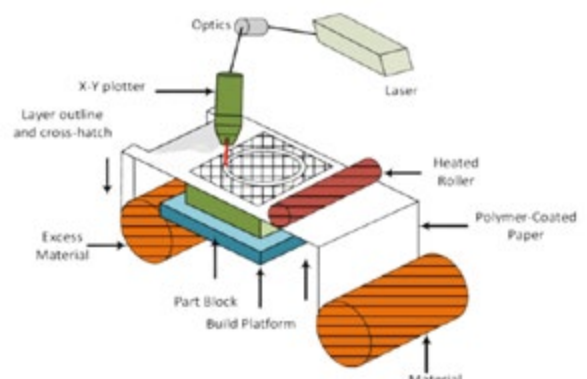


Figure 7. Sheet Lamination Process

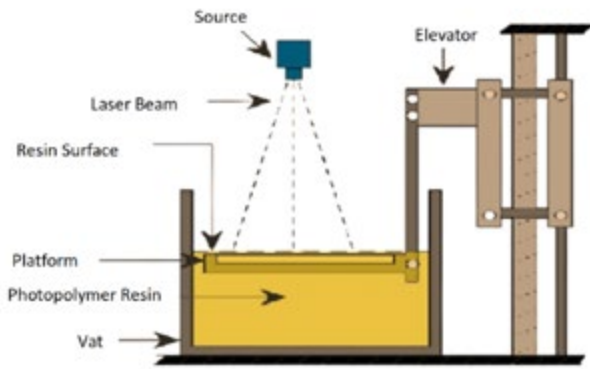


Figure 8. Vat Photo-Polymerization Process

VAT photo-polymerization process uses plastic and polymer materials to construct the model. Vat photopolymerization is classified into three types: stereolithography (SLA), digital light processing (DLP), and continuous digital light processing (CDLP).

A high level of accuracy and a good surface finish are obtained from this method. As a result, they're ideal for jewelry, low-run injection molding prototypes, and a wide range of dental and medical applications. One of the primary restrictions of vat polymerization is the brittleness of the produced fragments.

III. MATERIAL AND APPLICATION

The 3D Printing technology has evolved immensely since its early days. Technology has advanced not only in terms of machines but also in terms of the materials used to manufacture products. This advancement has greatly improved technology [15]. Today, the materials used in 3D printing are quickly growing, and material manufacturers are inventing new types of materials to meet a variety of industrial needs [16]. 3D printing technology can create completely functioning components out of a variety of materials such as ceramic,

metallic, nylon, aluminum, polycarbonate, titanium, and their hybrid composite or functionally graded materials (FGMs) [9]. Early research resulted in the development of a variety of conventional materials such as polymers, metals, and composites, but as more common materials are developed, the list of unconventional materials is constantly expanding. Let's look at some of the materials used in 3D printing, which is mostly employed in aerospace production.

1.1 Metals

Metal 3D printing technology is gaining popularity in the aerospace, automotive, medical, and manufacturing industries due to the benefits it provides [17]. A variety of metals in powder form can be utilized to make components using 3D printing. Titanium, stainless steel, aluminum, copper, cobalt chrome, tungsten, and nickel-based alloys are all available in powdered form for 3D printing to make aerospace components. A titanium-based alloy is suitable for use in 3D printing to make rocket engine components [18]. The other material, stainless steel, provides excellent corrosion resistance, making it perfect for printing pipes, valves, and steam turbine parts.

Furthermore, 3D printing technology can create aircraft parts out of nickel-based alloys. 3D-printed nickel-base alloys can be utilized in hazardous conditions. This is due to its strong corrosion resistance and hot temperature tolerance of up to 1200 °C. These distinct metals have various qualities that make them acceptable for a wide range of uses. For example, Super-alloys based on nickel High-temperature-resistant metals, such as Inconel, may also be 3D printed at temperatures as high as 1100°C. These nickel-based superalloys are also extremely strong and corrosion-resistant, making them perfect for use in the aerospace and energy industries [18]. Furthermore, because of their superior processability, parts may be produced reasonably easily utilizing various 3D printing techniques such as SLM and DED.

1.2 Polymers

3D printing technologies commonly use polymers for the production of components, from prototypes to functional structures with complex geometry in the aerospace field as well as for the biomedical industry. The most common materials used in 3D printing are Acrylonitrile Butadiene Styrene (ABS) and Polylactic Acid (PLA) [19]. Its widespread use may be attributed to its ease of availability, robust features, widespread application in industries, and low cost. The primary benefit is that it is biodegradable. It is also available in a variety of colors and even in clear form. Polymer Matrix Composites (PMCs) are also used to fabricate components in the aviation industry due to the benefits of shorter component manufacturing, rapid turn-around time for complicated parts, and lower cost of production [20].

1.3 Ceramics

Along with the constantly evolving science of ceramics, 3D printing is rapidly expanding the boundaries of what is possible in the future [21]. Ceramics are used in aircraft because they are lighter than metals, allowing for quicker speeds, lower fuel consumption, greater payloads, and longer space missions for exploration vehicles. Oxides, non-oxides, glass-ceramics, and ceramic matrix composites are examples of ceramic-based materials for aerospace applications. For example, silicon carbide composites, alumina, carbides, and borides. These materials provide dimensional stability across a wide temperature range and are tailored for mechanical strength and chemical resistance.

Ceramics are largely used in engine and exhaust systems, thermal protection shields, and structures for ultra-high-speed flying objects in aerospace. Parts of the exhaust system that improve acoustic attenuation and have a long life because of their abrasion and corrosion resistance, as well as lightweight turbine components like vanes, blades, nozzles, and combustion liners, are made of ceramics and ceramic matrix composites that can withstand temperatures as high as 1,600°C.

1.4 Composites

Composites are extremely adaptable, being applied for structural purposes as well as components in all aircraft and spacecraft, from hot air balloons and gliders to passenger jets, fighting planes, cargo, and the Space Shuttle. The Composite materials reduce the weight of components significantly. Carbon fiber-reinforced polymer composites [22] and glass fiber-reinforced polymer composites are two examples of composite

materials. Since 1987, the usage of composites in aircraft has increased every five years, with new composites appearing regularly. The kinds differ in mechanical qualities and are employed in many aspects of aircraft production. Carbon fiber, for example, has a distinct fatigue behavior and is fragile, as Rolls-Royce learned in the 1960s when the revolutionary RB211 jet engine with carbon fiber compressor blades broke catastrophically owing to bird attacks.

Alumide material which is used in the 3D printer is a polyamide mix with a trace of grey aluminum powder. Laser sintering is a process for producing robust and reasonably stiff complex, concept, functional, or series models. Alumide models can also absorb minor shocks and withstand moderate pressure under bending circumstances. It is an excellent material for beginning designers looking for low cost, maximum creative freedom, and increased printing capabilities. Furthermore, it provides better rigidity than polyamide alone and has an aluminum look. The surface is slightly porous and has a sandy, granular look. It can be left in its original grey matte form or dyed with a variety of colours.

1.5 Smart Material

Smart materials are materials that respond to environmental impulses and possess one or more qualities. They might also be referred to as responsive materials. These things can alter shape or behavior when exposed to hot water, pressure, chemicals, light, or heat. Form-memory alloys and shape-memory polymers are examples of group smart materials. Some shape-memory alloys, such as nickel-titanium, can be employed

in biomedical implants and microelectromechanical systems [13]. Transformation temperatures, repeatability of microstructure, and density are critical issues in the fabrication of 3D-printed objects employing nickel-titanium. Combining standard construction materials with smart materials might be an excellent method to produce structures that can quickly expand, self-repair, or adapt to their environment [2]. Airbus SAS is experimenting with a 4D-related "smart" material that reacts to temperature to cool aircraft engines and a wing that morphs according to aerodynamic circumstances to reduce air resistance. Having equipment that automatically adjusts to external conditions might be a huge benefit to a variety of sectors.

IV. THE APPLICATION OF 3D IN AEROSPACE TECHNOLOGY

In general, the aerospace industry was one of the early adopters of 3D printing technology, with early use dating back to the late 1980s. It is still regarded as the industry with the highest rate of adoption of 3D printing technologies today. Many prototype and end-use applications in the aerospace and aviation industries are a perfect choice for 3D printing. 3D printing technology has been used in a wide range of industries and it is also being used to produce car and airplane parts [23]. Many aircraft manufacturers now prefer to 3D-print components and parts rather than build them in contrast to conventional production techniques, 3D printing allows for the quick assembly of parts for both current and future aircraft models. Additionally, it enables engineers to test new materials while fabricating complex

engine components or fixing upcoming airplane components. Engineers can also utilize a 3D printer to create repair parts, sophisticated engine structures, and complex engine components on demand for individual aircraft.

Boeing has been experimenting with 3D printing for a long time. It began using 3D printing for satellite manufacture a few years ago, and in 2019 it built the first 3D-printed metal satellite antenna. NASA is also employing additive printing to further space exploration in a variety of ways, and it is working on many fascinating initiatives with the San Francisco-based start-up Made In Space. There are significant advantages for numerous more commonplace 3D printing applications, such as the manufacturing of jigs and fixtures. Companies have hundreds of fixtures, guides, templates, and gauges 3D created for each specific aircraft, often with 60 to 90 percent cost and lead time savings compared to traditional production techniques [24]. The challenge is increased for complicated designs with undercuts and overhanging features, which are produced by relatively few traditional production techniques [25]. Material Jetting 3D printing can create multicolor patterns with a surface polish equivalent to injection molding. These visually appealing models enable designers to gain a better knowledge of a part's shape and fit before making critical manufacturing decisions. Due to additive manufacturing more is possible because it is a manufacturing method that doesn't limit your creativity. Fast prototyping, rapid iteration design, and a full rethinking of components and assemblies enable you to develop in new ways

and get to something new faster. Engineers typically search for ways to lower fuel consumption and improve energy efficiency by reducing the aircraft's mass while designing and building airplanes. Engineers can use 3D printing technologies to minimize aircraft bulk by experimenting with various lightweight and high-strength materials. Engineers may utilize the correct industrial 3D printer to create lightweight components and parts with low waste. Furthermore, 3D printing technologies allow them to test lightweight materials by generating a range of components on demand.

V. FUTURE SCOPES OF 3D PRINTING TECHNOLOGY IN THE AEROSPACE INDUSTRIES

3D printing of greater size and larger dimension aircraft and space components, which are required for installation and use in compliance with future needs, is crucial. In the future, 3D printing technology will be able to use multiple material alloys to increase strength, reduce weight, and provide better solutions for aviation components. 3D printing at the nanoscale is also conceivable by using various types of nanomaterials to create sophisticated items that can be employed in space programs and aircraft industries. Companies such as SpaceX and NASA are employing 3D printing technology on a global scale to create societies on other worlds such as Mars. Many further advancements in 3DP technology and its applications in the aircraft sector are possible in the future.

VI. CONCLUSION

This comprehensive analysis paper demonstrates how Additive Manufacturing (3D printing) is growing and gaining traction in the aerospace industry. The number of patent applications in the industry surprisingly surged when 3D printing in aerospace improved due to speedier manufacturing methods and easier access to advanced materials. This implies that companies are still discovering new approaches to improve 3D printing in aircraft and will continue to do so in the future. More knowledge of 3D printing technology will assist the industry in upgrading and improving the architecture of 3D printing technology. Thus, the purpose of this analysis is to provide an overview of the many types of 3D printing technologies, the materials used for 3D printing technology in aerospace manufacturing, and finally, the applications of 3D printing technology and future possibilities.

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Privatization of Public Enterprises in Nepal

- Shistata Thapaliya

Privatization refers to the process of transferring ownership and management of state-owned enterprises, industries, and services to the private sector. This movement towards privatization in Nepal began in earnest in the early 1990s, influenced by the global trend of neoliberal economic policies. The initial push for privatization was formalized with the introduction of the Privatization Act in 1994, which provided the legal framework for transferring ownership and management of state-owned enterprises to private entities. The underlying rationale was to enhance the efficiency of public enterprises, many of which were underperforming, and to reduce the fiscal burden on the government. Historically, Nepal's public enterprises (PEs) had been plagued by inefficiencies, mismanagement, and substantial financial losses, making them a drain on national resources. The

push for privatization was also driven by international financial institutions like the International Monetary Fund (IMF) and the World Bank, which advocated for structural adjustments, including privatization, to foster economic liberalization and growth. However, the privatization initiative faced significant challenges, including labor disputes, corruption, political interference, and inadequate regulatory frameworks. These issues often hampered the expected benefits of privatization, leading to mixed outcomes in terms of economic performance and public acceptance. The process remains a contentious and complex aspect of Nepal's economic policy, reflecting broader struggles in balancing state control and market-driven growth.

Bhrikuti Paper and Pulp
Bhrikuti Paper and Pulp Nepal Limited was

established in 1982 with substantial assistance from the Chinese government, aiming to make Nepal self-reliant in paper production. The factory began production in 1986 and was officially

“The privatization case of BPP serves as a cautionary tale, emphasizing the importance of holistic planning and transparent governance in privatization efforts to mitigate risks and maximize long-term socio-economic benefits.”

handed over to the Nepal government in 1987. Initially, it played a pivotal role in the Nepalese paper industry,

fulfilling approximately 35-60% of the country's paper demand and even exporting pulp used for currency production to Japan. In 1992, the government privatized the factory as part of a broader strategy to enhance efficiency and productivity by transferring state responsibilities to the private sector. Despite the privatization efforts, the factory faced severe mismanagement and financial instability, leading to its eventual closure in March 2011. The factory was officially declared completely shut down on January 5, 2013.

The privatization involved selling the mill, including its land and assets, to a consortium of private companies—Golchha Organization, Kabra Group, and Concraft. Initially valued at around 17 crores, the mill was controversially sold for approximately 12.98 crores, a move seen by many as undervaluing a national asset. Bhrikuti Paper and Pulp (BPP) was a cornerstone of Nepal's industrial sector, fulfilling nearly 60% of the nation's paper demand at its peak. The factory utilized domestic raw materials, contributing significantly to the local economy and reducing the need for imports. BPP provided employment to thousands, supporting local families and fostering regional socio-economic development. However, the factory struggled with outdated machinery, financial mismanagement, and inefficiencies in production processes.

Post-privatization, BPP experienced a brief period of improved performance. The new management invested in modernizing the factory, upgrading machinery, and implementing more efficient production processes. Production capacity initially increased, and the factory regained some market share. Technological advancements,



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such as the switch from coal to rice husks for energy, were implemented to reduce costs and improve environmental sustainability. However, these improvements were short-lived. Financial mismanagement and operational challenges soon resurfaced, leading to a decline in production and market share. The factory faced stiff competition from imported paper products, leading to financial instability and eventual decline.

The privatization of Bhrikuti Paper and Pulp initially promised improvements in production capacity and efficiency, accompanied by technological upgrades and workforce expansion. These developments hinted at potential economic revitalization for the enterprise and its surrounding community. However, the short-lived gains soon gave way to significant challenges. Mismanagement of finances and insufficient reinvestment in operations undermined the initial successes. Operational inefficiencies, exacerbated by external factors like labor disputes and resource shortages, further eroded the factory's viability. The eventual closure of BPP not only led to substantial job losses but also triggered economic downturns in the local economy. The closure highlighted the critical need for effective management, strategic foresight, and robust regulatory oversight in privatization initiatives to ensure sustainable socio-economic benefits.

While the privatization initially sparked optimism with increased production and employment opportunities, the subsequent decline of Bhrikuti Paper and Pulp underscored the complexities and risks involved. The adverse impacts included severe economic hardship for workers and their families,

environmental degradation due to neglected infrastructure, and broader economic repercussions for local businesses. This case serves as a cautionary tale, emphasizing the importance of holistic planning and transparent governance in privatization efforts to mitigate risks and maximize long-term socio-economic benefits.

The closure of Bhrikuti Paper and Pulp Ltd. can be traced to a complex interplay of multiple detrimental factors that severely undermined its operational viability. From its inception, the enterprise grappled with pervasive political interference, characterized by frequent government changes and appointments driven more by political affiliations than merit. This instability fostered an environment of mismanagement and operational inefficiencies, hindering long-term strategic planning and investment. Financial mismanagement compounded these challenges, resulting in significant debt accumulation and the misallocation of crucial funds. Despite attempts at privatization, the process lacked transparency and effective oversight, failing to address the entrenched issues plaguing the company. The transition to private management under Golchha Organization was fraught with inherited debts, operational inefficiencies, and difficulties in securing essential working capital. Internal strife, including labor disputes and union issues stemming from unpaid wages and poor working conditions, further destabilized production. Externally, BPP struggled against market pressures, including stiff competition from cheaper imports and adverse economic conditions. Moreover, infrastructural deficiencies and supply chain disruptions, such as shortages of raw materials and logistical challenges,

compounded the factory's woes. Ultimately, the cumulative impact of political interference, financial mismanagement, ineffective privatization, labor unrest, market competition, and infrastructural deficiencies culminated in the inevitable closure and decline of BPP, marking the end of an era for the once-promising enterprise.

As of 2024, Bhrikuti Paper and Pulp (BPP) in Gaindakot-2, Nawalpur epitomize a poignant tale of industrial decline and socio-economic distress. Once a cornerstone of Nepal's paper manufacturing industry, BPP now lies abandoned and dilapidated. The factory grounds, once bustling with activity, are now overrun with weeds, while the buildings stand as reminders of neglect with collapsed roofs, crumbled walls, and rusted, unusable machinery. With only 15 security guards left to watch over the vast site, the contrast to its former bustling workforce is stark. Financially crippled by substantial debts to major banks like Nepal Bank Limited, Rastriya Banijya Bank, and Himalayan Bank, BPP faces insurmountable operational challenges, exacerbated by unpaid wages owed to its former employees, many of whom are still grappling with financial uncertainty after the abrupt closure that stripped away their livelihoods. The closure has dealt a severe blow to the local economy, which relied heavily on BPP for jobs and economic stability, causing ripple effects felt by surrounding businesses and suppliers. Despite intermittent governmental efforts and assurances, concrete strategies for revitalizing or repurposing the mill have failed to materialize, prolonging uncertainty about its future and leaving the local community in a prolonged state of limbo. The absence of definitive plans has underscored the challenges

in navigating the complex aftermath of industrial closure, highlighting ongoing struggles to restore economic activity and stability to a once-vital industrial site. BPP's fate stands as a stark reminder of the intricate challenges and socio-economic ramifications of industrial privatization, showcasing the enduring struggle to rejuvenate once-thriving industrial assets in the aftermath of closure.

To ensure the successful privatization of public enterprises in Nepal, it is crucial to adopt a balanced and strategic approach that includes robust regulatory frameworks, effective management practices, and stakeholder engagement. Privatization should be based on a planned strategy with a long-term vision, strong commitment, and dedication from privatized entities. Alternatives to outright privatization could include selling shares, encouraging public-private partnerships, and maintaining government ownership of major portions. Regular auditing, timely reporting, and creating policies that incentivize private sector participation, ensuring mutual market competition, and creating an investment-friendly environment are also necessary to achieve the best outcomes from privatization. The Government of Nepal should prioritize thoughtful consideration over haste in pursuing privatization and should aim for harnessing the economic benefits of privatization while safeguarding public interests and fostering sustainable growth.

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Damodar Bhandari

Minister for Industry, Commerce and Supplies
Government of Nepal



Addressing the challenge requires a multifaceted approach to create more job opportunities within the industrial sector



Congratulations on your appointment as the Minister of Industry, Commerce, and Supplies. How does it feel to lead the ministry, and what are your insights and observations over these past months?

Thank you. It is an honor and a privilege to assume the responsibility of serving through the policymaking realm in the domain of industry, commerce, and supplies. Over the past few months, I have believed that this sector is paramount for the nation's journey toward prosperity and the overall well-being of its populace.

Since the outset of my tenure, our ministerial team has been diligently engaged. We have meticulously crafted our action plan, encompassing all departments, divisions, and sections. Key policies such as the Start-Up Innovation Policy and SMEs Policy have been approved and are presently undergoing implementation. Additionally, our significant contribution to legal reforms is evident, with the government of Nepal having already amended eight different Acts and legal provisions considering the recent Investment Summit. Thus, our focus extends beyond policy formulation to actively supporting domestic and foreign investors during the implementation phase.

What plans and policies does the ministry have for the industrial development of the country? What opportunities and hurdles do you foresee in this direction?

Turning to the opportunities at hand, it's worth noting that the Ministry of Industry is not alone in its endeavors. The Prime Minister and cabinet have directed their attention toward entrepreneurship, industrial development, and employment. Securing one billion funds for Interest-Subsidized Start-Up loans for newly established businesses represents a notable achievement. Furthermore, efforts are underway to revise and enact new industrial and trade policies. These developments underscore the effectiveness of our motivated and energized joint team of political and bureaucratic stakeholders, successfully advancing annual objectives through various feasible programs this year.

However, it's important to acknowledge the challenges we face. The decrease in our budget ceiling for this fiscal year has resulted in resource scarcity. Moreover, stakeholder collaboration poses difficulties during the preparation and approval of directives, working policies, and procedures.

Nepal is in its 16th periodic plan with the vision of "Good Governance, Social Justice, and Prosperity." How does your ministry plan to synchronize its policies and actions with the goals outlined in the 16th Periodic Plan?

To align with the overarching vision of "Good Governance, Social Justice, and Prosperity" outlined in Nepal's 16th periodic plan, our ministry is strategically integrating its policies and actions. We focus on several key areas to ensure synchronization including policy alignment, program implementation, and stakeholder engagement.

We are reviewing and revising existing policies to ensure they align with the goals of good governance, social justice, and prosperity. This involves assessing the impact of our policies on various segments of society and making necessary adjustments to promote inclusivity and fairness.

Our ministry is actively implementing programs that directly contribute to the objectives of the 16th periodic plan. This includes initiatives aimed at promoting economic growth, reducing poverty, and improving access to essential services, among others.

We recognize the importance of engaging stakeholders at all levels to achieve the goals outlined in the periodic plan. This involves consulting with civil society organizations, private sector entities, and marginalized communities to ensure their voices are heard and their needs are addressed in our policies and programs.

Overall, our ministry is fully committed to aligning its policies and actions with the vision of "Good Governance, Social Justice, and Prosperity" outlined in Nepal's 16th periodic plan. Through strategic planning, implementation, and monitoring, we aim to contribute significantly to these goals to benefit all Nepali citizens.

With the rapid development of technology and the advent of Industry 4.0, what preparations is the ministry making to keep pace with global advancements?

This year, we have proposed a support program and budget for Industry 4.0. We will collaborate with private sector agencies such as FNCCI, CNI, NCC, and FNCSI to streamline global advancements in our industrial developments. Our data shows IT exports of around 60 billion this year, highlighting the potential of ICT development as a key industry in Nepal. To further this progress, we have introduced collaborations for advancements in intellectual property protection and promotion, including an MOU with the US Patent and Trademark Office.

In various other areas, we are implementing advanced technological means and methods across the industry sectors.

Are there any plans to revive dormant government-held industries during your tenure to contribute to the country's economic development?

Yes, there are plans to revive sick public enterprises during our tenure. We recognize the significant potential these industries must contribute to the country's economic development. By leveraging modern technologies and implementing strategic partnerships with private sector agencies, we aim to rejuvenate these industries, making them competitive and sustainable. This initiative is part of our broader strategy to boost industrial growth, create jobs, and enhance the overall economic landscape of Nepal.

What should the role of educational institutions be for them to contribute effectively to the vision of the 16th Plan?

Educational institutions play a crucial role in human capital development, and the upcoming 16th Plan aligns with this objective. To achieve this broader goal, institutions should focus on curriculum alignment, research and innovation, skill development, and promoting entrepreneurship.

Updating the curriculum to include skills and knowledge relevant to Industry 4.0 and other emerging sectors is essential to ensure graduates are well-prepared for the evolving job market. Encouraging research and development activities

that address local challenges and promote innovation is also crucial. Institutions should foster partnerships with industries to create practical solutions and technological advancements. Additionally, offering specialized training programs and vocational courses will equip students with the technical skills needed for high-demand industries, ICT, engineering, and advanced manufacturing. Promoting entrepreneurship through incubation centers and providing resources and support for startups will help cultivate a culture of innovation and business creation.

By focusing on these areas, educational institutions can significantly contribute to the vision of the 16th Plan and support the overall development of Nepal.

What are your expectations from organizations such as SOIES Nepal to help achieve the ministry's visions and targets?

Organizations like SOIES can collaborate with the ministry on studies and research relevant to the industrial sectors. They can provide valuable policy input during the drafting of new policies, as we are currently in the process of revising our industrial and trade policies.

We can also establish partnerships for providing support or funding to academia, provided these proposals are made at the appropriate time. Engaging in debates and interactions with industrial engineers is crucial for retaining quality engineers in Nepal, which will have a direct and positive impact on the country's industrial development.

As the Minister of the relevant sector, do you agree that Nepal faces significant unemployment, particularly among the youth? How do you envision creating more job opportunities within the industrial sector? What initiatives are being undertaken to promote skill development and vocational training to meet industry demands? Furthermore, what strategies can Nepal implement to foster a business-friendly ecosystem that attracts entrepreneurs, startups, and investors?

Nepal faces significant unemployment, particularly among the youth. Addressing this challenge requires a multifaceted approach to create more job opportunities within the industrial sector.

To create more job opportunities, we will focus on revitalizing dormant government-held industries and encouraging private-sector investments.

We are undertaking several initiatives to promote skill development and vocational training to meet industry demands. In addition, to foster a business-friendly ecosystem that attracts entrepreneurs, startups, and investors, we are implementing major policy reforms.

Is there anything you would like to convey to our team and industrial engineers?

We are committed to working with all stakeholders in preparing policies, plans, and programs. We welcome policy input and are eager to collaborate on program implementation.

Thapathali Campus has a faculty of industrial engineering, which is an asset. Developed countries have a long history of producing industrial engineers, and this is fundamental for any developing country striving to become prosperous. Therefore, I extend my hand in collaboration on research, development, and policy formulation to achieve our shared goals.

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ENERGY MANAGEMENT FOR SUSTAINABLE INDUSTRIALIZATION

-Saurav Khadka

Introduction

Have you ever thought about how valuable is a Single drop of Oil? To regard its worth, Oil Leakage at one drop every second means a loss of over 2000 liters in a year. Considering the market price of Cooking oil, the loss is worth more than 10 lakh Nepalese rupees in a year.

The wastage and misuse of energy from small household to big Industries have become common issues in the present time. There are large varieties of Energy available but the lack of core management and understanding of Energy Management has resulted in the haphazard exploitation of energy.

Energy management can be termed the backbone of Global Industrialization with effective Sustainable goals. It is the foundation of saving energy at the industrial and Organizational levels and is the most important aspect of Sustainable industrialization.

Energy Management (EM) is simply the effectual use of energy to maximize profit and minimize cost and waste. Energy management is the proper study, planning, and operation of Energy production and Energy Consumption units followed by distribution and Storage. It simply is the process of monitoring, controlling, and preserving energy in an industry and organization. Energy Management equally focuses on minimizing Environmental effects and promoting Sustainability. EM helps to reduce requirements per unit of output in industry and improve energy efficiency and productivity.

Why Energy Management?

Energy management is Vital for Environmental welfare, national security, Economic Productivity

Energy management is core for Cost saving and is Cost effective. By the proper monitoring of Energy consumption, Industries

can effectively reduce consumption and save money. With the growing demand and decreasing supply of Non-Renewable Energy, the cost of energy is increasing rapidly. EM deals with the most effective management of cost and focuses on Renewable energy.



The development of use and proper management of renewable energy sources can help to create jobs and stimulate energy growth, thus contributing to sustainable industrialization.



The proper Management of Energy reduces Carbon emissions and improves environmental quality. The primary culprit of every

industry is Carbon dioxide which greatly affects in Environment.

2.27 pounds of CO₂ is produced for every pound of Methane combusted. So EM reduces the Consumption of Methane. Less Energy Consumption leads to less thermal energy and less use of petroleum products leads to less On-site pollution.

Energy management is a crucial aspect of sustainable industrialization. Sustainable Industrialization refers to a process of industrial development that meets the needs of the present without compromising the ability of future generations to meet their own need. One of the major ways of Energy management that helps in sustainable industrialization is energy efficiency. The development of use and proper management of renewable energy sources can help to create jobs and stimulate energy growth, thus contributing to sustainable industrialization. Effective Utilization of Unused Renewable energy such as hydropower, solar energy, and Wind energy. Developing countries become independent, Growth in GDP, and Employment opportunities.

A Process on Energy Management:

To effectively manage energy, organizations need to have a clear understanding of their energy consumption and the associated costs

1. Energy Assessment:

We need to find out the current condition of energy Consumption, wastage, and availability of Energy. Industrial organizations can engage in energy audits and assessments to identify areas where energy is being misused or wasted. These Assessments can help organizations identify various opportunities for



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energy savings and help prioritize their efforts toward the most effective measures. An Energy Audit is the Depth and Proper Study to determine the utilization of energy and Conversion from one form to another. Global Manufacturing production grew by 7.2% in 2021, surpassing its pre-pandemic level which eventually led to growth in Energy consumption on different scales, if the same ratio continues, a lack of proper assessment will lead to major energy haphazardness.

2. Goal setting and proper planning:

By highlighting the aim of Production, Suitable and Measurable goals should be set to reduce energy consumption and increase efficiency. A sustainable way of setting goals will lead to proper management of energy. There must be proper skill development courses and industries need to educate employees on the importance of energy management and involve them in the process.

3. Proper Implementation and Management:

Identifying the Situation of Energy Consumption and limiting all the obstacles to proper utilization of energy through a Suitable plan, must be implemented carefully with the appropriate monitoring. There must be the recruitment of Capable and suitable manpower in every field. Proper Machines should be used and operated properly. Important management includes

- Facility management: It is the Organizational Function that integrates people and processes within the built environment to improve sustainability, efficiency, safety, and productivity. There

must be proper Facility Management.

- Logistics: Logistics is the management of the flow of resources from one point to another. I.e. transportation of goods. Proper Logistics tasks can help in the management of costs and protect the environment through proper Energy Management. Major Logistics tasks include
- Duration of transportation: Green Logistics including eco-friendly transport carriers is necessary.
- Energy Procurement: It simply refers to acquiring Energy. Poor Energy Procurement decisions can be a great loss for the Organization. Industries and Organizations can reduce the cost and effectively utilize the budget with the proper and efficient approach to buying energy. And the buying of Eco-friendly Energy can be beneficial to the environment.
- Production Planning and Control: production is the area with the largest energy consumption. So proper study and, Operational planning, control, and management of all the processes is necessary for the production in every industry and Organization

4. Regular Evaluation and continuous improvement

There must be proper management and Monitoring of the process involved and energy consumed and daily reports should be maintained to highlight improvements. The evaluation of equipment, machines, and manpower

must be done properly. Every flaw obtained while carrying out the process must be corrected instantly and every improvement possible must be operated under the guidelines of the Goals and regulations.

There must be suitable and long-term Energy Management Strategies prepared by every local to multinational Company and be included in the plans of Governments all over the globe.

Energy management and sustainable industrialization are connected through the importance of cooperation and collaboration between different stakeholders including businesses, industries, governments, and individuals.

Many Manufacturing industries like General Motors, Volkswagen, and many more have been preparing strategies highlighting Climate Change.

The Strategy of General Motors (GM) is based on continuous improvement having principles including restoring and preserving the environment, reducing waste, and educating the public about Environmental Conservation.

There are many Governments all around the globe which focus on promoting Renewable Energy. The Most Famous Strategy includes the strategy of the Swiss Federal Council which decided to shut down all the nuclear power plants at the end of life and not be replaced. So, every small and major act and action by small households to big multinational Companies in Energy management promotes the best utilization of energy and overall environmental conservation. Eventually, proper

functioning of Energy management will result in the reduction of cost and an increase in profit in every industry and organization, a large-scale reduction in CO₂ emission helps to protect the environment and pursue a sustainable way of running industries from everyday to day activities, norms, and machinery applications. This will lead to local awareness of energy issues with the proper supply of energy in every household to big industries. And eventually, lead to sustainable ways of development in every sector.

Hence, for a sustainable future, the proper management of Energy is mandatory. By implementing energy-efficient technologies and practices, using renewable energy sources with effective energy management systems, and conducting energy audits, industries and organizations can significantly reduce their energy consumption and minimize their impact on the environment. It simply is understanding the worth of a single drop of oil and moving forward effectively for the best utilization of every energy possible. With the great development and advancement of every sector across the world, and leading towards a more globalized community with innovative industrialization, energy management will become the backbone of Sustainable Industrialization and a Sustainable Future.

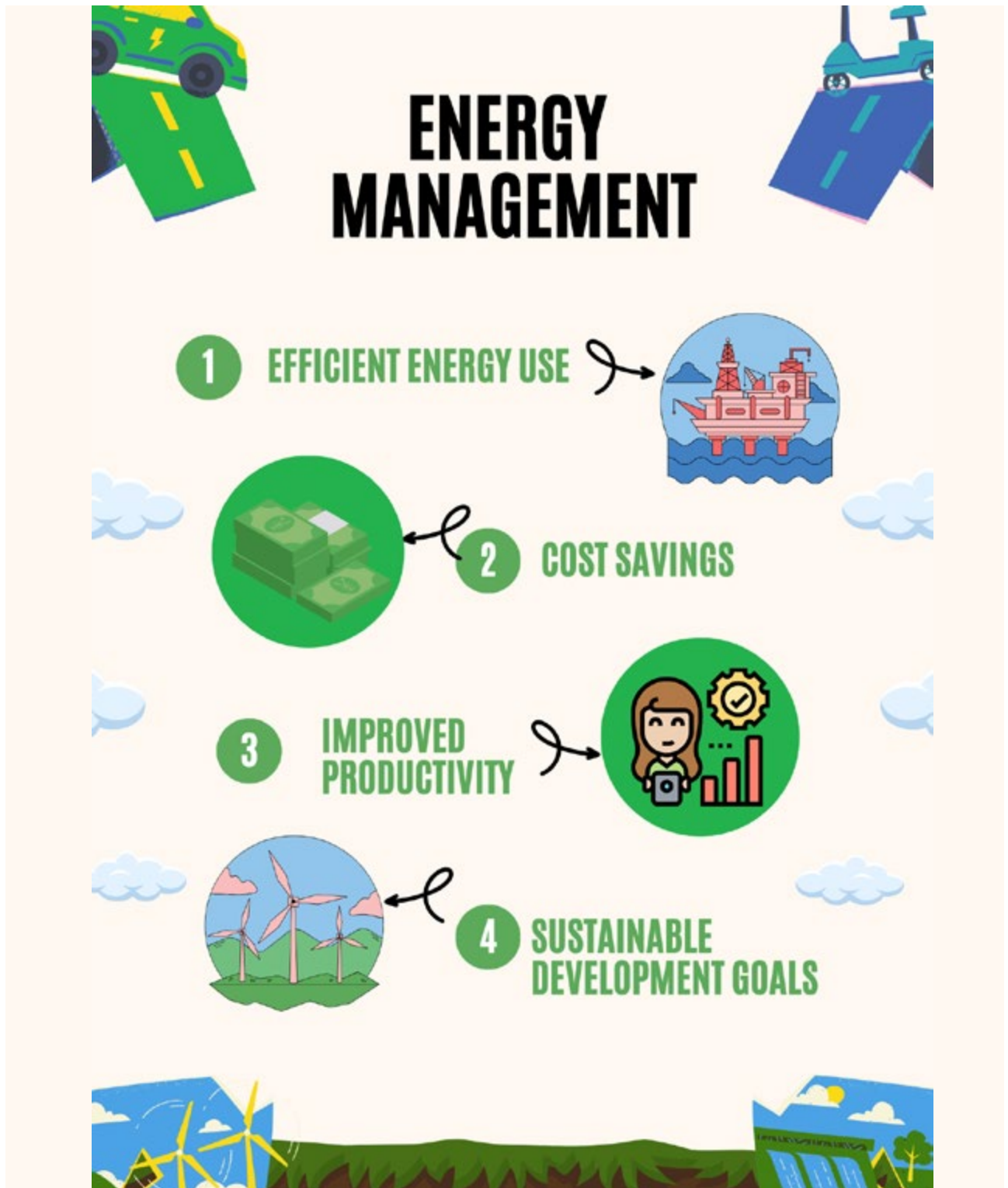
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<https://eaguk.org/energy-services/energy-management/>

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Dr. PRANAY SHRESTHA

Postdoctoral Fellow in Clean Energy | University of Oxford

winner of several honors including, Vanier Canada Graduate Scholarship and the Gold Medal of the Canadian Society of Mechanical Engineering

“

I have focused on the concept of heterogeneity which is a major factor affecting the performance of a fuel cell.

”

About Pranay Shrestha

I was born in Germany and brought up in Nepal. I studied at St. Xavier's Jawalakhel till grade eight. After that, I went to a boarding school in Mussoorie, India. Professionally, my interest has always inclined towards Science and Math and that was my driving force for pursuing engineering. I did my undergrad at the University of Victoria, Canada. They had a co-op program every four months, we used to alternate between courses and studies. During that time I joined internship programs and research activities. One of my internships was in a fuel cell company and there I was introduced to electrochemistry and electrochemical devices that covered batteries and fuel cells. It included the mechanical side, chemistry, and electrical and to scale it up you need the industrial side so I found it quite fascinating and that's what I have been following until now. During my master's and PhDs, I worked in electrochemical devices, and now as a postdoc at Oxford, I'm continuing the same. My field has shifted from fuel cells to batteries, similarly, my interest has shifted from mechanical engineering to fuel cells, that's what I like about electrochemistry; there's so much expertise that you need and you can switch between fields and it's good to know more and that's what keeps my interest alive.

Can you provide a brief overview of your current role as a Postdoctoral Research Fellow at the Faraday Institution at the University of Oxford and the specific focus on your ongoing projects?

The project I'm involved with in Oxford is called SolBate. My team is working towards solid-state batteries. It's not commercialized but we believe it to be the next generation of batteries. Most commercial batteries have a liquid component called electrolyte which is mostly used to transport lithium ions. The liquid electrolyte does work but has problems regarding safety, toxicity, etc. Also, liquid electrolyte batteries are hitting the ceiling currently, which is the theoretical limit to how good they can be in terms of let's say, energy density, but solid-state batteries promise to have higher energy density and have a high regard for safety.

One of the big ones that I'm looking at is degradation. These batteries degrade quicker than the currently available commercial ones. If you want to put it in a car, for example, it

will not work because you will have to charge and discharge it quite a few times for it to be feasible. So we're trying to look into "why" that happens. At this point, the focus is on what is fundamentally wrong with the battery and how we can make it better.

How do you envision your work contributing to the broader goals of achieving clean energy solutions, and what impact do you believe your findings could have on the transition to a cleaner and more sustainable energy landscape?

Sustainable energy is a big task for all of humankind right now. My current focus is on characterizing these electrochemical devices in realistic environments. I want to understand how they work on a microscopic scale. My work includes developing tools to look inside the fuel cell or the battery while it's running to observe processes that occur in real time. The reason I focused on characterization is because that gives us a lens into that device and we can figure out how it works. If we can figure out how it works in realistic environments then we can have a better chance of finding out why they fail and try to design them in a more rational way rather than a random trial and error process. I would say my contribution right now is still like a drop in the ocean but I try to focus on trying to understand. Once we can understand, we can have a ripple effect.

Can you provide insights into the importance of your research in unraveling degradation mechanisms within fuel cells and how your findings contribute to the advancement of next-generation fuel cell designs?

I have focused on the concept of heterogeneity which is a major factor affecting the performance of a fuel cell. Heterogeneity exists in fuel cells because of the components and the way it is set up. The current manufacturing processes, assembly processes, and operating processes inherently lead to heterogeneity in fuel cells. In my Ph.D., I tried to characterize this heterogeneity and develop tools to do it. I'm trying to see more clearly how heterogeneous the fuel cell is and how that impacts the performance. More importantly, once we know that we can look into how we can fine-tune this heterogeneity. So instead of it being present because of the way the cells are, we want to see if we can engineer that heterogeneity and if we can fine-tune it more rationally to our advantage. That's something I would like to focus on more as I continue. It is to leverage heterogeneity to our advantage.

Looking ahead, what are your aspirations in sustainable energy innovation, and how do you see your work contributing to broader environmental and community sustainability?

In terms of sustainability and especially energy sustainability, there is a big shift going on. There is a huge shift towards sustainable energy practices and sustainable energy technologies and I think there is a lot of work to be done. We need the government, policymakers, businessmen, and marketing experts. We need these people to be on the side and say “Okay, let’s try to fix this problem, let’s try to accelerate this transition to sustainability”. I believe there is a lot of work to be done and as I said before, what I’m doing is just a drop in the Ocean. Even though it’s a drop I hope that if you do good work, even if it’s a small contribution, it might ripple on to more effects. Let’s say if I’m able to characterize something better and have a better understanding, hopefully, that leads to better design and things that are beyond just my effort but then, I think it is a complex problem and we need more people working together. At this scale, it’s less about the individual and more about “How do we work together to solve this problem?”

I aspire to keep doing this work and collaborate with people and get them together to solve this problem because, again, no individual can solve the problem on their own. We need everyone.

Can you elaborate on how your work, particularly in fields of sustainable energy, aims to positively impact developing countries, such as Nepal, and contribute to addressing energy challenges and fostering sustainable development in those regions?

I think developing countries have immense opportunities to adopt sustainable technology as a development strategy, rather than as an afterthought because these sustainable technologies are developing almost alongside developing countries. Some of these technologies are mature enough to be adopted, and some of these technologies are cost-competitive or nearly cost-competitive sufficient that they can be adopted on a country-wide scale. And I think that is where a lot of times, say, education or support from the government or even just initiatives of people play a big role because a lot of things can be changed during this transition phase.

For example, in fuel cells, we have lots of talk about green hydrogen, a lot of countries are pushing green hydrogen, developing their waste-produced green hydrogen; if Nepal incorporates that in their development strategy and they have a big production capacity of green hydrogen within the next ten years; Within the next ten years the demand for green hydrogen will grow and if Nepal has an advantage in that strategy already then when the time comes they can scale up even more or they can provide green hydrogen for the economic benefit of the country. So, I think there’s almost no doubt that we are transitioning into sustainability, it is better to be a step ahead and try to incorporate that in the planning itself rather than afterward.

Could you kindly share the pivotal moment when you decided to pursue Industrial Engineering? Additionally, what were your initial expectations upon joining the course, and did your experience align with those expectations?

After completing high school, I decided to take industrial engineering, it had practical implementation and satisfied my liking for science and math a lot. A few things aligned with my expectations, and a few were surprises. For example, growing up I used to say “I aspire to be a scientist” but I never really knew how to get there once I did engineering, I took some research projects and some courses, and I started to get a better idea and I think engineering is still a key foundation as I do more research. Engineering has been a practical foundation so I’m glad I chose Engineering. I didn’t know what to expect but I just went in because I liked a few things. I’m glad that I did it.

With your academic background encompassing both a Master’s and Ph.D. in Mechanical and Industrial Engineering, how do you see the principles of industrial engineering playing a role in your research, and how has this interdisciplinary approach influenced the outcomes of your projects?

Even in research, Engineering is still at the core. I was drawn to science from the beginning but once I was trained in engineering, it has helped a lot. When I approach problems, I try to approach them in a more practical way which helps. Even now, when I’m approaching some fundamental questions about, let’s say, why a battery fails in a certain way, I still have Engineering at my core. When I’m designing setups for experiments, what I need to do is design miniature cells that replicate large-scale environments. In that, I bring in a lot of engineering concepts of pressure, and temperature and how to precisely maintain them. Just general design concepts in engineering have helped quite a bit. I would not be able to answer a lot of these fundamental questions if I could not design my experiments properly. So engineering is essential to my scientific career.

Exploring the potential of industrial engineering in the Nepalese context, do you believe there is a need for heightened awareness and education about this field among students, professionals, and the general public, considering its significant prospects and benefits on a global scale?

I agree. I think awareness is the key, if students who are about to choose what they want to do are not aware of engineering and its possible benefits, they won’t choose engineering. And also, engineering can be foundational to a lot of different things. Even if you were to go into policy-making or government, engineering can be quite a foundational platform because it’s a way of thinking. I think awareness is the first step.

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PROJECT RETROSPECT



The Bamboo Slicing Machine

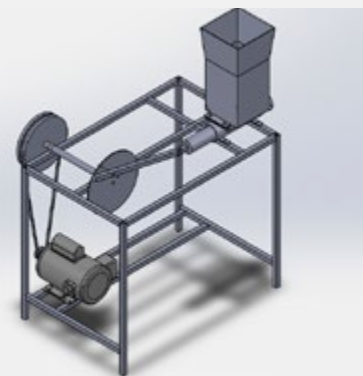
The Bamboo Slicing Machine project introduces an automated solution to the slow and imprecise manual process of bamboo slicing, significantly enhancing efficiency and accuracy in bamboo processing. Capable of accommodating various sizes and types of bamboo, the machine features adjustable rollers for precise control over slice thickness. Operating akin to a sugarcane juice making machine, it utilizes a pulley system and motor to drive bamboo pieces through sharp-edged blades, resulting in uniform and precise bamboo strips. With a daily production capacity of 160 kg of slices and an operating cost of Rs.1571, the machine surpasses manual methods in productivity and cost-effectiveness. Powered by a 1HP single-phase electric motor at 600 rpm, it efficiently produces thin bamboo strips while offering adaptability through adjustable slides for varying strip shapes and sizes. In summary, the Bamboo Slicing Machine offers a financially sound and efficient

solution for bamboo processing, promising significant improvements in productivity and quality compared to traditional manual methods.

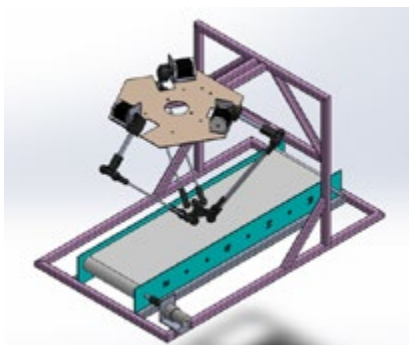
Team members: Bir Bahadur Tamang, Dil Bahadur Kunwar, Laxman Amgai, Rupesh Budha, Ujjwal Pathak

Can-Crusher Machine

Generally, empty beverage cans thrown in trash are to be crushed in order to reduce the space they consume within a container of trash. Crushing can be done using our feet as well but when it comes to crushing hundreds of cans within a certain time, the work becomes a burden. With the mindset of reducing the amount of force required to crush cans and to hopefully automate the process, the can-crusher machine was designed. The machine follows the slider-crank mechanism which is a principle that governs the conversion of rotational motion into linear motion. It consists of a motor (0.75Hp) and is driven by a pair of pulleys. Based on the slider-crank mechanism, the machine is able to convert rotary motion from the pulley system into linear (back-and-forth) motion. The linear motion aids in the motion of a piston - that is responsible to crush cans - along a hollow cylinder, called the guide. Cans are fed through the feeder/hopper which is fabricated with a series of obstructions on the inside so as to make empty cans fall horizontally onto a cavity in the guide. The crushed cans fall off the guide through another cavity.



Team member: Dipesh Dahal, Nabin Poudel, Oliver Tamrakar, Prajita Ghimire, Ramesh Panth

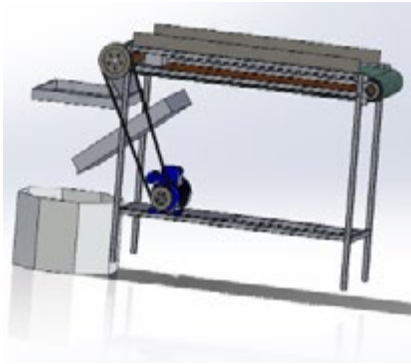


A camera equipped delta robot for advanced tomatoes grading in conveyor system

The 'Delta Robot' project introduces a novel parallel arm structure for unparalleled precision in pick-and-place tasks, particularly in tomato sorting. It integrates high-tech camera sensors and a suction gripper to achieve seamless object identification and sorting on conveyor systems. Advanced computer vision and deep learning algorithms enable real-time tracking and grading of tomatoes based on predefined criteria. Synchronized parallel arm movements and high-resolution camera sensors ensure swift and accurate sorting. An Arduino-based electronic control system orchestrates the operation, seamlessly synchronizing sensors, gripper, and conveyor for cohesive functionality. The user-friendly Graphical User Interface (GUI) empowers operators to make real-time adjustments for optimized

performance. Beyond Nepal's tomato industry, this innovation promises enhanced sorting accuracy, distribution efficiency, waste reduction, and quality control. It sets a precedent for broader industrial applications, showcasing the potential of sensor-integrated robotics to revolutionize global manufacturing, packaging, and logistics.

Team members: Bishal Adhikari, Gokarna Budhathoki, Madan Shrestha, Madhav Bhandari, Nabin Dhungel



Eddy current separator

The core functionality of the ECS lies in its ability to sort non-ferrous metals, such as aluminum and copper, from a stream of waste material. This not only streamlines the recycling process but also significantly reduces the amount of waste sent to landfills.

The working principle of the ECS is based on the interaction between magnetic fields and conductive materials which is given by Faraday's law of Em induction and Lenz Law. The repelling force is produced as Lorentz Force. As the waste material passes over the ECS's conveyor belt, a high-speed rotating magnetic rotor generates eddy currents in the non-ferrous metal components. These currents produce a magnetic field opposite to the original field, exerting a force that repels the non-ferrous metals away from the rest of the material. This separation process

is highly efficient and operates without direct contact, minimizing wear and tear on the machine. Environmentally, it contributes to sustainable waste management by enabling more effective recycling of metals. Economically, it offers the recycling industry a cost-effective solution to recover valuable materials. Moreover, the ECS we've developed is designed to be user-friendly, ensuring that it can be easily integrated into existing waste management system.

Team Members: Abhishek Wasti, Grishma Bhandari, Prajit Adhikari, Rush Pradhan, Santosh Pd. Rimal

AUTOMATION OF HANDLOOM MACHINE

The project aims to automate handloom weaving by integrating science and technology, particularly through the use of motors, actuators, and Arduino programming. By experimenting with four heddles in a single row instead of one, the project seeks to produce patterned fabrics efficiently. The system automates tasks such as reed movement, heddle control, and shuttle propulsion, reducing physical and time demands for weavers. The primary goal is to enhance productivity in manual handlooms, leading to faster weaving, lower labor costs, and improved usability. A servo motor drives heddle motion, controlled by Arduino code. Four sets of heddles move in opposition to create patterned fabrics. Shuttle pickers slide and beat the shuttle, compressing the weft across the warp. A linkage mechanism connects the reed frame to ratchet gears, facilitating the rolling of the cloth beam. The project combines various fields of study to innovate in handloom weaving automation, reflecting not only on discoveries but also on exploration and innovation processes. Overall, the project represents a significant step towards revolutionizing the handloom industry through automation and technological integration.



Team members: Roshan Dani, Sadikshya Gautam, Samarpan Silwal, Santosh Pokharel, Susil Bhattarai



Automatic Sanitary Pad Dispensing Machin

The Automatic Sanitary Pad Dispensing Machine project aims to address menstrual hygiene challenges by developing an efficient and cost-effective solution. Through iterative design phases, it integrates a three-bar mechanism, servo motor, ultrasonic sensor, and Arduino microcontroller to facilitate touchless and efficient dispensing. Emphasizing user-friendly interfaces, the machine undergoes rigorous testing to ensure accuracy, hygiene, and reliability. The objectives include enhancing the capacity-to-cost ratio of existing machines and addressing menstrual hygiene resource inadequacies. The chosen design incorporates a three-bar mechanism for simplicity, cost-effectiveness, and maintenance ease. Key components comprise servo motor, ultrasonic sensor, Arduino microcontroller, inner box, guide channel, clamp mechanism, hinge

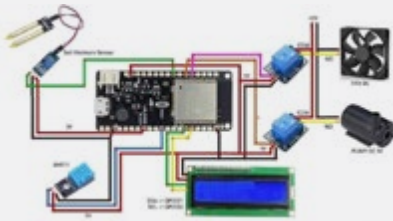
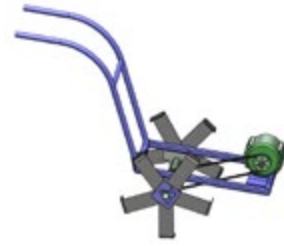
mechanism for refilling, LCD screen, and a metal frame for structural support. The machine operates through dispensing and return processes, ensuring a seamless user experience.

Team members: Avinash Gauli, Girbana Gyawali, Rojit Shrestha, Ronish Phuyal, Sezal Gaire

Sharp Cultivator Tiller Machine

The Sharp Cultivator Tiller Machine boasts a wheel design engineered for superior soil gripping, facilitating efficient tilling. Powered by an electric motor via direct electricity, it eliminates the need for batteries. With four cultivator forks, it ensures precise and effortless tilling, catering to farming needs. Its lightweight, portable construction enables easy maneuverability and control. Operational simplicity and low maintenance make it an attractive option for agricultural tasks. The machine's functionality relies on the motor's power, transmitted via a belt drive system to the tiller wheels. A meticulously crafted supporting frame maintains constant voltage output, enhancing stability during operation. Incorporating a regulator and sensor mechanism ensures energy efficiency, with the sensor preventing excess energy consumption. Overall, its benefits include adjustable tines, efficient soil breaking capabilities, user-friendly operation, and minimal maintenance requirements, offering a smart, fuel-free solution for farm and garden tilling needs.

Team members: Aaradhana Shree, Ankita Bhujel, Manisha Pradhan, Samikshya Tamang



Greenhouse Monitoring and Control System using IoT.

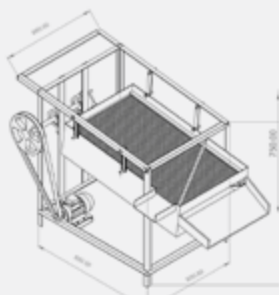
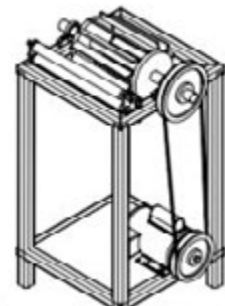
The project titled "Greenhouse Monitoring and Control System using IoT" aims to efficiently manage soil moisture and automate the watering process within a greenhouse environment, ensuring optimal conditions for plant growth. The system incorporates soil moisture sensors to detect moisture levels in the soil. When the moisture level falls below a predefined threshold (set at 40%), the system automatically initiates the watering process until the moisture level reaches the threshold. Once the desired moisture level is attained, the watering process ceases, ensuring optimal soil moisture conditions for plant growth. Additionally, the system employs a DHT11 sensor to monitor humidity and temperature levels within the greenhouse. If the humidity falls below 50% or the temperature drops below 18°C, the system activates a fan to regulate and balance the temperature and humidity levels, creating an optimal environment for plant growth. In the experiment, garlic plants were cultivated within this controlled environment over a period of 14 days. Data on the growth of garlic plants under these conditions was collected, demonstrating that the implemented system effectively supported the growth of garlic plants by maintaining appropriate soil moisture, temperature, and humidity levels within the greenhouse environment.

Team members: Shistata Thapaliya, Pratikshya Thapa, Swastika Bardewa, Aakarshan Pradhan

Banana Fiber Extractor Machine

This project was designed with an aim of revolutionizing the extraction process of banana fiber and promoting sustainable resource utilization. This machine mechanizes the extraction process efficiently. It consists of two feed rollers which rotate to squeeze the stem and remove moisture and third feed roller transports the squeezed stem to the drum roller, which decorticates the stem, removing scrap and separating fiber. Manual force is required to pull out the separated fiber that is washed with water and dried in sunlight for further processing. After successful fabrication of the project and multiple times testing it was concluded that high clearance (more than 3mm) between drum roller and feed roller results presence of scrap, using high rpm drum roller (more than 400rpm) results in fiber breakage, only lower part of each blade needs to be sharpened, attaching 12V DC motor to one of the feed roller decreases the operator fatigue. We have also tested for other plant sample (Ketuke) which results high strength fiber, more fiber yield. Our testing also includes Fiber Extraction Analysis such as 35kg stem gives 1kg fiber, 8hrs of stem feeding (i.e 960 kg stem) gives 27 kg of fiber (per day).

Team member: Aastha Dhungel, Aayusha Malla, Anjana Tamang, Garima Joshi



Sieving Machine for multiple agricultural crops

A sieve is a device that uses a screen, such as a mesh or net, to separate necessary elements from unnecessary material. The basic principle involves the transformation of continuous rotary motion provided by the crank into reciprocating linear motion of the slider, also called the slider-crank mechanism. When the machine is turned on, the material to be sieved is placed on the sieve deck and the vibrations produces back and forth movement. Two layers of sieve are provided. The sieve tray is connected using nut and bolts which allows sieves with various types of holes to be used depending on the types of particles that is to be separated. The vibrating motion of the sieve causes the particles to move and stratify. Larger particles tend to stay on top, while smaller particles work their way down through the openings in the sieve. The separated particles are then collected through a discharge system, while the oversized particles continue to be sieved until the desired separation is achieved. The single phase DC motor is connected to the shaft that rotates the crank which causes the chamber, where sieve tray is connected, to pick up the speed.

Team members: Ankit Raj Rijal, Dipesh Khatiwada, Iliya Adhikari and Kundan Nyaupane.



Questioning the Quantum:

What Does Superposition and Entanglement Mean for AI's Future?

- García-Barrios, David Andrés

Introduction

Artificial Intelligence (AI), with its extraordinary growth and transformative potential, has already started to redefine the landscapes of various sectors. From healthcare to finance, AI has demonstrated its power in harnessing large amounts of data to make accurate predictions, automate processes, and even mimic human cognition (A. & R., 2023). Yet, for all its current capabilities, AI stands on the brink of an even more dramatic leap forward as it begins to intersect with another cutting-edge field: quantum computing. This new frontier opens up a world of possibilities previously considered to be the exclusive realm of science fiction, creating a profound fusion of AI and quantum physics. At the heart of quantum computing lie the mysterious and

often counterintuitive principles of quantum mechanics - superposition and entanglement. Superposition allows quantum bits or 'qubits' to exist in multiple states at once, providing an exponential increase in computational potential. Entanglement, on the other hand, intricately links qubits in such a manner that the state of one instantly influences the state of the other, regardless of distance, thus introducing a new dimension of synchronization and correlation in computation (Yum & Choi, 2022).

These quantum phenomena, when applied to AI, hold the potential to fundamentally enhance its capabilities, propelling it into new domains and enabling solutions to some of the most complex problems we face today. Yet, our understanding of

these principles and how best to apply them within the realm of AI is still in its infancy, making this field both an enigma and an



The quantum phenomena of superposition and entanglement provide a key to unlock an unprecedented realm of computational power, setting the stage for a new generation of AI that transcends the limitations of today's models.



exciting area of exploration (Ying, 2010). The objective of this article is to elucidate

the enigma of quantum physics in a beginner-friendly approach, beckoning readers to understand the revolutionizing potential of principles such as superposition and entanglement. It also encourages them to envisage the future these concepts could chart for the field of Artificial Intelligence. As we stand on the cusp of this groundbreaking era, quantum physics possesses the potential to radically alter the contours of AI, ushering us into a future where the line between science fiction and reality becomes progressively indistinct.

The Quantum Phenomena

The principles of superposition and entanglement are the bedrock of quantum mechanics and the key drivers behind the awe-inspiring potential of quantum computing. To fully grasp how these principles can revolutionize AI, it is crucial first to understand their underlying mechanisms and implications (Jadhav et al., 2023). Superposition, one of the most fascinating concepts in quantum physics, is the ability of a quantum system to be in multiple states at the same time.

While a classical bit in a computer can be either a 0 or a 1, its quantum counterpart, the qubit, can be in a superposition of both states simultaneously, thanks to this principle (Yum & Choi, 2022). It's as though a coin, when spun, isn't just heads or tails but is spinning where it's effectively both heads and tails at once. This ability to be in several states at the same time is what gives quantum computers their inherent parallelism and allows them to process an enormous amount of information concurrently. For AI applications, this could translate into a drastic reduction in computation time, enabling the processing of large volumes of data and complex



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computations much more effectively than traditional computers (Jadhav et al., 2023).

Entanglement, the other cornerstone of quantum mechanics, is a phenomenon wherein qubits become interlinked, and the state of one immediately influences the state of the other, irrespective of the distance separating them. This strange but powerful property enables an extraordinary level of synchronization and correlation between qubits, creating a quantum system where the whole is far more than just the sum of its parts. The entanglement of qubits leads to a collective quantum state, with each qubit inextricably linked to the others (Fang & Chang, 2003). This entanglement enables a quantum computer to perform many calculations simultaneously, opening the door to vast computational speed-ups. In the context of AI, this could mean more sophisticated pattern recognition, higher prediction accuracy, and the capability to solve complex problems that are currently beyond reach.

This, superposition and entanglement, when coupled together, form the foundation for quantum computing's vast potential. However, harnessing these quantum phenomena is not without its challenges. Quantum states are fragile and easily disturbed by their environment, a problem known as decoherence (Mannone et al., 2023). Moreover, creating and managing entangled qubits poses significant technical hurdles. Despite these challenges, the potential benefits that superposition and entanglement could bring to AI are significant, making the quest to overcome these obstacles a key priority in the ongoing journey of technological advancement. In the context of AI, this ability of

qubits to hold vast amounts of information and perform multiple calculations concurrently could result in a profound reduction in computational times. Complex tasks that would take traditional computers years, or even centuries to complete, could potentially be performed in seconds. This ability to process and analyze large volumes of data rapidly and efficiently is particularly relevant in the field of AI, where the capacity to handle big data is often the difference between a functioning model and a superior one (Jadhav et al., 2023; Ying, 2010).

Furthermore, even once these challenges are surmounted, there will be considerable work to adapt our existing AI algorithms and models to exploit the unique properties of quantum computing fully. However, these obstacles do not diminish the promise that superposition and entanglement hold for the future of AI. They simply underscore the magnitude of the scientific and technological journey we are embarking upon. The marriage of these principles with AI has the potential to completely redefine what is possible within the realm of computational problem-solving. As we delve deeper into these phenomena and continue to unfurl the quantum enigma, we stand at the precipice of a future where the limitations of today's AI are transcended, and a new era of unimaginable computational power begins.

Implications for AI

The fusion of AI and quantum computing also brings with it a set of unique challenges. Quantum systems are inherently fragile and prone to errors, and the management of quantum data requires new methods and systems.

Moreover, quantum computers that are powerful enough to outperform classical computers—a stage known as quantum supremacy—are still in development (Khrennikov, 2021). Despite these challenges, the potential implications of quantum AI are too significant to ignore. By harnessing the unique properties of quantum mechanics, we have the opportunity to push the boundaries of AI and usher in a new era of technological innovation. As we continue to explore and navigate this exciting frontier, we can expect to see a transformation in the way we conceptualize and implement AI systems. Quantum computing promises not only to enhance the speed and capacity of AI but also to introduce entirely new capabilities that could revolutionize fields such as healthcare, finance, cybersecurity, and more (Viggiano & Brin, 2022).

For instance, in healthcare, quantum-AI algorithms could enable more personalized treatment plans by analyzing a patient's unique genetic makeup and lifestyle data (Davids et al., 2022). In finance, quantum computing could improve risk assessment models, enabling more accurate predictions of market trends, while in cybersecurity, quantum encryption methods could provide unprecedented levels of security (Viggiano & Brin, 2022). In the realm of natural language processing, a field of AI that seeks to enable machines to understand and generate human language, quantum computing could allow for the development of models that better understand context, subtleties, and nuances in language (Ganguly et al., 2022). This could lead to more sophisticated digital assistants, more accurate sentiment analysis

tools, and more effective automated translation services, to name a few applications.

Also, complex systems, like global climate models, intricate biological systems, or large-scale economic systems, are characterized by their vast number of components and the intricate, non-linear interactions between those components. The immense computational power of quantum computing, combined with AI's ability to learn from data, could allow us to create more accurate, detailed models of these systems than ever before. This could lead to significant breakthroughs in a variety of fields. For instance, climate science could enhance our ability to predict long-term climate patterns and understand the impact of various interventions. In biology, it could revolutionize our understanding of complex biological processes, leading to advances in drug discovery and personalized medicine (Cordier et al., 2022).

Real-time analytics is another area that stands to benefit significantly from quantum AI. Many industries rely on the ability to process and analyze data in real-time to make informed decisions. For example, financial institutions need to analyze market data in real time to make trading decisions, while healthcare providers need to monitor patient data continuously to provide timely care. However, the volume and velocity of data generated today can overwhelm traditional computing systems, leading to delays and inaccuracies. The ability of quantum computers to process large amounts of data simultaneously, combined with AI's predictive capabilities, could drastically improve

the speed and accuracy of real-time analytics, enabling faster, better-informed decisions across various industries (A. & R., 2023; Jadhav et al., 2023; Ying, 2010).

Lastly, the area of optimization problems, where the goal is to find the best solution among a set of possible options, could see tremendous improvements with the advent of quantum AI (Abd El-Aziz et al., 2022; Jadhav et al., 2023). Many of these problems, such as route optimization for logistics, portfolio optimization in finance, or supply chain optimization in manufacturing, involve several variables and constraints, making them computationally expensive, if not impossible, to solve with classical computers. Quantum computers, with their ability to explore multiple solutions at once through superposition and to find optimal solutions more efficiently through quantum interference, could significantly reduce the time it takes to solve these problems. When paired with AI techniques like reinforcement learning, which can learn and improve from experience, the potential to find optimal solutions more quickly and accurately becomes even greater.

In essence, the union of quantum computing and AI heralds a new era of technological potential. As we push the boundaries of what's possible, we stand to not only improve upon current AI capabilities but also unlock entirely new applications that were previously beyond our reach. The path forward is complex and fraught with challenges, but the promise of quantum AI makes this a journey worth embarking upon. As we embark on this journey, it's also essential to consider the ethical implications of

quantum AI. With increased power comes increased responsibility, and the advent of quantum AI raises new questions about data privacy, algorithmic fairness, and the societal impacts of ultra-intelligent systems. These are issues that the AI community and society at large must grapple with as we navigate the future of quantum AI.

Conclusions

The convergence of quantum computing and artificial intelligence (AI) presents a revolutionary paradigm shift that could redefine the contours of technological innovation. This short article has sought to illuminate the transformative potential inherent in this intersection and the far-reaching implications it holds for our understanding of AI. Throughout this exploration, we've delved into the intricacies of the two quantum phenomena that underpin this transformation—superposition and entanglement. Superposition, with its ability to expand computational potential exponentially by allowing quantum bits (qubits) to exist in multiple states simultaneously, stands poised to elevate the processing speed and capacity of AI systems. This phenomenon offers a pathway toward a dramatic reduction in computational times, which, in turn, could boost AI's efficiency in handling large and complex data sets. This capability could be particularly instrumental in areas like complex system modeling, real-time analytics, and optimization problems.

Quantum entanglement, the other quantum marvel, adds an unprecedented degree of synchronization and coherence to quantum systems. By allowing qubits to exist in a state where the modification of one instantaneously

influences the other, regardless of distance, quantum entanglement presents an opportunity to radically improve pattern recognition and decision-making capabilities within AI systems. The immediate correlation facilitated by entanglement could boost the efficiency of information processing, with potential applications spanning from real-time language translation to instant global financial transactions and furthering our understanding of complex biological systems and climate models. Yet, the fusion of these quantum phenomena with AI is not without significant challenges. Quantum decoherence, the instability and interference from the environment that quantum states are susceptible to, presents a prominent hurdle. Additionally, creating and managing entangled qubits introduce substantial technical obstacles that the research community must surmount. Furthermore, adapting our existing AI algorithms and models to harness the unique properties of the entire quantum computing is an arduous task that necessitates substantial further research and development.

However, the immense promise and transformative potential of quantum AI far outweigh these hurdles. The myriad of applications that could benefit from quantum AI underscores the value and significance of ongoing efforts to navigate these challenges. With the dawning of the quantum era, we are bearing witness to the early stages of a revolution that could reshape our perception of computational problem-solving and redefine the limits of AI capabilities. The ethical implications and considerations surrounding quantum AI are equally crucial. The arrival of

quantum AI introduces an array of pressing questions surrounding data privacy, algorithmic fairness, and societal impacts. As we stride further into this new era of quantum AI, it becomes increasingly important to integrate these considerations into our journey, ensuring that the development of this technology aligns with ethical standards and societal needs.

In summation, the marriage of quantum computing and AI ushers in a future teeming with possibilities. The quantum phenomena of superposition and entanglement provide a key to unlock an unprecedented realm of computational power, setting the stage for a new generation of AI that transcends the limitations of today's models. While the path towards fully unfurling the quantum enigma remains filled with scientific and technical challenges, the prospect of a future characterized by more efficient, accurate, and advanced AI systems propels us forward. As we stand on the precipice of this exciting frontier, we are obliged to not just marvel at the transformative potential of quantum AI but also to engage deeply with the questions and challenges it poses. In so doing, we can ensure that this technological revolution is not just about advancing computational capabilities, but also about fostering a future where technology serves humanity's broader needs and aspirations in an ethically sound and socially responsible manner. The quantum future is not just on the horizon—it is here and ours to shape. on the horizon—it is here and ours to shape.

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- न्यूनतम पारिश्रमिक कार्यान्वयन गरौं ।
- व्यवसायजन्य सुरक्षा तथा स्वास्थ्य सम्बन्धी व्यवस्था लागू गरौं ।
- असल औद्योगिक सम्बन्ध कायम गरौं ।



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Laws Relating to the Engineering Profession in Nepal

Introduction

The engineering profession in Nepal is guided by a comprehensive set of laws aimed at ensuring regulation, standardization, and advancement of engineering practices. Among the key is the Nepal Engineering Council Act 2055 (1998), which was established by the Nepal Engineering Council (NEC) to manage the registration and professional standards of engineers. In addition, laws covering labor rights, environmental protection, contract management, and intellectual property further support the engineering sector. These regulations promote ethical practices, maintain safety and quality standards, and facilitate the growth of engineering, which is crucial for Nepal's infrastructure and socio-economic development.

1. Engineering Professional Related Laws

• Engineering Council Act 2055

The Nepal Engineering Council was established to register engineers' identities according to their qualifications and to effectively and methodically activate the engineering profession in Nepal. There are a total of nine different chapters in this act, that make provision for the prohibition of practicing the engineering profession without getting registered with the NEC. Further, it made provisions on the application to be made for the registration of the names of licensed engineers, which follows inquiry, examination, and recommendation, and the name registration certificate to be issued is clearly mentioned in various sections. Similarly, this act empowers the council to strike engineers off the registration book if found guilty of breaching the professional code of conduct or convicted in a criminal court. Also, it outlines penalties for offenses, including fines up to three thousand rupees, imprisonment for up to three months, or both.

• Professional Code of Conduct for Engineers

The professional code of conduct to be followed by the registered engineers of the council, subject to the provisions of the Nepal Engineering Council (NEC) Act, 2055 (1998) and the Nepal Engineering Council Regulation, 2057 (2000) includes discipline, honesty, and dignified practice. Engineers must treat customers with politeness and confidentiality, avoiding discrimination based on religion, race, sex, or caste. They are to work within their expertise, referring tasks outside their scope to qualified experts. Financial integrity is emphasized, prohibiting improper financial gains. Engineers are personally responsible for their work and must clearly state their name, designation, and NEC registration number on all professional documents. Publicity and advertisements that might unduly influence customers are discouraged. Unregistered engineers, including those from unapproved programs, face legal penalties.

2. Related legal provisions (Special Industrial Engineering Profession)

• Industrial Enterprises Act 2076

The Industrial Enterprise Act 2076 aims to enhance the industrial sector by emphasizing import substitution and export promotion. There are overall 9 different chapters which make provision for efficient utilization of domestic resources to increase production, generate employment,

and cultivate an investment-friendly atmosphere. The Act is structured into eight chapters, covering aspects from industry registration to regulation to cancellation of the registered company. It has made provisions on classifications and fixed capital of various industries, incentives, exemptions, and concessions. Additionally, provisions for addressing sick industries, punishments, and appeals are outlined, ensuring comprehensive management and regulation of industrial activities.

• Labor Act, 2074

The Labor Act 2074 serves as a comprehensive framework to protect the rights of workers, define employer obligations, and combat labor exploitation. It encompasses various essential provisions, including those pertaining to minimum standards, the prohibition of forced labor, and the prevention of discrimination in employment. The Act addresses diverse forms of employment, from regular to part-time arrangements, while offering detailed provisions for apprentice and trainee programs as well as part-time labor. Additionally, it regulates the issuance of work permits for foreign workers and establishes rules governing working hours, including overtime. Ensuring fair remuneration, the act mandates annual increments and prohibits unauthorized deductions from workers' salaries. In Chapters 8 and 9, it outlines provisions for employee welfare, encompassing leave entitlements and schemes such as the Provident Fund, Gratuity, and Insurance, underpinning a commitment to fostering a fair and supportive work environment.

• Proprietorship (Private Firm) Act 2014

This act is expedient to provide for provisions on registration of private firms engaged in trade and industry and other related provisions there with in order to maintain the convenience and economic interest of the general public. It has 11 sections, which include provisions regarding the submission of an application for the registration of a private firm and registration. It also addresses the validity period of the certificate of a private firm and the method of renewal, and it also makes provision that there won't be any valid transaction carried out in the name of a private firm that is not registered under this act.

• Partnership Act 2020

This act is expedient to provide for legal provisions on partnerships for the interest and convenience of the general public. It consists of six chapters that address the registration of a firm in the concerned department and the issuance of a certificate within a period of six months from the date when the associates enter into the agreement of partnership pursuant to this act. To renew a firm registered under this act, submit an application in the prescribed format with the required fee to the concerned department within 35 days of the fiscal year-end. It also includes provisional relations with third parties, dissolution of the partnership after expiry of the terms and conditions, or failure of one partner under specific circumstances. Various provisions related to liability and penalties are clearly stated in this act.

- **Contract Related Provisions provided on National Civil Code, 2074 (Amendment of Contract Act 2056)**

The National Civil Code, 2074, sections 521-534, outlines essential aspects of contract law, including 18 provisions that cover general principles, time periods, validity, and compliance of contracts. These sections also address compensation for breach of contract and detailed procedures for such breaches. The updated provisions are organized into different chapters of the Civil Code Act, 2074, addressing various types of contracts such as goods sales, bail agreements, negotiable instruments, mortgage agreements, agency contracts, goods transport agreements, lease contracts, hire purchase agreements, labor contracts, and torts. Section 517 specifically details the conditions under which contracts are deemed void. Additionally, the Code provides rules for contracts involving collateral or deposits and outlines the rights of individuals obtaining collateral or deposits.

- **Environmental Protection Act, 2076**

The Federal Parliament has enacted this Act to safeguard the fundamental right of every citizen to live in a clean and healthy environment and to mitigate adverse impacts on the environment. The act comprises of nine different chapters, which outline the requirements for submitting an Initial Environmental Examination (IEE) report for development and construction projects. It details the procedures for scoping, scheduling work, and obtaining approval from relevant authorities. Additionally, the act addresses pollution control measures to prevent significant harm to public life, health, and the environment, and it prohibits actions that violate government-established standards. Furthermore, it includes provisions for the protection of national heritage sites and environmental protection areas, as well as stipulations for fines and compensation for projects undertaken without proper approval from the concerned authorities.

- **Patent, Design & Trademarks Act, 2022**

This legislation underscores the process of obtaining patent, design, and trademark rights for new methods, shapes, symbols, words, and images associated with a business. There are altogether 5 chapters which outline the application process and investigation by relevant authorities for acquiring these rights. Similar procedures are provided for designs and trademarks. Moreover, the legislation includes provisions for the classification of goods and services for trademark registration, prohibitions on trademark use, and time limits for trademark usage.

- **Copy Right Act, 2059**

This legislation permits the citation of copyrighted works without the author's authorization, allowing for fair use. It has seven different chapters which outline the economic rights of the copyright owner, including reproduction, modification, sale, distribution, and rental of the work to the public. Infringement of these rights, such as unauthorized use, reproduction, distribution, or adaptation of copyrighted material, is addressed comprehensively. Punishments for importing unauthorized copies and infringing on protected rights are also detailed. Additionally, it specifies that copyright ownership can be transferred through a written agreement or authorization, with or without specifying terms.

- **Public Procurement Act, 2063**

This legislation has 10 different chapters that mandates before procuring any goods, construction work, or services, a public body must first prepare comprehensive specifications, plans, designs, and special requirements.

Additionally, a detailed cost estimate must be prepared for each procurement. The methods for procurement by public entities are determined based on specific conditions and purchase prices for the necessary goods, works, or services. The legislation outlines the entire bidding process, including prequalification, documentation, and an invitation to bid. It also details the procedures for bid evaluation to identify any deviations from specifications, including provisions for bid rejection. Finally, the acceptance of bids and the formation of procurement contracts are thoroughly discussed, ensuring a clear and transparent process for all stakeholders involved.

- **Income Tax Act, 2058**

This tax system outlines annual tax obligations comprehensively, categorizing income into separate baskets for business, employment, and investment to determine the appropriate tax treatment. It consists of 24 different chapters that make provision for calculating the tax owed based on income from each category. To ease the burden, the system offers exemptions that reduce your taxable income, including specific amounts and certain expenses. Additionally, it allows for the deduction of specific costs, such as loan interest and maintenance, further decreasing your taxable income. Finally, it includes an in-depth approach to calculating the net profit for businesses managing property and liabilities, ensuring a thorough and precise determination of tax obligations.

- **Company Act, 2063**

This Act aims to amend and consolidate laws related to companies, fostering economic development by encouraging investment in industry, trade, and business. It comprises 21 chapters that govern company incorporation, with applications to be submitted and registration to be completed within 15 days. The Act establishes limited liability for shareholders and specifies the number of shareholders and company obligations. It addresses the conversion of private companies to public, detailing requirements for the Memorandum of Association, Articles of Association, and prospectus. Additionally, it mandates the preparation of annual financial statements and board reports before the annual general meeting, along with the appointment of auditors in accordance with regulatory guidelines.

Conclusion

The acts relating to the engineering profession in Nepal provide a comprehensive legal framework that is essential for the regulation, standardization, and advancement of engineering practices in the country. Key legislation, such as the Nepal Engineering Council Act 2055, ensures that engineers are registered and held to high professional standards, fostering competence, ethical behavior, and accountability. This legal foundation is crucial for maintaining the safety, sustainability, and quality of engineering projects, which are vital for Nepal's infrastructure development and socio-economic growth. Moreover, these acts address critical aspects of industrial engineering, including labor rights, environmental protection, contract management, and intellectual property. By ensuring adherence to safety protocols, promoting innovation, and upholding ethical standards, the legislative framework supports industrial engineers in effectively managing labor relations, financial decisions, and contractual obligations. As Nepal continues to modernize and industrialize, these regulations will play a pivotal role in enabling industrial engineers to contribute significantly to the country's economic development and overall progress.



भरतपुर महानगरपालिका

नगर कार्यपालिकाको कार्यालय

भरतपुर, चितवन, नेपाल

Bharatpur Metropolitan City

Office Of Municipal Executive

Bharatpur, Chitwan, Nepal



अनुरोध

- ❖ अनिवार्यरूपमा नक्सा पास गरेर मात्र घर, कम्पाउण्डवाल आदिको निर्माण गरौं। सम्भावित विपदबाट बचाऔं।
- ❖ सडक मापदण्ड पालना गरेर मात्र भौतिक संरचनाहरू निर्माण गरौं। सडकमा जथाभावी निर्माण सामग्री नथुपारौं।
- ❖ हरियाली प्रवर्द्धनको लागि सडकको दायौँबायौँ वृक्षारोपण गरौं। रोपिएको विरुवाका संरक्षण गरौं।
- ❖ फोहरको उचित व्यवस्थापन गरौं। रोग लाग्नबाट बचाऔं। 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 तिर्औं। समृद्ध महानगर निर्माणमा सहभागी बनौं।
- ❖ महानगरले प्रदान गर्ने कर छुटको फाइदा लिऔं, म्याद नागेपछि लाग्ने जरिवानाबाट जोगिऔं। तिर्नु पर्ने कर रहरले तिर्औं, करले होइन।
- ❖ महानगरको अनुमति बिना कुनै पनि सार्वजनिक स्थानमा रोडक्रस गेट, ब्यानर, होर्डिङ बोर्ड, फ्लेक्स, पर्चा पम्प्लेट नराखौं, नटाँसौं। सुन्दर महानगर निर्माणमा जुटौं।
- ❖ कोरोना कहरबाट बचाऔं, बचाऔं। नेपाल सरकारले तोकेका मापदण्ड पूर्णरूपमा पालना गरौं।
- ❖ "सूर्तोजन्य पदार्थको प्रयोग नगरौं, स्वास्थ्य रोजौ: सूर्तोजन्य पदार्थ होइन।"

थाप जानकारी तथा समन्वयको लागि नजिकको वडा कार्यालय वा महानगरमा सम्पर्क गरौं।

फोन नं. ०५६५२०१६७, ०५६५२१४६७, ०५६५२५७७१ दमकल ०५६५२१०८३

मोबाइल नं. ९८४५१४३८७८ टोल फ्री नं. १६६०५६५२२२२

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DC motor controller

Development & Testing of High Power DC Motor Speed Controller

-Nitesh Barnawal

Introduction:

This article consists of the guidelines and documentation for building a high-power DC Motor Speed Controller using 555 Timer IC and two N-channel MOSFETs. The circuit holds a working capacity range as follows:

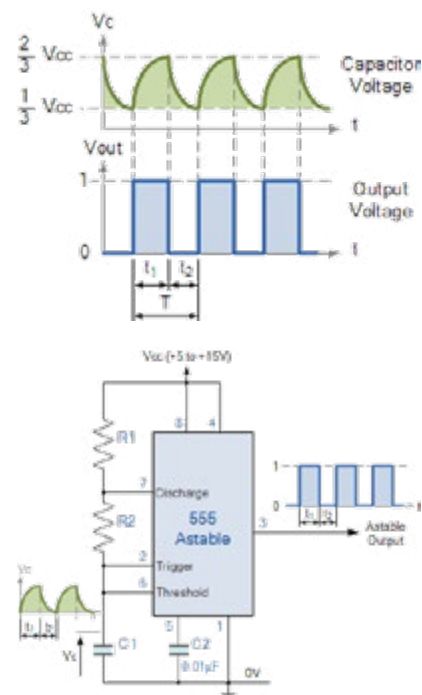
1. Voltage : 12V - 55V
2. Max. Current: 49A
3. Max. Power: 2700W

The main purpose behind the development of this circuit was to control the speed of 250W, 19A, 24V DC geared motor, for which it worked very well as expected. The circuit was later tested on a high torque 12V wiper motor and it performed well on this motor as well.

Working Principle

In the circuit, the NE555 Timer IC works as an astable multi-vibrator. In this mode, the IC produces a continuous High & Low PWM (Pulse Width Modulation) signal from the output pin which can be adjusted by changing the value resistor and capacitor, attached to the IC. Here, I used Potentiometer so we can change the resistance value by rotating the knob.

The IC's output goes to the Gate terminal of the IRFZ44N MOSFETs. When we rotate the potentiometer knob, the IC's output value also changes. Here, the MOSFET works as an amplifier. So, when the NE555 timer IC output voltage goes Low to High then the IRFZ44N MOSFET voltage amplification rate also increases, and this amplified voltage goes to the motor then the DC motor Speed/RPM also increases and vice-versa.



Description of the Major Components Used

List of the Components Used:

SN	Components	Quantity
1	NE555 Timer IC	1
2	LM7805 Voltage Regulator	1
3	MBR3045PT Schottky Diode	1
4	IRFZ44N MOSFET	2
5	1N4007 Zener Diode (5V)	2
6	B10K Potentiometer	1
7	104 Ceramic Capacitor	2
8	Resistor - 1K	2
9	Resistor - 10K	1
10	LED	1

1. 555 Timer IC

555 timer is used in almost every electronic circuit today. A 555 timer works as a flip-flop or as a multi-vibrator. In the circuit developed, the 555 timer is used as the Pulse Width Modulator(PWM). A potentiometer used in the circuit varies the speed of the motor.

The output of 555 controls the DC motor. The motor voltage used is 24 volts and the current is limited to the capacity of the output transistor.

For speed variation, the pulse width can be modified at pin 3, providing additional functionality to the existing astable working condition of the timer IC. This is achieved with the Zener diodes, resistors, the potentiometer, and the capacitor. The purpose of these components is to regulate the charging and discharging times of the capacitor connected across pins 1 and 2 of the timer IC, thus establishing the time that the 555 has high and low output.

Since the output of the 555 IC is of the square wave type, the motor will have between its terminals a time of 24V (a little less) and another time 0V (a few millivolts).



Nitesh Barnawal

CI Engineer at Nidec Motor Corporation

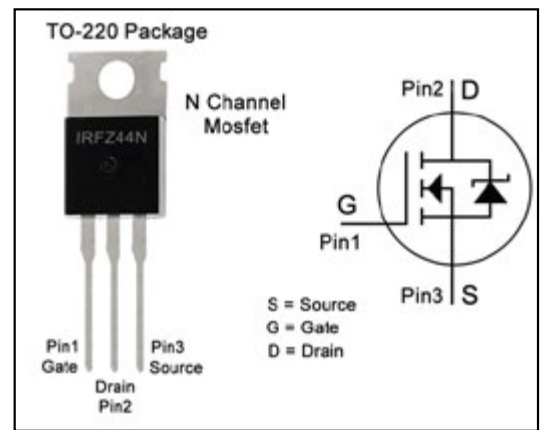
2. N-Channel MOSFET (IRFZ44N)

Features

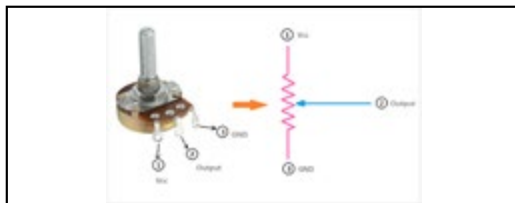
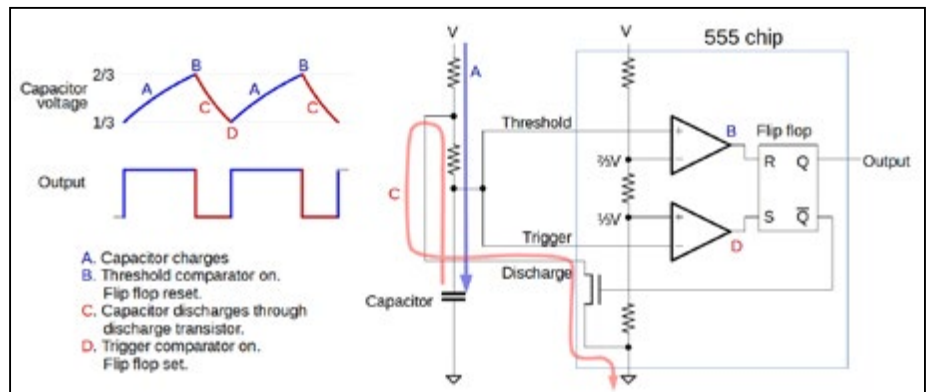
1. Drain Current $-I_D=49A$ @ $T_C=25^\circ C$
2. Drain Source Voltage : $VDSS= 55V$ (Min)
3. Static Drain-Source On-Resistance : $R_{DS(on)} = 0.032\Omega$ (Max)
4. Fast Switching

Description

Designed for low voltage, high-speed switching applications in power supplies, converters, and power motor controls, these devices are particularly well suited for bridge circuits where diode speed and commutating safe operating areas are critical and offer additional safety margin against unexpected voltage transients.



First, we have our source of energy a 24V DC battery. The output signal from 555 Timer IC is connected directly to the Gate of both the MOSFET. The Source pins of both the MOSFET are connected to the ground or negative terminal of the battery. When both sources are connected to the ground or negative terminal of the battery, we will have the output for our DC motor in the drain pin and source pin of two MOSFETs. Due to the switching actions of these MOSFETs, the motor receives the required negative supply from the Drain pins of both the MOSFETs connected in parallel.

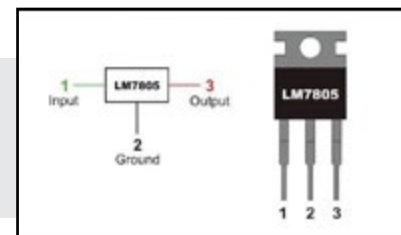


3. Potentiometer

In this circuit, to control the speed of the DC motor, I used a B10K ohm potentiometer to change the duty cycle of the PWM signal. Two Zener diodes are connected in series across the ends of the potentiometer, while the middle arm pin is connected to the threshold pin 6 of the 555 Timer IC.

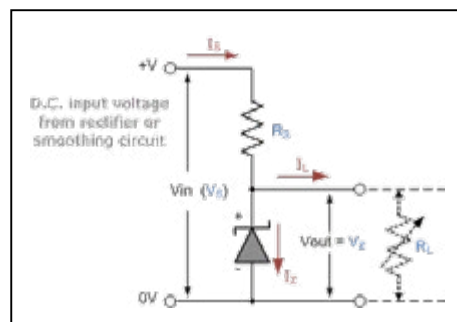
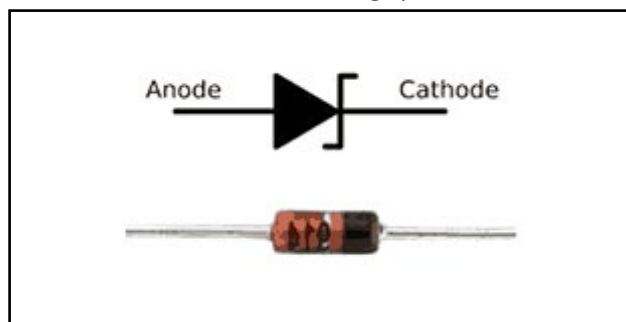
4. LM7805 Voltage Regulator

The 7805 voltage regulator is used to step down the input voltage (12V - 24V) to 5V, which powers up the 555 Timer IC through the +VCC supply at pin 8.



5. Zener Diode

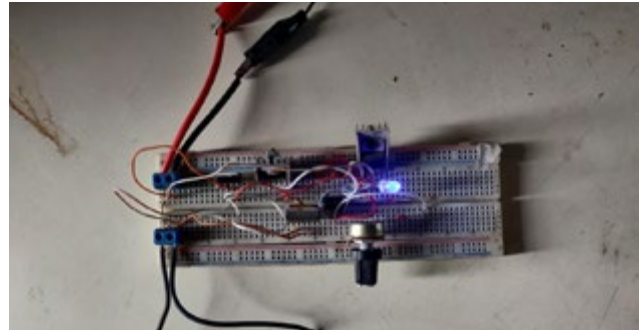
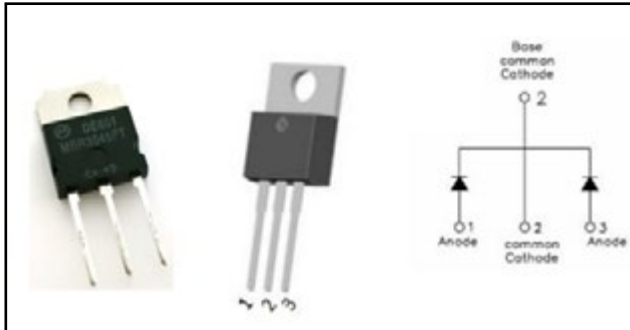
Two Zener diodes are used to regulate the voltage of any point inside the circuit. It is handy for obtaining a regulated voltage at the output. In the circuit, two Zener diodes are connected in series across pins 1 and 3 of the potentiometer to regulate the voltage across the speed controller circuit. The effect of the Zener diode after voltage regulation is fed to the 555 timer IC at the Discharge pin 7.



6. Schottky Diode

The characteristics of a Schottky diode make them well-adapted for power or circuit applications because of their low forward voltage drop. The presence of these diodes also prevents reverse current flow from one supply entering the other.

In the circuit, the Schottky diode (MBR3045PT), 30A 45V switch-mode power rectifier is connected across the positive supply and the negative output from Drain pins of the IRFZ44N MOSFET. The output from the diode is then connected to the motor, to prevent the reverse flow of current across the motor.



PWM Simulation of 555 Timer in MATLAB

To visualize the nature of the PWM signal generated by the 555 Timer through voltage controlled by the B10K potentiometer (P1), I made a Simulink model and simulated the circuit in MATLAB.

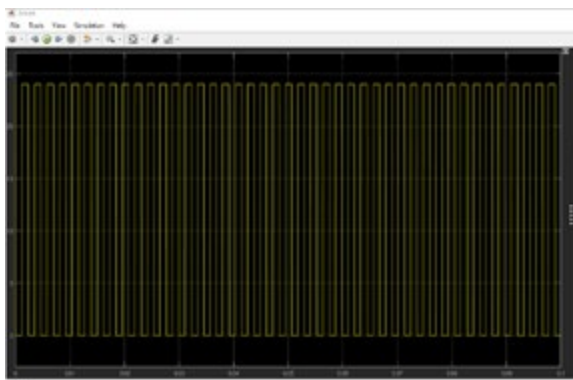
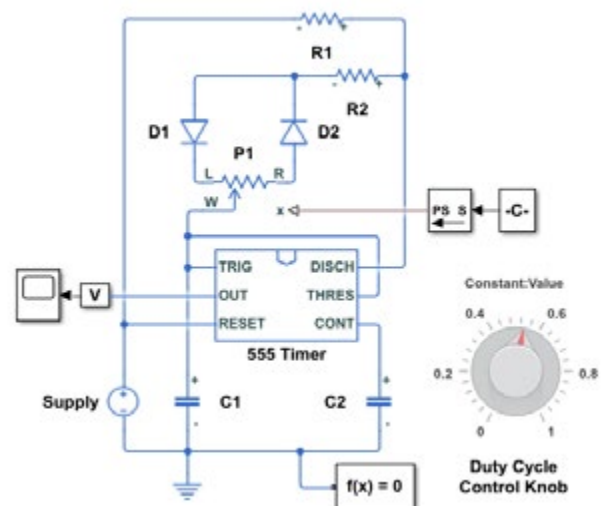
The components specifications during the simulation of the circuit are:

DC Supply: Constant 24V

C1 & C2 : 104 (0.1uF)

R1: 1K

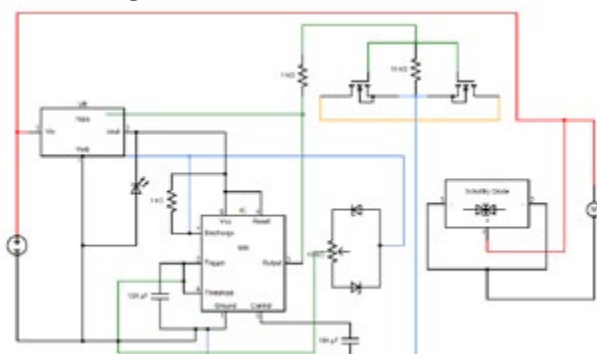
R2: 10K



Result :

As a result of the simulation, the nature of the waveform generated is square form PWM signals, with the amplitude ranging between 0V in minimum to 24V in maximum with a mean period of 0.042 seconds. The signal statistics and bilevel measurements of the generated signal are shown in Figure 11.

Circuit Diagram



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DC motor controller

Development & Testing of High Power DC Motor Speed Controller

-Nitesh Silwal

Introduction:

This article consists of the guidelines and documentation for building a high-power DC Motor Speed Controller using 555 Timer IC and two N-channel MOSFETs. The circuit holds a working capacity range as follows:

1. Voltage: 12V - 55V
2. Max. Current: 49A
3. Max. Power: 2700W

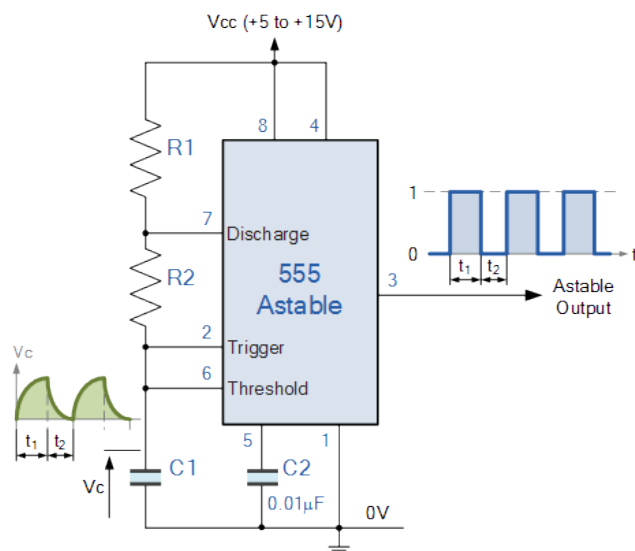
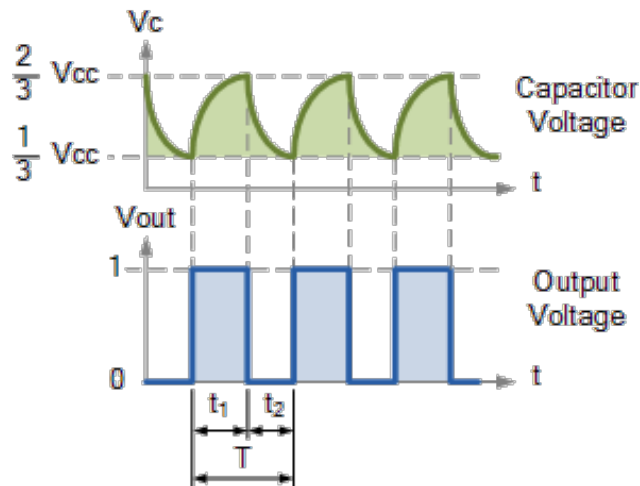
The main purpose behind the development of this circuit was to control the speed of 250W, 19A, 24V DC geared motor, for which it worked very well as expected. The circuit was later tested on a high torque 12V wiper motor and it performed well on this motor as well.

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In the circuit, the NE555 Timer IC works as an astable multi-vibrator. In this mode, the IC produces a continuous High & Low PWM (Pulse Width Modulation) signal

from the output pin which can be adjusted by changing the value resistor and capacitor, attached to the IC. Here, I used Potentiometer so we can change the resistance value by rotating the knob.

The IC's output goes to the Gate terminal of the IRFZ44N MOSFETs. When we rotate the potentiometer knob, the IC's output value also changes. Here, the MOSFET works as an amplifier. So, when the NE555 timer IC output voltage goes Low to High then the IRFZ44N MOSFET voltage amplification rate also increases, and this amplified voltage goes to the motor then the DC motor Speed/RPM also increases and vice-versa.



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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.

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Society of Industrial Engineering Students - Nepal is a student-driven 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.

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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.

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We are grateful to our Well-wishers!



I am overjoyed to learn that Industrial Vision Volume-9.0, 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

Congratulations on the auspicious occasion of releasing the 9th edition of "Industrial Vision"! Your relentless commitment to academic excellence and innovation is truly commendable. This is the matter of pride for Thapathali campus. This milestone reflects your dedication to advancing knowledge and fostering a culture of learning. May this edition be a beacon of inspiration for students, providing valuable insights and contributing to the growth of industrial engineering. Your collective efforts resonate throughout Thapathali Campus and beyond. Best wishes for the entire team of SOIES Nepal, and may "Industrial Vision" continue to illuminate the path of knowledge and discovery.



Dr. Khem Gyanwali

Campus Chief, IOE, Thapathali Campus



Dear Members of the Society of Industrial Engineering Students Nepal (SOIES Nepal) and the Industrial Vision Team, On behalf of the Department of Industrial Engineering, it gives me immense pleasure to extend my heartfelt congratulations to you on the successful publication of the ninth volume of Industrial Vision magazine. Your commitment to promoting industrial engineering principles, sharing insights, and showcasing innovative ideas within the field is truly commendable. Over the past volumes, Industrial Vision has become a valuable resource for students, professionals, and enthusiasts alike, providing a platform for knowledge exchange and networking opportunities. As we celebrate this achievement, I encourage you to continue striving for excellence and pushing the boundaries of what Industrial Vision can offer to its readers.

Er. Sushant Raj Giri

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

I am thrilled to extend my heartfelt congratulations to the SOIES Nepal team on the publication of Industrial Vision- Volume 9.0. Witnessing the continuous innovation and excellence demonstrated by the team brings me immense joy. Watching SOIES Nepal grow and achieve new heights each year is a privilege. May this volume continue to inspire and provide valuable insights to the industrial community. Best wishes for your continued success and impactful contributions!



Er. Prakash Acharya

Founding president of SOIES Nepal,

Co-Founder and COO at Harilo, Founding Chairman at Green Valley Recyclers- GVR Cooperative, Co-Founder/Engineer at Mukti Energy



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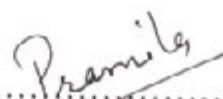
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Well-Wishing Message

I am overjoyed to know that "INDUSTRIAL VISION-volume 9" is being published by the entire team of "society of Industrial Engineering Students Nepal" which is instrumental for technological advancement and innovation in the sector of education, the backbone for the development of the country. I would like to extend my best wishes to the entire team of SOIES-Nepal for their dedication and commitment in the annual magazine and taking it to a whole new level. I am hoping for more innovative and informative ideas from the SOIES-Nepal team in the coming years.


.....
Pramila Devi Bajracharya
Secretary



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President's Message

It is with immense pride and a deep sense of honor that I present the ninth edition of our annual publication, Industrial Vision. Reflecting on the journey that began ten years ago in 2014, it is awe-inspiring to consider the foresight and dedication required to initiate such an academic tradition. Today, in 2024, I am incredibly proud to contribute to this legacy, continuing the excellence in the field of education and the advancement of Industrial Engineering. This edition is particularly special as it is brought to you by a team powered by feminine energy, demonstrating our dedication and unity in advancing the field. I hope this edition provides you with valuable insights and enriching reading.

The year 2023-24 has been exceptionally fruitful for SOIES Nepal, marked by a wide range of activities aimed at integrating industries, students, and policy frameworks. These activities included seminars, training sessions, talk shows, workshops, and technical exhibitions both on campus and outside. SOIES Nepal stands as a beacon in Industrial Engineering, committed to elevating the field and addressing its challenges. Our culture embodies responsibility, enthusiasm, and a commitment to continuous improvement. The launch of our flagship project, "Industrial Vision-9," underscores our commitment to promoting academic excellence and fostering intellectual growth among students. Witnessing our institution's growth is deeply satisfying, and I extend heartfelt gratitude to the Department of Industrial Engineering, IE alumni, students, and all our supporters and well-wishers whose constant motivation and encouragement help us remain the most essential and dynamic student society within the campus community and beyond. Leading this dedicated team has truly been a privilege.

Lastly, I would like to express my sincere appreciation and thankfulness to our valuable content providers, generous sponsors, technical supporters, and all the helping hands who made this milestone of Industrial Vision 9.0 possible. On behalf of the entire magazine team and the SOIES Nepal team, I thank you.

Good times ahead!

Shistata Thapaliya

President

SOIES Nepal

16th executive committee



Editor's Note

Welcome to the latest edition of Industrial Vision, where we continue our mission of driving innovation, industrial excellence, and sustainable prosperity. As we navigate through 2024, the world of industrial engineering is more dynamic than ever, with groundbreaking advancements and insightful analysis shaping the future of our field. Our commitment to bringing you the latest and most impactful developments remains steadfast, and this volume is a testament to that promise.

This edition is packed with diverse and compelling content that spans a broad spectrum of topics crucial to modern industry. From shedding light on different facets of AI and its integration into various industrial processes, energy management to the strategic importance of facility layout and location, our articles are designed to provide you with a deep understanding and actionable insights.



Every article, every layout detail, and every visual element in this magazine is crafted with the utmost care and dedication. In this volume, we have endeavored to connect industry, academia, and policy. I extend my deepest gratitude to our incredible team for their relentless hard work and creativity. Special thanks to people around me who kept me motivated throughout this journey.

We value your feedback and suggestions, as they are crucial for our continuous improvement. In this ever-evolving world, there is always room to grow, and your insights help us to better serve our readers.

Thank you for joining us on this exciting journey, we hope this edition of Industrial Vision not only informs but also inspires you to push the boundaries of innovation.

Happy Reading!!

A handwritten signature in black ink, appearing to be 'Sg' or similar, written in a cursive style.

Sadikshya Gautam

Editor-in-Chief

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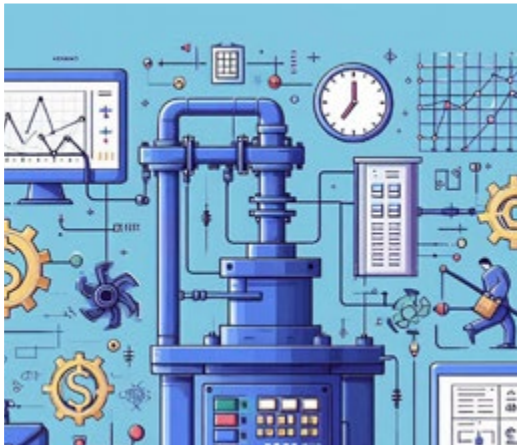
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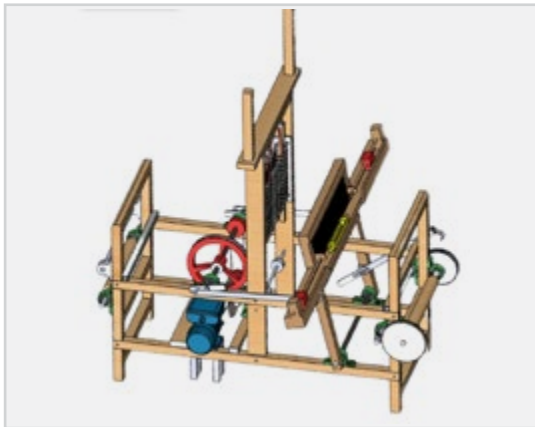
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Damodar Bhandari

Honorable Minister of Industry, Commerce and Supplies



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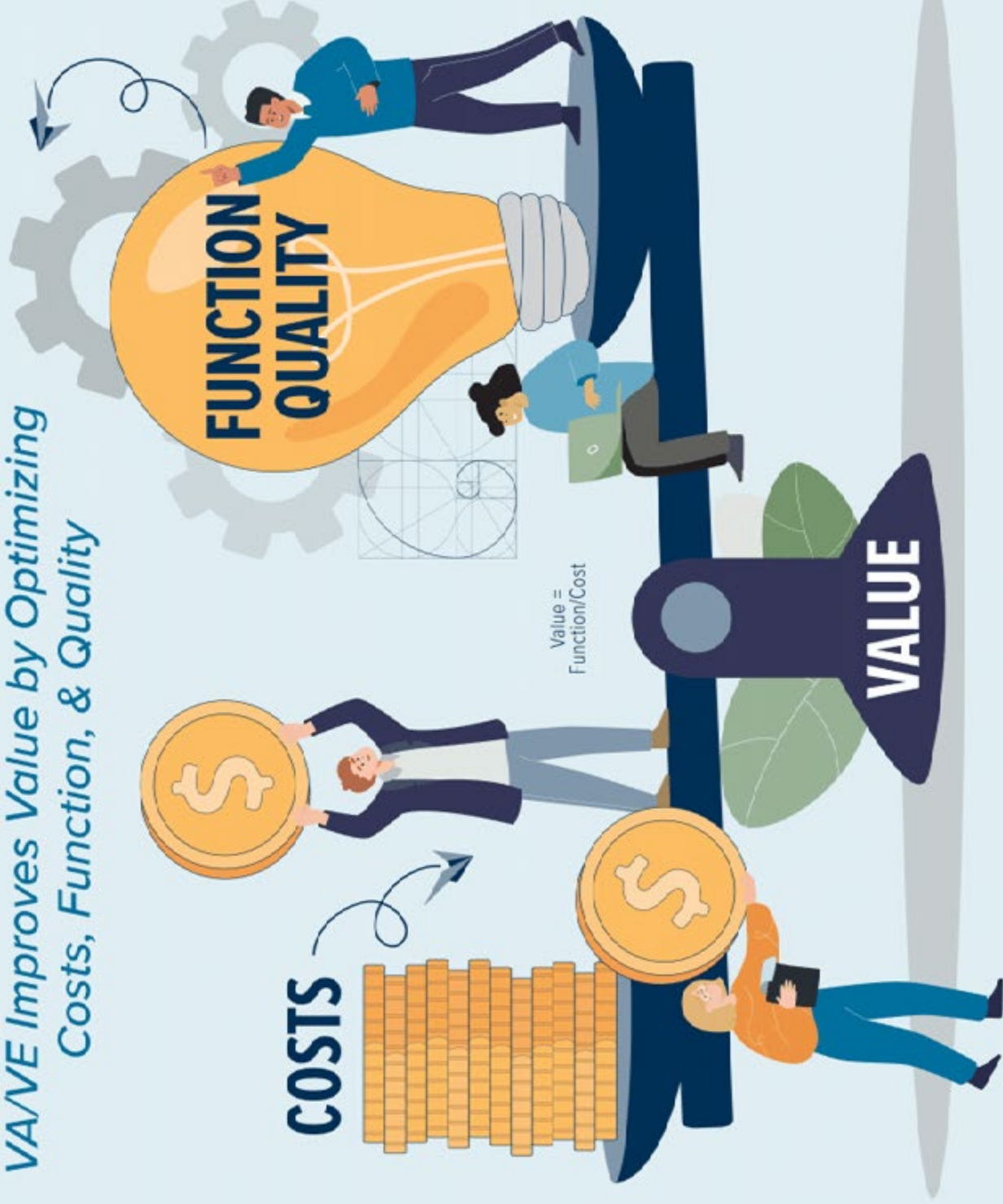
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Value Analysis (VA) / Value Engineering (VE)

*VA/VE Improves Value by Optimizing
Costs, Function, & Quality*



Value Analysis

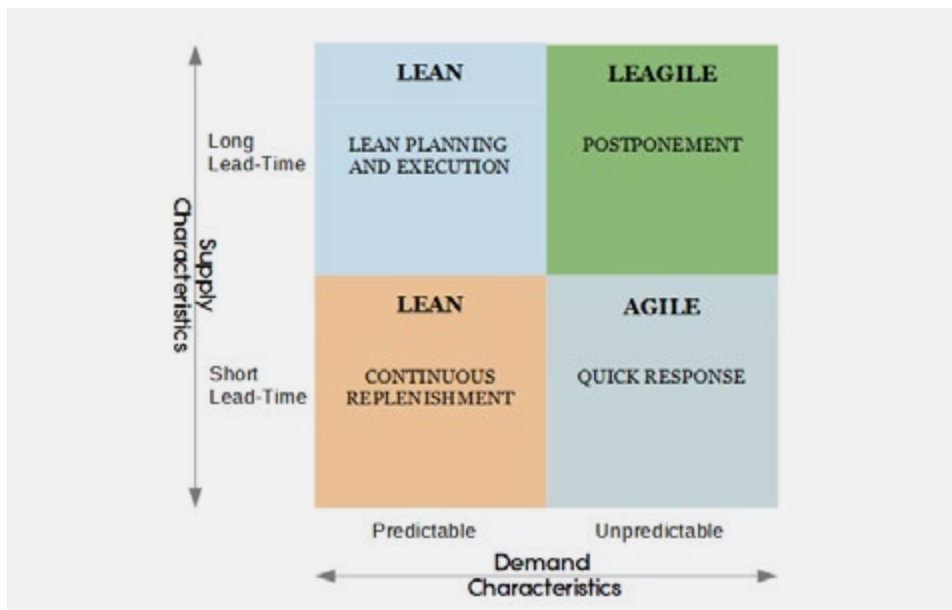
- Applies problem-solving methods to increase the value of **existing** products or services by reducing costs, improving function, &/or boosting quality
- Remedial Process
- In the Manufacturing Stage
- Sparks Process Innovations
- Removes Unnecessary Costs & Improves Performance

Value Engineering

- Identifies innovative ways to improve the design or process of a new product or service **before** it is produced
- Preventive Process
- In the Design or Prototyping Stage
- Sparks Function Breakthroughs
- Increases Value



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with adaptability. The supply chain is depicted to enable businesses to respond quickly and effectively to changes in demand and or supply, market conditions, and other internal and external factors. In an agile supply chain, decision-making is decentralized and responsive to real-time data, rather than relying on predetermined plans and forecasts. Key elements of the agile supply chain philosophy include collaboration, transparency, visibility, flexibility, and responsiveness.

Agile is the new Lean.

- Sabin Silwal

Agile is the new Lean and mass customization is the competitive advantage. Any process, sub-process, or action that does not have value to the customer is a waste, Muda, or non-value-adding. Lean Manufacturing experts in Toyota introduced seven wastes widely known as TIMWOOD (Transportation, Inventory, Motion, Waiting, Overproduction, processing, and Defects). The heart of the Lean supply chain is the streamlining and coordinating of information flows, material flows, and cash flows to reduce waste and deliver more value to customers. The key elements of lean supply chain philosophy include Just in Time (JIT) Production, Lean Logistics, Continuous Improvement, Communication, and Co-operation. Lean supply chain framework and tools guide the supply chain to continuously improve, standardize, and sustain the flows. However, too much standardization of

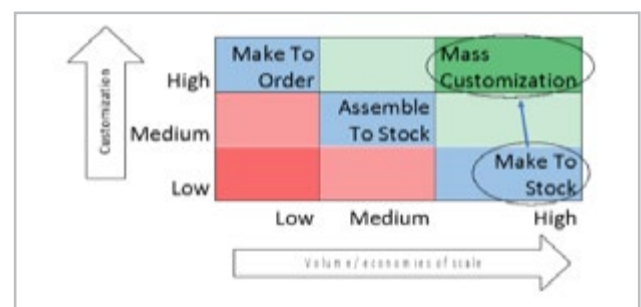
“Companies do not compete with each other, but the supply chain does.”

flows and centralization of decision-making reduces customization possibilities in manufacturing. i.e., ‘one size does not fit all’ in a multi-product environment with a diverse product portfolio lean supply chain philosophy might not be agile enough to adjust and cope with complexities.

Agile supply chain management is an outlook characterized by velocity with vision and acceleration

With huge respect to both Lean and Agile philosophies, for Global Supply Chain Management (GSC) practitioners in multi-product environments, what comes in handy is the type of material replenishment strategy. What does that mean? Simple, the figure at the right is a visual representation of categorizing the product portfolio in terms of volume vs customization.

We can observe that the product portfolio is clustered mostly diagonally and following replenishment strategies:



Make to Stock (MTS) → High volume * Low customization
(e.g., Toyota Innova)

Assemble to Stock (ATS) → Medium volume * Medium customization
(e.g., BMW 6 series and above)

Make to Order (MTO) → Low volume * High customization
(e.g., Ferrari, Rolls Royce)



Sabin Silwal, Regional Upstream Planning Leader (GSC Europe) at Schneider Electric

Supply Chain professionals are currently performing a balanced act to cluster their product portfolio in a diagonal represented as the blue zone in the figure and assigned to the best-fit replenishment strategy.

The red zone behind this blue zone is the less profitable zone. This means that the farther away from the blue zone, where both volume and customization are low, the less profitable it is.

On the other hand, the green zone at the right is known to be the more profitable zone. The same interpretation applies here, the farther away from the blue zone, the better. If the company can offer a high level of customization to high-volume products, that will boost profitability and increase competitive

advantage in the global market.

A couple of decades ago, mass customization embarked on a paradigm shift for material replenishment that is currently offering low customization due to the MTS strategy. This new material replenishment strategy was coined by Stan Davis which was later developed and popularized by Joseph Pine (1993). Mass customization offers customization of products and services best fitting individual customers' needs while keeping near mass production efficiency during the operation. An example is the Advanced driver-assistance systems that car manufacturers offer to some basic car models as optional features to end users. James H. Gilmore and Joseph Pine introduced

four approaches to mass customization: collaborative customization, adaptive customization, transparent customization, and cosmetic customization.

Companies do not compete with each other, but the supply chain does. Supply chain competitive advantage is in manufacturing strategy like Toyota but providing customer perceived value like Ferrari. We all know that since the early 20th century, Lean SC philosophy has been incorporated into several industries and business processes. However, the COVID pandemic guided the global supply chain to unprecedented demand and supply disruptions resulting in highly increased challenges and the need for immediate adaptation, decision-making, and

flexibility which we know as the agile supply chain.

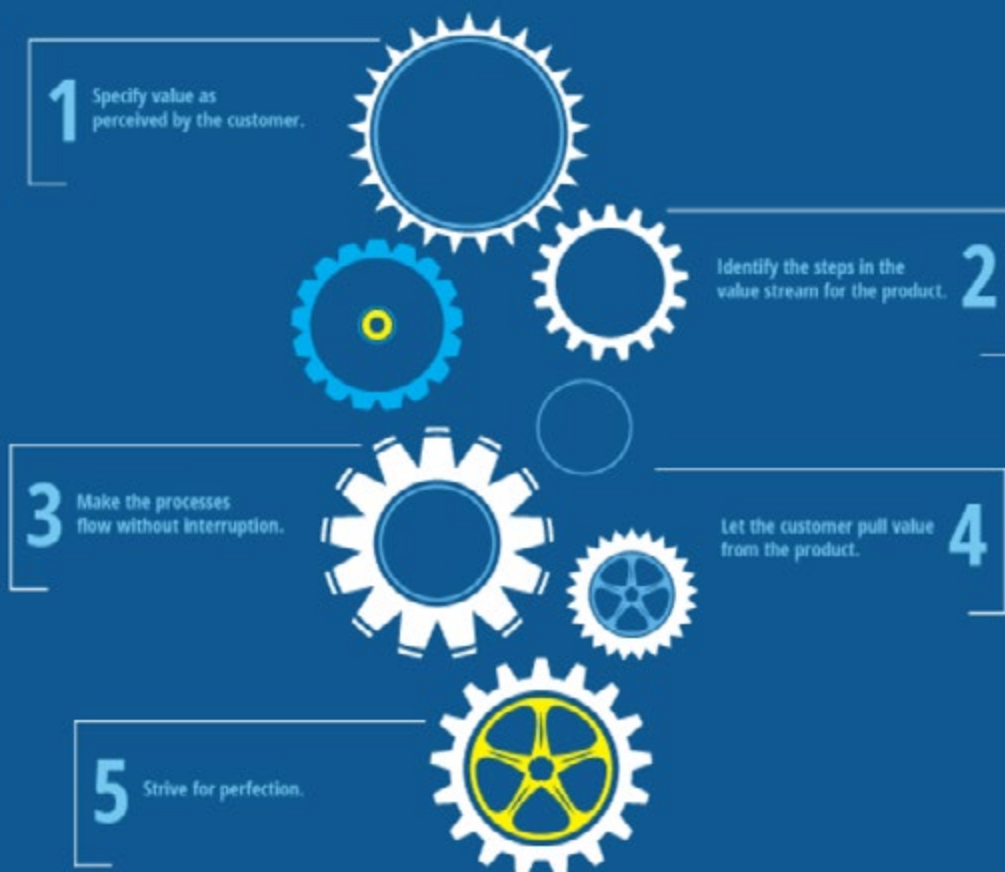
In summary, theoretical understanding of lean supply chain and agile supply chain boils down to material replenishment strategy when it comes to multi-product environments and constantly changing demand market trends. Customizing products where they count, product late differentiation, and LeAgile supply chain management will drive them to reach mass customization for high-runner (high sales volume) products. Make your lean supply chain as agile as possible and navigate your Agile supply chain as leaner as possible.

Therefore, Agile is a new Lean.

5 Key Principles of Lean Manufacturing

Lean manufacturing or lean production is a specific way to eliminate waste. It focuses on adding value by eliminating or reducing aspects that are unnecessary.

The 5 step thought process for implementing lean techniques is as follows:



TEAM SITUATION AWARENESS

- Prameet Ranjan Jha

Introduction

Situation Awareness (SA) refers to the engagement of people or the entire sociotechnical system with the dynamics of their operational environment (Moray, 2004, as cited by Stanton et al., 2017). It is the level of awareness that an individual or a team has of a situation. The past three decades have seen much work in the field of SA, particularly explored in operational contexts of military settings, aviation, transportation, healthcare and medicine, and emergency services. Most of these works are, however, focused on individual SA developed mostly around Endsley's three-level model (Stanton et al., 2017).

Compared to individual SA, relatively fewer studies, so far, have been concerned with determining what is necessary for Team Situation Awareness (TSA). Though the studies have advanced the issue of TSA, a lot remains to be understood about the practices underlying the formation and maintenance of overall TSA in dynamic systems (Garbis and Artman, 2004). Salas et al. (2006) argue that research into the TSA construct is difficult, deficient, and complex because of the complicated cognitive nature of teams. Researchers agree on the fact that the performance of teams rather than individuals is crucial for the success of dynamic systems such as air traffic control, nuclear power plants, industrial plants, etc. In such dynamic systems, the state can change autonomously

or because of the decision maker's actions, and real-time interdependent decisions are required continuously if the system is to be controlled (Brehmer, 1992, as cited by Garbis and Artman, 2004). Because of these characteristics, considerable teamwork is often required for the management of dynamic systems and one of the important aspects of teamwork is TSA. Further, systems continue to become more complicated, technology, and team-driven. So, how best to support awareness across teams and systems is becoming an important question, and today, there is a much stronger and growing focus on TSA. The following section of the paper presents the current status of TSA models and theories.

Team Situation Awareness Teams are distinguishable sets of two or more people interacting dynamically, interdependently, and adaptively toward a common and valued goal with each person having been assigned specific roles to perform (Salas et al., 1992). Thus, shared goals, interdependence of actions, and division of labor are the characteristics of a team. Endsley's (1995) model of TSA is based on this framework of team. TSA is the degree to which every team member possesses the SA required for his or her responsibilities in the team (Endsley, 1995, as cited by Endsley & Robertson, 2000). Each team member will have their own independent SA requirements because

of the division of labor. At the same time, team members will also have SA that is shared among team members because of shared goals. Hence, each team member's SA requirements may overlap with other team member's SA requirements. The overlapping occurs when team members have the same SA on shared SA requirements, which Endsley (1995) refers

“There is no unifying theory and commonly agreeable model of TSA, and the research topic is still a work in progress.”

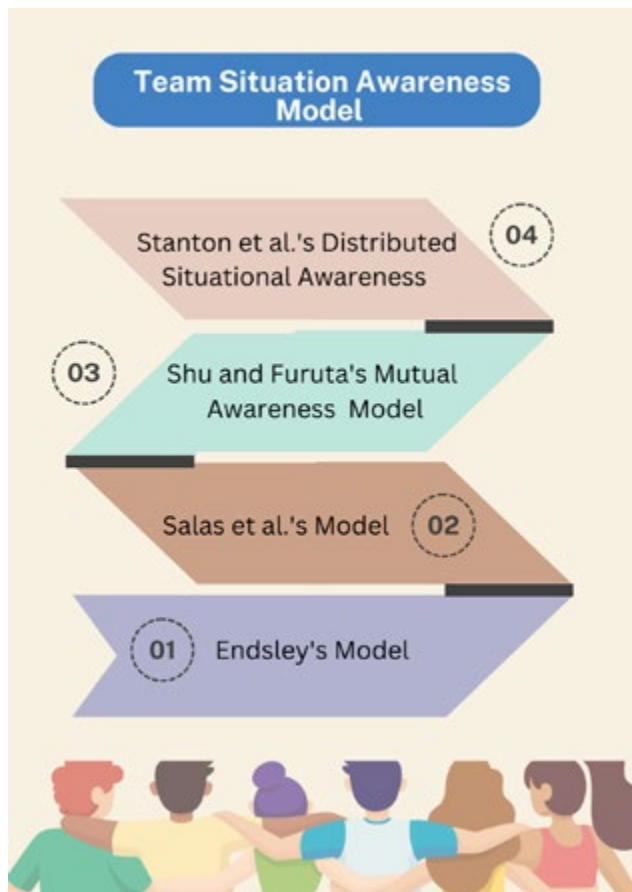
to as shared situation awareness. Therefore, TSA is determined by each team member's responsibilities within a team and the awareness of SA elements about which he or she is concerned. Further, the effectiveness of team coordination is dependent on the quality of team member's SA of shared elements. Successful team performance is dependent on individual team members' SA on their specific elements and the equivalent SA for the necessarily shared elements (Endsley and Robertson, 2000). Team SA suffers when there is a discrepancy between team members' knowledge

of certain pieces of information that they need to know. This discrepancy in SA can be corrected through information transmission which could be through verbal exchange or separate displays. This model has, however, received criticism for only emphasizing Endsley's three-level framework of individual SA and underestimating the importance of team dynamics when addressing SA in team settings.

Unlike the Endsley model, Salas et al. (1995) defined their model of TSA not only from an individual SA perspective but also from the viewpoint of team processes. The model defined TSA as a shared understanding of a situation among team members at one point in time. This understanding is facilitated by team cognitive processes or behaviors that help in developing and maintaining a shared assessment of a situation. According to Salas et al. (1995), communication at various levels in a team influence TSA. Further, the model hypothesizes that the communication of team objectives, individual roles, team capability, and other team performance-shaping factors also influence the perception of SA elements among team members. Any limitations in individual SA can be compensated by information exchange and communication provided by the coordination between the team members (Salmon et al., 2008). Also, the comprehension of this information is impacted by interpretations made by other team members, which in turn is affected by their own individual SA. Thus, cyclical TSA is formed whereby SA (comprehension) leads to new SA and modifies SA of other team members when it is shared. Individual SA and TSA, therefore, evolve because of the interaction and communications at



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various levels and based on the dynamics of teamwork. Shu and Furuta (2005) introduced the mutual awareness (MA) concept to define the TSA model. The model is very much consistent with Endsley's model of TSA. However, the model also defines TSA from the perspective of "belief" that team members possess in other members' SA to capture the dynamics of team cooperation. Thus, TSA is formed and maintained through interaction within the team members and understanding of the situation which is partly shared and partly distributed among team members. The explicit or implicit interaction among team members is the foundation of mutual understanding and awareness of each other's activities, beliefs, and intentions (Stanton et al., 2017). For example, in a maintenance team, mutual awareness will be achieved when all the team members participating in a

maintenance activity can understand, either explicitly or implicitly, each other's behaviors and motives related to maintenance work. Thus, Shu and Furuta (2005) defined TSA as two or more individuals sharing a common environment, an up-to-the-moment understanding of the situation of the environment, and another person's interaction with the cooperative task.

Stanton et al. (2015) departed from the usual norms and introduced the concept of Distributed Situational Awareness (DSA) which is borne out of distributed cognition theory. In the DSA approach, both human and non-human actors as well as the interaction between the actors are considered. The unit of analysis is not the individual or the teams, it is the entire system under investigation (Hutchins, 1995). The activated knowledge for a specific task at a specific time can be held either by human or non-

human actors in the system. Hence, the system may still perform effectively even if individual human agents do not have knowledge or SA on certain pieces of information. Of course, non-human actors in the system must hold such information to compensate for the discrepancy. DSA approach, thus, contradicts the conventional shared understanding view of TSA. DSA, rather, assumes that non-human collaborative agents can also possess cognitive properties that are not part of individual human cognition (Salmon et al., 2008). Therefore, cognitive processes including SA are considered as emergent properties of collaborative systems. For example, a worker in an industrial plant with degraded SA can update his/her SA by either interacting with other human agents (co-workers) or with a display panel in the control room from where he can receive updated information.

Conclusion

Based on a synthesis of the literature, it is apparent that while there exist many models of TSA, such models view the construct differently. There is no unifying theory and commonly agreeable model of TSA, and the research topic is still a work in progress. From the early Endsley (1995) model which views TSA simply as the extension of a three-level individual SA framework to the recent DSA model which considers the entire system as a cognitive architecture and assumes TSA to be distributed between human and non-human agents of the system, the concept of TSA looks radically different and intriguing when projected through different theoretical frameworks. It can be argued that such a lack of unifying theory could pose a challenge to issues such as the measurement of TSA. However, such

a challenge should not dissuade researchers from continually pursuing this captivating construct. New and emerging constructs of TSA would only add richness to the ongoing debate around TSA.

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Research and Industry: How do they go hand in hand?

-Rajan Kandel

Only industries that embrace continuous innovation through R&D teams can flourish and remain competitive in the market. The powerful technologies we use today, from supercomputers, and AI models to search engines and advanced manufacturing, are all products of a thriving collaboration between academia and industry. This synergy can be extended far beyond the passive exchange of ideas. Industry can become a proactive patron of progress by being involved with academic endeavors in various ways. This can take many forms such as funding for academic prototyping, partnering with academia to conduct trials and studies; industries can provide researchers with invaluable access to real-world scenarios, accelerating the practical application of research findings. Industries can collaborate with universities to identify and prioritize research areas that address the most pressing challenges faced by their specific market segment. Through such a multifaceted approach, the wall between academia and industry crumbles, fostering the environment of cross pollination where theoretical brilliance meets practical ingenuity.

Industry and academic research:

Academic research serves as the intellectual launchpad for innovation and acts as a catalyst for development of technology and society. Although much of the academic literature is simply untrue. The studies are afflicted with small sample sizes, tiny effects, dubious exploratory analysis and inconsequential effects. Despite these shortcomings, academia remains a cornerstone of a robust economy. Transformation of the academic research into a tangible commercial product can be long and arduous. However, through the rigorous peer review, attempts for replication and reproducibility of the methodology, academia lays the groundwork for reliable research and best practices. For instance, the software company RedHat takes open-source technologies, the raw outcomes of academia and transforms them into the enterprise-ready products. Their expertise in packaging, integration, and security adds immense value, just as industry polishes the rough gems unearthed by academic research.

Engineer Entrepreneur:

Bridging the gap between academic research and industry can be a challenging but rewarding endeavor. This begins with identifying the industry pain points and unmet needs, and evaluating the academic research through this lens. Does it address an industry problem? Does it offer a novel solution or significant improvement? In order to translate the research into products consider developing a prototype or minimum viable product as a proof of concept development to showcase feasibility and market potential. Additionally intellectual property management tools such as patent and copyright should be sought to safeguard the innovation. Piloting and market launch, time-

line, team building and clear communication between researchers, industry partners and investors are other crucial considerations. By fostering the collaborative environment, you can effectively transform promising academic research into groundbreaking industry products.

Interdisciplinary Studies

Interdisciplinary study in academia offers a tool to tackle the complex challenges in new ways in a multitude of ways such as breaking down silos; traditional academic disciplines often operate in isolation. Interdisciplinary studies bridge these gaps, encouraging researchers from different fields to collaborate. This cross-pollination of knowledge leads to fresh perspectives and novel solutions for industry problems. By combining different disciplines, interdisciplinary studies can lead to unexpected discoveries and breakthroughs. This fusion of knowledge can spark entirely new ideas and approaches to product development and process improvement. Ultimately, interdisciplinary studies prepares well-rounded talent with a broader skill set and a deeper understanding of how different fields connect, who will lead the industry in the near future. For example, combining engineering with biology can lead to the development of innovative medical devices and diagnostics.

By fostering collaboration and breaking down traditional boundaries, academia can equip industry with the tools and talent needed to tackle complex challenges and drive innovation in the years to come.

“Only industries that embrace continuous innovation through R&D teams can flourish and remain competitive in the market.”



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Sudeep Acharya

Managing Director, Dish Media Network

“Satellite internet is a costly proposition; financial feasibility for residential customers requires government support.”

In your interviews you have mentioned that ‘think globally, act locally’ in terms of media content creation, how can the Nepalese industries adapt to this slogan?

The world has become narrower due to ease of logistics and majorly due to internet connectivity. These days its very easy to communicate using the internet to and from any part of the world. A person living at the remotest part of the world can communicate with anyone through phone or through the internet. Similarly, they can showcase their product and services around the world in matter of minutes.

From the Nepalese perspective, we can produce and sell goods or sell services through these means. We should think in creating and selling high value, low weight (volume) items to the world. Digital Content, tech services seem to fit in this regard. For tangible products, it could probably niche agro products, or something unique from Nepal. In digital content and tech services, it could be online teaching, content creation, call centers, customer service centers (BPOs), data entry etc. For tangible products, it could be Himalayan Honey or Himalayan Tea or something unique to our country.

In the Nepalese market, we give monetary value to tangible goods and services rather than art, creativity and media content. As industrial engineers how can we incorporate production with creativity?

I see an Industrial Engineer as someone who not only optimizes the cost of production but also increase the output (revenue) of the goods or services provided. What we deal with is efficiency, increased output with given resources. For this definitely, creativity is required. Part of being an Industrial Engineer is to analyze data and come out with and optimum solution. This can be utilized in day to day life.

How is the environment for entrepreneurs in Nepal? What suggestions would you like to give to the aspiring entrepreneurs? How can these people monetize a new concept? Is monetization a factor why Nepalese industries shut down in recent years.

I heard about this story where some British shoe company sent two of their people to Africa in the mid 1800s to asses their prospectus business in the continent. One was from Finance, who assessed that there is no business opportunity in Africa as no one wore shoes. The other from Sales, assessed that there was great opportunity in Africa as no one wore shoes but they could in the future.

So I see Nepal as a land of opportunity. Lots of businesses opportunity is there, but people have not been able to tap

them. The downside of this opportunity is that the gestation period is high, so patience is required. Coming up with a new concept is fairly easy for Nepal- as we can see what kind of businesses are successful around the world and specially in India and localize it. I think most of the new concepts that fail or shut down is mainly due to the fact that proper research and planning is not done. Like a said new concepts need a good gestation period, for which we need to pre-plan.

In today's time, we have seen a lot of change in methods of media consumption, shifting cables to various streaming platforms like YouTube or Netflix connected through the internet instead. What has your company's move been to maintain your customer base in terms of services? Are you planning to update your company with the changing times?

As you know with the fast-paced improvements in technologies, it is much easier to dissipate new ideas/ product/service to the market these days. So similarly, with the availability of new technology, market is dynamic. While most of Nepal still gets linear television service via our DTH (DishHome) platform, we are also catering to our customers through internet tv (DishHome ITV), through OTT platform for mobile phone (DishHome GO). Again, we might not be able to compete with Netflix or Amazon Prime or Youtube through global content, however, we can compete with our localized content. For example we are showing the bilateral and tri series of Cricket match on our TV platform and exclusively on our DishHome Go (mobile phone).

You have mentioned trying to find ways to deliver internet to people, even in places where wires can't reach with the help of satellite and wireless internet. How is your company's progress in this regard?

Satellite internet is a costly proposition. While technically it is feasible, financially it is not for residential customers. In the developed world, internet is a basic need and rural customers usually get satellite services through subsidized rate from the government support. If there is support from government is there, we can easily provide these service.

In the recent times of COVID and lockdown, many businesses suffered hardships. As an entrepreneur what measures did you adapt to sustain your business, what suggestions do you have if similar situations arise in the future?

COVID created an opportunity for us to start our DishHome Fibernet business. It was during this time we started our Fibernet services. During difficult times, we need to optimize. I think this is a great time to showcase IE skills. Utilizing limited human resources, we could run the business. We had people sleeping at our Earth Station in bi-weekly rotating basis so that COVID could not spread. Our downtime during COVID was close to zero.

"Dish Home" has an interesting origin story with how two companies who would mostly be considered competition managed to collaborate instead to build a brand that is the most preferred and reliable but also one that strives to keep doing better. What obstacles did you face while finding a middle ground on how you all wanted your brand to represent, and how did you overcome them?

While it was a challenge to merge two companies, but it was the necessity at the time. When companies merge, the major discussion is in the strategic level (board level) rather than in operation level. While there was discussions at the board level for some time, once the decision was made, it was easily carried out in the operational level. Since the companies were fairly new, the merge was not as difficult as it might have seemed.

Striving to do better is something we all inherently have in us. Are there any projects or plans that you are currently allowed to share with us that would help grow your company further? What are your plans for the future?

One of our mottos at DishHome is continuous improvement and creativity. As time passes we understand the change in consumer behavior and expectations and we strive to keep up or sometimes create products and services new to the customers. Moving from traditional DTH services to IPTV (DishHome ITV), DishHome Go (video and linear content on customers mobile phone) are some of the things in the past. DishHome Fibernet (internet service) is also another feat that our valuable customers have liked and made us the 2nd largest provider in about 3 years. Going forward, we will provide more VOD and Sport contents through television platforms and OTT (GO) platforms. We are already providing Data Center (Datalaya) where cloud hosting services and data storage is provided. We are also providing solutions in hospitality sector. We will come up with solutions for smart tvs where no set top box is required. Internet of Things (IOT) will be the next range of products we will be looking at to cater to our customers where they can remotely know who is knocking on their doors and open it with a click.

As industrial engineers, we always appreciate an opportunity to learn from one of our seniors who has been through different experiences. How was your experience studying Industrial Engineering abroad? Is there anything in particular you would like to share about your journey with us aspiring engineers?

Industrial Engineers or IE's are sometimes joked by traditional engineers as Imaginary Engineers, imagination is what differentiates us from traditional engineers. We tend to see the human aspect in engineering which gives us an edge. IE is very vast, OR, which is at the core of IE can be applied to any operations, be it production in a factory or creativity of optimizing in scoring goals in sports. Machine learning, robotics etc. all are part of IE. IE's have managed large corporations like in auto industries to studying and optimizing NFL players to improve their score. So I recommend aspiring IEs to look at this field of study as an engineer who not only understand the technical side but also the management side of business. I see great opportunity for IEs to lead different fields all over the world.

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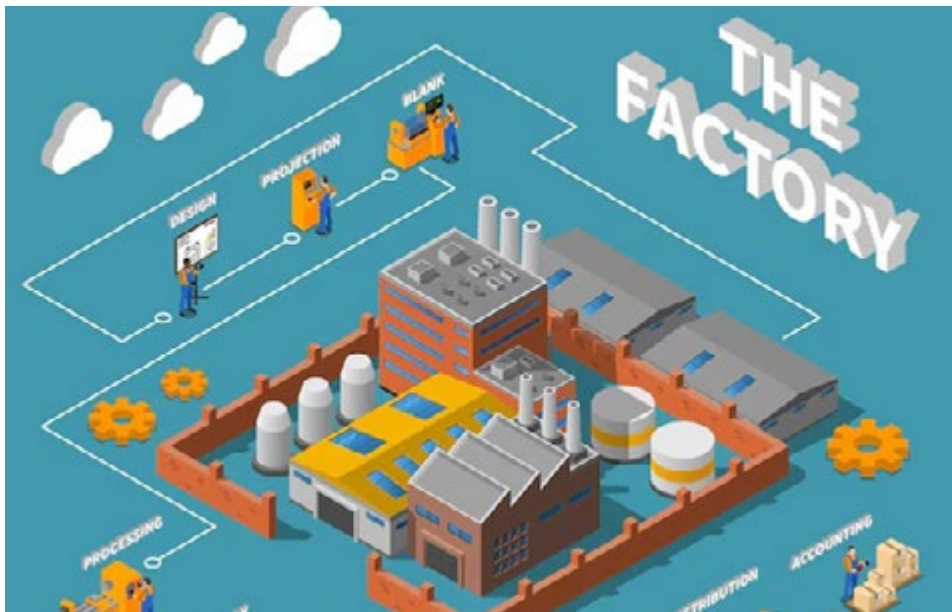
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Tanahu Hydropower Limited

महाराजगञ्ज, काठमाडौं, नेपाल



FACILITY LAYOUT AND LOCATION

- Aashish Bhandari

Business and company's operations are affected by various factors. Basically, while opening new business many factors / aspects of business should be considered and out of those many factors "Facility Layout and Location" is one of the most important factors while establishing a new business. Facility layout and location are the key factors that impact a company's operations and overall success.

Simply, facility layout refers to the physical arrangement of resources within a company facility which includes raw materials, company's RND and workers. A well-structured facility layout can improve production, reduce waste and ensure safety at its fullest. If we further classify facility layout then there are several types of facility layout such as process-oriented, product-oriented and fixed-position layouts.

On the other hand, location refers to geographical location of a facility (i.e. location of your business). If the facility location is right, it can improve accessibility, reduce transportation cost and provide healthy access to workforce. Companies should consider several factors when choosing location including tax, accessibility, environment, etc.

Facility location selection is considered as one of the biggest challenges for new entrepreneurs or for those who want to extend their production capacity by changing locations and layout. Location selection decision is one of the most difficult things to do as the entrepreneur should consider several other major factors before selecting it. In the past, there have been several debates and discussions where they have tried to figure out the best way to choose facility location. It is very necessary for a company to find the most

suitable facility location as it guides to setup the facility layout. Layout of facility mostly depends on facility location so these things should be considered parallel. A poorly-selected location can cause an increase in production and logistics cost which will surely lead to difficulties in finding many things such as raw materials, government support, human resources, etc. More importantly the wrong choice of facility might be somehow easy to turn back by investing more capital on it but in case of facility location it is not easy to turn back. So, in this article I have tried to explain about pros and cons of selecting good and bad facility layout respectively with some case studies of pre-established business and also a hypothetical example about setting a facility and its location for a chocolate factory.

PROS OF CHOOSING GOOD FACILITY LAYOUT

1. EFFICIENCY ENHANCEMENT

A well-designed facility layout allows for smooth flow of goods and services reducing delays caused due to facility. For example: a factory that has a well-structured production line will have a faster turnaround time with higher production rates.

2. SAFETY

Good facility layout helps in ensuring workers and equipment are placed in safe locations with emergency exits clearly marked. For example: a warehouse which has properly stored goods will reduce the risk of accidents.

3. ENHANCED COLLABORATION

A well-designed facility layout can improve communication and make healthy relations between employees and departments. For example: A call center with good floor plans and shared workstations can help to

“A well-designed facility layout can add productivity while a best-suited location can improve foot traffic and increase overall customer experience.”



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foster teamwork and improve customer service.

4. BETTER CUSTOMER EXPERIENCE

Good facility layout directly supports for good foot traffic on the company. For example: A good grocery store with organized and clearly marked products can save time and effort of customers which makes it more convenient.

5. COST MINIMIZATION

A well – organized facility can highly reduce operating cost as good layout focuses on space utilization, minimizing waste, etc.

Similarly, the cons are just opposite to pros so it is presented as follows:

- Poor product flow
- Maintenance difficulty
- Increased cost
- Decreased productivity

Now after knowing the pros and cons of facility layout, it is very important to know the ways of selecting good facility location and also a procedure to setup good facility can be helpful too.

FACTORS TO CONSIDER DURING SELECTION OF FACILITY LOCATION:

1. ACCESSIBILITY

The location should be easily accessible to employees and customers with good transportation facility and should be near to highways.

2. RAW MATERIAL AVAILABILITY

Talking specifically about chocolate industry, chocolate factories require a steady supply of raw materials such as coca beans and sugar, so it is also important to consider suppliers while choosing a location.

3. GOVERNMENT RULES

The facility should be located in an area with appropriate regulations for a manufacturing facility and also be within environmental law.

4. SPACE REQUIREMENTS

The facility should have sufficient space for production, storage, and distribution and should also allow for future expansion in case needed.

5. COST

Finally, operating cost, land cost and other expenses should be considered while choosing a location.

6. MARKET DEMAND

Location should meet the demands of your target market such as proximity to suppliers, customers or employees.

And to setup good facility some considerations needs to be done:

- Objectives and goals should be clearly defined if you want to achieve with the facility.
- A site selection analysis should be done in order to evaluate potential locations based on criteria.
- The design that meets the operational and aesthetic needs of facility should be designed of facility and should be revised and discussed with experts.
- A standard operating procedures, policies, and systems that ensure the facility to run smoothly and efficiently should be developed.
- The necessary equipment and technology should be installed such as machinery, computers, and communications systems, to support the operations of the facility.

- The performance of the facility should be continuously monitored and adjustments should be done as needed to improve efficiency and productivity.

CASE STUDIES:

I have shortlisted certain companies which are successful due to their great location and smooth facility layout while those with poor facility location and layout is also shortlisted and studied.

1. BHAT-BHATENI

If we shortlist for biggest retail market in Nepal, Bhat-Bhateni surely comes on top. We might have often visited this particular supermarket at least once. Bhat-Bhateni was founded 38 years ago at Bhatbhateni, Kathmandu and now there are 23 locations of this store all over Nepal.

Bhatbhateni a popular retail chain in Nepal, has been seen in success due to its strategic facility layout and location.

ANALYSIS ON LOCATION

The location of the store is major to its success. They have their branches on major crowded places inside valley.

Let us take an example of Koteswor Bhatbhateni ; due to its suitable location, it is easily accessible to different types of customers. This has helps to increase foot traffic and attracts a larger customer base. Similarly, all other branches of their supermarket are placed strategically in areas with a high density of population and it is very important for retail stores to do that.

ANALYSIS ON FACILITY LAYOUT

Bhatbhateni has well designed facility layout. A well designed facility layout allows for smooth flow of goods and services reducing delays and Bhatbhateni have a well - designed layout as it has smooth flow of goods and services. The customer experience is good as it have proper parking spaces and large choice of products. There are various sections available for various products from which the customers get easy search of desired products also.

As Bhat-Bhateni has been the largest tax payer in the retail sector for the last five consecutive years in Nepal so it can be considered as a successful business.

LOCATIONS OF BHAT-BHATENI STORES INSIDE VALLEY

LOCATION	DISTRICT
Bhat-Bhateni	Kathmandu
Maharajgunj	Kathmandu
Tokha	Kathmandu
Koteswor	Kathmandu
Chuchepati	Kathmandu
Anamnagar	Kathmandu
Balaju	Kathmandu
Kalanki	Kathmandu
Tripureswor	Kathmandu
Krishna Galli	Lalitpur
Satdobato	Lalitpur
Sanagaun	Lalitpur
Radhe Radhe	Bhaktapur

2. AMAZON

Amazon's success is largely attributed to its strategic facility layout and location. The company always keeps their customers ahead in business which has resulted this success in their business.

FACILITY LAYOUT:

Amazon has implemented highly streamlined automated facility layout which helps in minimizing labor costs and increases efficiency. The company uses robots and other automation tools for moving packages from one place to another which generates efficiency. As they use automated technology, a large number of orders are processed quickly which ensures that customer receives their package on a timely manner. Their continuous automation in their layout through new inventions and by adding new technology is key for their success.

LOCATION:

Amazon centers are located near major cities and population centers. This has allowed the company to reach customers quickly and to drastically minimize costs associated with long-distance shipping. For example: In 2019, Amazon opened its first center in France near the city of Bordeaux which was chosen because of its reach to major hubs of transportation allowing them to quickly reach customers in France and major other parts of Europe.

ACHIEVEMENTS:

In 2020, Amazon had 100 fulfillment centers worldwide. According to data from National Retail Federation, Amazon's Prime service had over 200 million members worldwide in 2020, a 40% increase as compared to data from 2019. This demonstrates their focus towards their facility and

location optimization.

In conclusion, Amazon's success can be attributed to its strategic facility layout and location, which has allowed company to reach out customers very fast which results in customer satisfaction.

3. CIRCUIT CITY

The next example of business flop due to its wrong facility and location is the biggest electronics retailer Circuit City. Circuit City was once the largest electronics retailer in the US, with over 800 stores nationwide. But it was not sufficient for its success. The company faced several challenges including competition from other electronics retailer and financial crisis.

The other reason was its poor facility layout and location. There were several stores but the stores were often located in areas with low foot traffic and the electronics market was cluttered as its facility. Circuit's City's facility was not designed to keep up with the changing markets. Unlike other brands they didn't focus on online sales. As a result its sales suffered a lot. According to the data available on internet, in 2005, the company reported \$11.8 billion in sales which dropped to \$7.8 billion by 2008. In 2009, Circuit City declared bankruptcy.

This example clearly shows the importance of considering layout and location of their facilities for businesses. A poor facility as well as location can have significant impact on sales and can ultimately lead to business failure.

Now, let me give an example of hypothetical factory explaining the ways to select facility location and setting its facility layout.

4. EIB SETALOCOCO CHOCOLATES (Nepal)

Chocolate market in Nepal

is not very flourished. When we look at the chocolate market in Nepal, it is not very entertaining as almost 98% chocolate consumed in Nepal is imported which is worth more than 2 billion rupees with an annual growth rate of 6%. As we can see only 2% of demand is fulfilled by Nepali products, this will certainly create a huge opportunity.

FACILITY LOCATION SELECTION

As already mentioned in this article multiple times, there are many factors to be considered while choosing location. Availability of raw materials is must. The raw materials available for producing chocolates are:

- COCOA BEANS
- SUGARS
- COCOA BUTTER
- MILK
- MILK ALTERNATIVES
- EMULSIFIERS

The most important raw material cocoa beans are not available in Nepal. So it is clear that it should be imported. Airways and roadways are the available means of importing it to Nepal. If I prefer roadways my cost will reduce so the possible way of importing through India is through roadways. Now if we screen other raw materials then it can be found easily in Nepal. So for setting my factory location, I am almost ready. Now it is certain that I should choose the area nearer to boarder of India with an easy availability of sugars and milk. The other determining factors for setting my factory location will be government rules and it should be nearer to highways for quick dispatch of produced goods.

FACILITY LAYOUT

Facility layer for chocolate factory includes several layers.

By considering these things for chocolate factory, this business will undoubtedly

not fail due to its facility layout and location.

In conclusion, facility layout and location can be termed as an important aspect to be considered before opening a new business or organization. A well-designed facility layout can add productivity while a best suited location can improve foot traffic and increase overall customer experience. Therefore, it is necessary to consider both of these factors when making business initial decisions. Whether it is a small retail store or a large manufacturing plant, investing on right location and right facility always pays you back and the longevity of the business is secured.



Another Hype or the Key to Unlocking the Future

Exploring the Potential of ChatGPT and DALL-E

- Mahesh Dahal

ChatGPT and Dall-e are the topics most discussed on the internet today. ChatGPT was launched on November 30, 2022, by San Francisco-based OpenAI, the creator of Dall-e and Whisper. Initially, OpenAI was co-founded by Elon Musk and Sam Altman. However, according to some rumors, Microsoft is now expected to fund \$1 billion for further development and research of ChatGPT. The service was initially launched free to the public, with plans to monetize the service later. ChatGPT and DALL-E are both state-of-the-art language models developed by OpenAI. They understand and generate human-like text and realistic rendering of images making them powerful tools for a wide range of applications. There are currently four

models with training data up to 2021. Davinci, Curie, Babbage, and Ada are the models available to the public. The Davinci Model has training data up to June 2021.

One of the most significant ways that ChatGPT and DALL-E can change the future of industrialization in developing countries is through natural language processing (NLP). NLP is the ability of a computer to understand and interpret human language, and both ChatGPT and DALL-E have been trained on vast amounts of text data, making them highly proficient at NLP tasks. One application of this technology in industry is in automating customer service. ChatGPT and DALL-E can be employed to create chatbots that

can get and react to client inquiries and complaints in a usual dialect, liberating human client benefit agents to focus on more complex

“

ChatGPT and DALL-E are state-of-the-art language models developed by OpenAI, proficient at natural language processing (NLP) tasks.

”

issues. It could drastically move forward toward client fulfillment and decrease costs for companies.

Another way that ChatGPT and DALL-E can affect industrialization in creating

nations is through mechanizing information investigation. Both models can extricate experiences from large amounts of content information, such as client audits or news articles. It could be employed to distinguish patterns, anticipate future occasions, and make more educated commerce choices. For instance, a company can use ChatGPT and DALL-E to analyze client criticism and recognize common complaints, permitting them to create changes to progress client fulfillment.

In expansion, ChatGPT and DALL-E can also be employed to make strides in communication and collaboration inside companies. They can be exploit to automatically generate reports, emails, and other composed materials, liberating representatives to center on more imperative errands. They can also be exploit to make language-based collaboration instruments, such as chatbots that offers assistance to workers for exploring inside frameworks or discover data. ChatGPT and DALL-E have the potential to play a critical part in tending to a few of these challenges. For example, ChatGPT can be utilized to produce point-by-point reports on mechanical exercises, counting natural affect appraisals, and social impact evaluations. It appears to offer assistance, distinguish, and relieve negative impacts on the surrounding and communities. Also, ChatGPT can be employed to create point-by-point enlightening for working complex apparatus, making it simpler for laborers to memorize and work modern gear. DALL-E, on the other hand, can be utilized to produce plans for modern mechanical items and processes. This may offer assistance to companies in creating nations to



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move forward their competitiveness by making modern, imaginative items that can be sold on the worldwide showcase. Furthermore, DALL-E can be utilized to optimize existing mechanical forms, making them more productive and feasible.

ChatGPT and DALL-E can also play a part in expanding access to data and instruction for specialists in creating nations. For illustration, ChatGPT can be utilized to produce instructive materials, such as preparing manuals and direction recordings, that can be utilized to educate specialists on new skills. This may offer assistance to companies in creating nations to move forward their competitiveness by making modern, imaginative items that can be sold on the worldwide showcase. DALL-E can also be utilized to create point-by-point specialized details for mechanical items and forms, making it simpler for specialists and engineers to understand and move forward upon them. Moreover, ChatGPT and DALL-E can be connected in different segments, from healthcare to transportation. In healthcare, they can be utilized to analyze medical records, recognize designs, and anticipate illness episodes. In transportation, they can be used to analyze traffic patterns and predict traffic congestion, allowing for more efficient transportation planning.

Overall, ChatGPT and DALL-E have the potential to change the future of industrialization in developing countries in several ways. They can help to improve environmental and social outcomes, increase productivity and efficiency, and increase access to information and education. While these

models are still in the early stages of development, they have the potential to make a significant impact in the years to come.

However, it's worth noting that these models are not a panacea and their impact will depend on how they are used and implemented in the context of the country and its industrial sector. For example, if the infrastructures, policies, and regulations are not in place to support the use of these models, their benefits may not be fully realized. Therefore, it's important to consider the unique context of each country and work closely with local stakeholders to effectively implement these models.

When we talk about Nepal, it is quite obvious to say that there won't be any immediate implementation

of such technologies. Though the adoption of ICT is slightly ahead, we can expect not much but some companies are developing chatbots and flaunting around. Like Blockchains and ride-sharing, there might be hurdles from the policy level in regulating such technologies. Many companies and copywriters are already using ChatGPT for research and content generation.

In conclusion, ChatGPT and DALL-E are powerful tools that could change the future of industrialization in developing countries in several ways. They can help to improve environmental and social outcomes, increase productivity and efficiency, and increase access to information and education. While these models are still in the early stages of development,

they have the potential to make a significant impact in the years to come, but their implementation must be done carefully and strategically. ChatGPT and DALL-E are advanced language processing models that have the potential to revolutionize the way industries operate in developing countries. They can be used for automating customer service, data analysis, and communication within companies. However, the successful implementation of these models in developing countries will require addressing challenges such as data availability and job displacement.





INTERVIEW

ROJESH MAN SHIKHRAKAR

Sr. Manager Tech Talent Development

fuse | machines

About Fuse Machines

Founded in 2013, Fusemachines is a global provider of enterprise AI products and solutions on a mission to democratize AI. Leveraging proprietary AI Studio and AI Engines, the company helps drive the clients' AI Enterprise Transformation, regardless of where they are in their Digital AI journeys. Under the leadership of chief executive officer and founder Dr. Sameer Maskey, Ph.D., Adjunct Associate Professor at Columbia University, Fusemachines continues to actively pursue the mission of democratizing AI for the masses by providing high-quality AI education in underserved communities and helping organizations achieve their full potential with AI. Fusemachines is headquartered in New York, with operations across Asia, Canada, the USA, and Latin America.

About Rojesh Man Shikhrakar

Rojesh Man Shikhrakar is the Sr. Manager of Tech Talent Development and leads Fusemachines' AI Academics function. He has extensive hands-on experience in machine learning, deep learning, artificial intelligence, designing algorithms, and application development. Mr. Shikhrakar oversees the development and deployment of Fusemachines' comprehensive AI curriculum and manages an elite team of AI Instructors. He is also a member of the academic subject committee and a visiting faculty at Kathmandu University Computer Science Department, where he teaches Data Science to undergraduate students and Data Acquisition Management Systems to grad students.

Mr. Shikhrakar holds a Bachelor of Technology degree and a Master of Science in Mechanical System Design. He holds 100+ certifications from different organizations. He has extensive expertise and experience in Robotics, design and development of unmanned aerial vehicles (UAV) for medical deliveries, topography surveys, 3D reconstruction, urban planning, and more.

What do you consider the most challenging and rewarding project you have worked on at Fuse Machines Nepal?

The most challenging project was a CSR internal Drone Project. We believe that this project could impact the remote landscape of our country. We designed the AI algorithm to deliver packages to different locations automatically, we could not continue the project due to inadequate funding and realized that such projects required a separate organization.

The most rewarding project is our AI fellowship course. The course design included interviewing engineers and asking them about the acquired skills that became relevant in their professional careers. We have compressed mathematical concepts like optimization, numerical methods, linear

programming, statistics, and information methods into a single program and solved them using computer programming. We also included programming, data structures, and algorithms in our course. We converted these ideas into learning objectives and designed a course "Foundation in AI". Our program is a 6-month rigorous program, and I believe its impact is more than a four-year bachelor's course we find this rewarding in the sense that students get to learn more in a short time.

The trend is something we all seek to give attention to. What is the current trend in AI that you are excited about and are following through?

Generative AI is trending, and foundation models are getting attention in the current context. Since my background is in physical science, I am more inclined and excited about theory-guided AI learning. I think this dual network is trending. It is a design architecture that incorporates physical principles or equations into the learning process.

Regarding the societal impacts of Artificial intelligence, particularly the efforts to democratize AI and make it accessible to audiences. Can you share your insights on the democratization of AI? How does your organization approach the challenges of making AI technologies more accessible to diverse users and communities?

Democratization of AI is expanding artificial intelligence research and development to a large user base, including those without specialist expertise in AI. We have been providing AI services and solutions in different countries, but education was the purpose of starting Fuse Machine, and education remains our focus. We educate graduate students so that they can develop AI solutions in the market, and this is how we see the democratization of AI.

How can AI be used in Engineering?

One aspect in which AI is widely beneficial is Preventive maintenance by helping system designers identify potential downtime. AI is used in airplanes for generative foundational models. The other aspects are material forecasting, material prediction, supply chain, and auto desk.

In Nepal, we say we have limited access to data in every aspect. While we move towards a data-driven world, how can countries like ours work on data mining and benefit from adopting a data culture and investing in data infrastructure and innovation?

Believing that we have access to limited data is a misconception. There are two different domains: engineers who use data and people who have data. Lack of collaboration among these two parties is the problem, not the limitation of data. The collected data are written on files and not digitalized. Hence, we face problems accessing them. If the data are computerized we could build modeling data systems, data mining, and building data in fracture.

Nepal ranked 150th in the Government AI readiness index, which indicated a lack of enough infrastructure to develop AI. Digitalization of available data, developing infrastructure and policies, and collaboration among various parties involved in data collection can solve this problem this issue.

When it comes to collaboration among different domains, it should start from the base, for now, we students can collaborate with students of other faculties to develop projects conduct research, and develop a culture.

In what ways do you see democratized AI impacting small and medium-sized enterprises (SMEs)? What opportunities or challenges might arise for these businesses in adopting AI technologies?

One major problem with (SMEs) when it comes to adopting AI technology is the lack of a link between their business goals and the impacts of AI. Intensive research is required to bridge this gap. In most cases, businesses need to build AI solutions themselves, but due to the increasing effects of brain drain, they find it difficult to hire potential manpower.

What do you think can be the real-time use of AI in Nepal? What sectors or areas can benefit from the proper utilization of AI in Nepal?

There is a lot to do. Nepal is just becoming familiar with the concept of digital Nepal. One of the main projects could be conversational AI: creating chat buds for the Nepali language. AI can create a huge impact on the agriculture sector by using Satellite-based images can be used to predict production. AI can also be used to know when crops rip to solve problems during harvesting and storing. AI can protect national parks by tracing and counting endangered animals and plant species.

AI is equally important in the government sector, but we have faced difficulties in performing legal tasks in government offices. The government can use an autoresponder to answer questions related to legal processes and government offices.

How can AI help in retail and manufacturing? Can you provide examples in other domains in which you have worked?

While we talk about manufacturing let me highlight the production and retail sector. AI can facilitate production through demand forecasting, and support effective production through system optimization and overall scheduling of machines to support preventive maintenance. For the retail AI can help group customers bring market basket analysis. It can also play a huge role in fraud detection. AI can be used to create a supply chain network between the manufacturers and the buyers. Fuse machines have worked in the fields of healthcare, insurance and finance, technology, healthcare, and retail and manufacturing.



AI learning is getting quite popular among youths in Nepal. Are there any experience-based advice you want to give to the students or youths who want to pursue their careers in this field?

Let us not limit our education to the curriculum set by the government. Students should not focus on application-based education and study with the mindset to apply their knowledge rather than just pass their exams. There should be a mindset for research-based learning, and to learn and understand rather than solve past papers to ace a paper. To use AI it is not necessary to learn programming, however, it is not efficient. Learning to program is essential for AI engineers. The basics would be to learn a programming language develop skills to build a system in a computer, and make a strong base in mathematics. Learn algorithms, and data structure and learn to implement mathematical skills in programming. Learn to build a system on the computer.

To what extent do Fuse machines collaborate with other companies, research institutions, or industry associations to foster innovation and advancement in AI for manufacturing and engineering?

We collaborate with industries and businesses and develop systems according to their demand. We can collaborate with IE through training, the main focus is the train AI engineers through fellowship and training, we have seen that those people who come from other domains than BCE have become better AI engineers. We do partner with colleges. We are open to suggestions if you have any.

How does Air Conditioning System Work?



Condenser

Releases the heat absorbed from inside the house to the outdoor air, cooling the refrigerant before it recirculates.

Compressor

Circulates the refrigerant throughout the air conditioning system, facilitating heat exchange and ensuring continuous cooling.

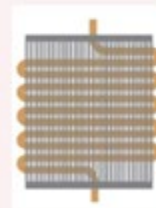


Blower motor

Moves warm air from inside the house through the air ducts, pushing it across the evaporator coil for cooling.

Evaporator coil

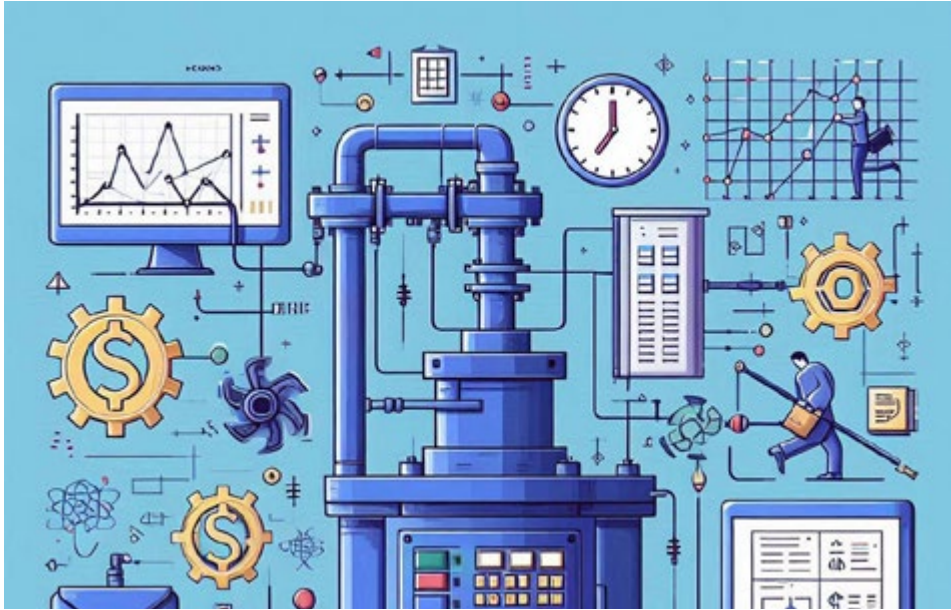
Absorbs heat from the indoor air, cooling it down before it is recirculated back into the house through the supply vents.



Thermostat



Controls the operation of the air conditioning system by activating it based on the desired temperature set by the homeowner.



Improving the Feasibility Pump Heuristic for solving Integer Programming Optimization problems with the help of Machine Learning

- PhD Candidate Ashim Khanal

Abstract

Finding a feasible solution to mixed integer programming problems (MIPs) is critical for many practical applications and can be very difficult at times. In this regard, we focus on improving the performance of Feasibility Pump (FP), which is one of the most influential heuristics for finding feasible solutions to MIPs. An integer programming problem is a mathematical optimization or feasibility program in which some or all the variables are restricted to be integers. If some decision variables are not integers, the problem is known as a mixed-integer programming problem. Some notable applications of MIPs are Production Planning, Scheduling, Territorial partitioning, Energy systems Optimization, Transportation Networks, Smart and sustainable infrastructures etc. Feasibility pump is a methodology to solve such

problems mathematically and computationally. For the FP algorithm, choosing the appropriate number k , number of variables to be flipped (change the value of 0 or 1), is very important for its performance. So, in this work, we propose a learning-based scheme to determine the best value of k for a specific class of instances to be solved.

Introduction and Problem Definition

Overview

Mixed integer programming problems (MIPs) are those whose goal is to minimize a linear objective subject to linear constraints, where some or all variables are integers (Wolsey, 1998). Finding a feasible solution to mixed integer programming problems (MIPs) can be difficult (NP hard) (Nair et al., 2020). Feasibility Pump (FP) (Fischetti and Lodi, 2005) has been con-

sidered as one of the most influential heuristics for finding feasible solutions of MIPs. The basic idea of feasibility pump is to perform rounding to the LP relaxed solution and then make the distance between the so obtained integer point and any feasible integer point to be zero through iterations. However, the main obstacle for this method is stalling through cycling, meaning that after some iterations, the procedure gets into a loop, and variables keep on visiting the previous values repeatedly. In the original FP, this issue is handled by a random perturbation: a random number, k variables are flipped (change the value of 0 or 1 for binary var.) (Fischetti and Lodi, 2005). For the test instances mentioned in Fischetti's work, k was set to 20, and perturbation frequency parameter R was set to be 100. They were determined randomly. Considering the potential pattern between the value k and features of the MIPs instances, we wish to develop a framework aiming to find the optimal value of k with the assistance of machine learning.



Feasibility pump (FP) has been considered as one of the most influential heuristics for finding feasible solutions of MIPs.



Literature Review

The Feasibility Pump, (Fischetti and Lodi, 2005), talks about the methodology of finding a feasible solution for a generic MIP which is a NP-hard problem. Despite simple foundation of this heuristic, it is competitive with commercial solver in terms of quality and speed for first solution delivered. Revisiting local branching with a machine learning lens, (Liu and Lodi, 2022), talks about finding high-quality solutions to mixed-integer linear programming problems. Here the paper computationally shows that the size of neighborhood in local branching heuristics can be learned and can be generalized across instances.



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Integer Programming, (Wolsey, 1998) includes detailed mathematical models, methodologies, and theories for Mixed Integer Linear Programming.

Introduction to Data Science, (Shah, 2020) explains in detail about the various statistical and machine learning theories and methods with applications.

Machine Learning for Integer Programming, (Khalil, 2016) applied machine learning approaches to making decisions

in branch and bound search. Features that characterize variables at each node of the tree have been collected, to predict the branching decision variables as target.

Learning to branch in mixed integer programming, (Khalil et al., 2016) proposed an instancespecific learning framework to pattern the strategy-making by Strong Branching which can determine the variable gives the best improvement to the objective function before branching.

Feasibility Pump

The process of Feasibility pump algorithm was introduced in detailed in (Fischetti and Lodi, 2005). Generic MIP problem can be written as model 1|

$$\begin{aligned} \text{(MIP)} \quad & \text{minimize} \quad c^T x \\ & Ax \leq b \\ & x_j \text{ integer } \forall j \in I \end{aligned} \quad (1)$$

After solving the LP relaxation and rounding the results. The algorithm updates the objective to the L1 norm distance between a generic point x and given integer point $\tilde{x}$ (equation 2): $\Delta(x, \tilde{x}) =$

$$\sum_{j \in I} |x_j - \tilde{x}_j| \quad (2)$$

Given an integer point $\tilde{x}$, the closest optimal point is given by:

$$\min \Delta(x, \tilde{x}) : Ax \leq b \quad (3)$$

For 0-1 instances we minimize the following function:

$$\Delta(x, \tilde{x}) := \sum_{j \in I: \tilde{x}_j = 0} x_j + \sum_{j \in I: \tilde{x}_j = 1} (1 - x_j) \quad (4)$$

Integrating the machine learning, we modified the original feasibility pump algorithm:

Algorithm 1: Feasibility Pump with Machine Learning

```

Input: instance dataset  $P = \{p_i\}_{i=1}^M$ 
for instance  $p_i$  in  $P$  do Initialize  $nIT := 0$ 
     $\hat{x} := \operatorname{argmin}(c^T x : Ax \geq b)$  // Solve the LP relaxation if  $x$  is integer
    then
        return  $\hat{x}$ 
    else
        Rounding:  $\tilde{x} := \lfloor \hat{x} \rfloor$  // Rounding
        while  $\text{time} < TL$  and  $nIT \leq s$  do  $nIT++ = nIT$ 
             $\hat{x} := \operatorname{argmin}_{\Delta}(\hat{x}, \tilde{x}) : Ax \geq b$  // Linear projection if  $x$  is Integer
            then return  $\hat{x}$ 
            else
                if  $\exists j \in I : [\hat{x}]_j \neq [\tilde{x}]_j$  then  $\tilde{x} :=$ 
                     $[\hat{x}]$ 
                else
                    Flip  $k := f_{\theta}(\beta)$  variables // Perturbation with the result of machine learning

```

Machine Learning

First, we generate the labels for regression model. To do so, we define the cost of solving an instance using FP as function 5 (Liu and Lodi, 2022), where t denotes the solving time for finding a feasible solution with FP, o indicates the objective value for the minimize problem. So in this case, the cost is a trade-off of the computational time and the solution quality. In the practice, we scaled both t and o to the range $[0,1]$ to make them comparable.

Then the label for learning can be determined by equation 5. Then we train our machine learning model to find the best model parameters:

$$c^k = \alpha * t_{scaled}^k + (1 - \alpha) * o_{scaled}^k \quad (5)$$

In equation 7, s means the flipping frequency, i.e., after how many iterations we need to start to flip. We repeat solving

$$k^* = \operatorname{argmin}_{k \in \mathbb{Z}^+} c^k \quad (6)$$

the same instance with different values of k (numbers of variables to be flipped) and s (flipping perturbation frequency) and select the k value which minimizes the cost as our learning target.

Experiments and Results

We generated 100 instances. The number of variables is selected randomly from the integer set ranging from 300 to 1000, by 100. The number of constraints is determined to be twice the number of variables. While generating the instances, we also considered the following things. We set the sparsity of matrix A to 50%, i.e., $SA := 0.5$.

The entries of matrix A belonging to 'binary' variables are randomly drawn from the discrete uniform distribution $[1, 30]$.

The entries of matrix A belonging to 'continuous' variables are randomly drawn from the discrete uniform distribution $[30, 30]$. The components of vector b are randomly drawn from the discrete uniform distribution $[nsA, 10 nsA]$, where nsA is the expected number of non-zero elements in each row of matrix A .

For each instance, we ran 25 times, with different combinations of k and s , for all $k \in \{1,2,3,4,5\}$ and $s \in \{0,1,2,4,6\}$.

Features we collected for learning includes:

The instance size	• Number of iterations • Number of constraints • Number of variables • Number of non-zero items in objective
Stat. of Coefficients	For the coefficient matrix A, each column, compute min, max, standard deviation, then calculate: • Min(min), min(max), min(std) • Max(min), max(max), max(std) • Std(min), std(max), std(std) For the RHS b: • Min(b), max(b), std(b) For the coefficient of the objective function: • Min(c), max(c), std(c)
The result of subproblem	• LP relaxation objective value • LP relaxation solving time

Figure 1: Features for machine learning

Overall, we have 100 observations of 21 features. The values of target k are in the set $\{1,2,3,4,5\}$ for our case, and the frequency of the five classes are: {"5" : 46, "4" : 23, "3" : 23, "2" : 5, "1" : 3}. Then we tried both multi-class classification and regression models to make predictions. The models we used were MLP (Multi-layer Perceptron) and RF (Random Forest). Following are the results

		Fold1	Fold2	Fold3	Fold4	Fold5
MLP_clf	accuracy	0.15	0.25	0.45	0.45	0.4
RF_clf	accuracy	0.4	0.5	0.45	0.35	0.35
MLP_reg	neg-MSE	-5.69733209	-8.13448746	-4.93337479	-3.0350729	-5.37760519
RF_reg	neg-MSE	1.69707625	-1.23977625	-0.68804149	-0.86898986	-0.86472125

Figure 2: Results of machine learning

Random forest showed better results, so we fine-tuned it with grid search and conducted feature selection, it turned out that the best score showed when we select 16 features: ['LP objective', 'LP solve time', 'bMax', 'bMin', 'bStd', 'coefMaxMax', 'coefMaxMin', 'coefMinStd', 'coefStdMax', 'coefStdMin', 'coefStdStd', 'costStd', 'nIT list', 'nonZeroCost', 'numConstraints', 'numVariables']. After that, we re-fit the random forest model with 16 features, the new neg-MSE results are:

[-1.68317875, -1.21939, -0.70543262, -0.84601076, -0.86247811].

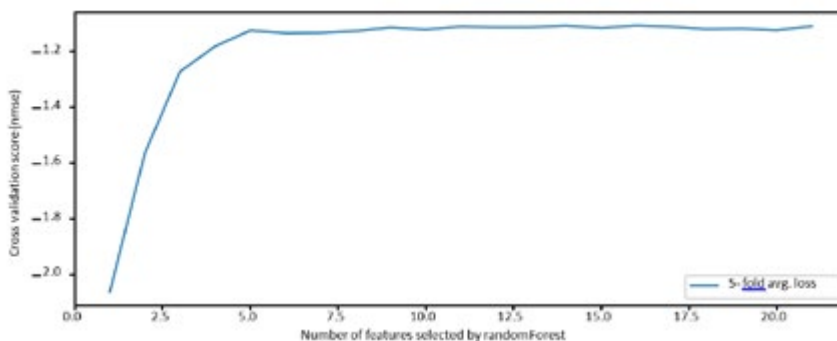


Figure 3: Random forest feature selection

Result Test

To test the regressing result, we generated 4 instances for testing, with 300, 500, 700, 900 variables respectively. k values predicted by the model:

instance	k	cost	k_pred
1	1	1	5
	2	0.928335	
	3	0.730788	
	4	0.690865	
	5	0.685714	
2	1	0.905118	5
	2	0.688557	
	3	0.691076	
	4	0.785714	
	5	0.685714	
3	1	0.9	4
	2	0.688158	
	3	0.736058	
	4	0.785714	
	5	0.734712	
4	1	0.999115	5
	2	0.688418	
	3	0.685714	
	4	0.785714	
	5	0.686325	

Figure 4: Testing results

The table above shows the predicted k values for the 4 new instances. We displayed the cost values corresponding to 5 different k values and the model has correctly predicted 3 decisions based on the costs in the second column.

Conclusion

In this research, we made decisions for the originally random step in Feasibility Pump with the assistant of machine learning. The result of multi-class classification are not good.

In this research, we applied machine learning to making decisions in the flipping step of Feasibility Pump. It shows that machine learning can provide references for determining the number of variables to be flipped for a better trade-off benefit considering both the computational time and the solution quality.

We tried multi-class classification and regression models for learning the target, but the classification model didn't perform well. The reason maybe that we have set a relatively narrow range for k because of the small scale of instances. This leads to the values of each class are very close to each other. In this case, a classification model cannot perform its ability.

To improve our work or as a planning of future work, we can dig more into feature engineering, including feature extraction, processing and selection. Besides, we have an assumption that the k value is a constant for each iteration. Making the learning sequential and dynamic with the help of reinforcement learning can be one of the future works.

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डिजिटल वित्तीय सेवाको प्रयोग गर्दा के प्रयोजनको लागि कसलाई भुक्तानी गरेको हो सोमा सावधानी पुर्याउनुपर्ने दायित्व सम्बन्धित व्यक्तिको नै हुने भएकोले बैंकको नाम, खाताको नाम, खाता नम्बर, मोबाइल नम्बर, भुक्तानीको प्रयोजनलगायतका विवरण यकिन गरेर मात्र कारोबार गर्नुपर्दछ ।

सजग भई डिजिटल वित्तीय सेवा प्रयोग गरौं ।

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कार्य गर्न अखण्डिपञ्चाल सेवा



State-of-the-Art and Emerging Techniques for Defect Detection Using Deep Learning

- Dr. Sinan Onal

Defect detection is the process of identifying and addressing defects in products or materials before they cause problems, such as reduced performance or safety issues. In recent years, there has been a growing interest in the development of new defect detection methods, particularly those that are more efficient and reliable than traditional approaches. However, detecting defects can be a challenging task, particularly in industries where products are complex or produced at high volumes. Traditional methods of defect detection, such as visual inspection or manual testing, can be time-consuming and prone to human error. As a result, there is a need for more efficient and reliable methods of defect detection that can be used to identify and address defects in a timely and accurate manner. There are several problems associated with the current

approaches to defect detection:

1. Inefficiency: Traditional methods of defect detection, such as visual inspection or manual testing, can be slow and labor-intensive, making it difficult to keep up with the demand for high-volume production.

2. Inaccuracy: Human error is a common problem with traditional methods of defect detection, leading to missed defects or false positives.

3. Limited scope: Traditional methods are often limited in their ability to detect defects, particularly in complex or hidden areas of the product.

Overall, the defect detection problem is one of finding a more efficient and reliable method for identifying and addressing defects in products or materials. This requires the development

“

In recent years, there has been a growing interest in the use of machine learning and artificial intelligence (AI) techniques for defect detection, as these approaches have the potential to significantly improve the efficiency and reliability of the process.

”

of new approaches that can accurately and quickly detect defects, regardless of their location or complexity. In recent years, there has been a growing interest in the use of machine learning and artificial intelligence (AI) techniques for defect detection, as these approaches have the potential to significantly improve the efficiency and reliability of the process.

One of the most widely used machine learning techniques for defect detection is deep learning, which involves the use of artificial neural networks to process large amounts of data and perform tasks such as pattern recognition, image and speech recognition, and language translation. Deep learning has been applied to a variety of defect detection tasks, including the identification of defects in images and videos (Chen et al., 2018; Zhang et al., 2018), the analysis of sensor readings (Chen et al., 2018), and the analysis of audio signals (Zhang et al., 2018). In some cases, deep learning models have been shown to outperform traditional machine learning techniques, such as support vector machines, in defect detection tasks (Zhang et al., 2020).

In addition to deep learning, other machine learning techniques, such as support vector machines and random forests, have also been applied to defect detection tasks (Zhang et al., 2020). These methods have been used to analyze a variety of data types, including images, sensor readings, and audio signals. For example, a study published in the journal *Measurement* (Li et al., 2019) used a deep learning model to detect defects in the laser cutting process based on sensor readings, achieving an accuracy rate



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of 95.8%. Another study published in the journal *Measurement* (Rao et al., 2017) applied image processing techniques to the detection of defects in textile fabrics, achieving an accuracy rate of 97.6%.

Other approaches to defect detection using machine learning have been proposed in the scientific literature, including the use of ultrasonic testing (Zhou et al., 2016) and online monitoring systems (Li et al., 2019). These approaches have the potential to improve the efficiency and accuracy of defect detection by automating the process of identifying defects and providing real-time feedback. For example, an online monitoring system can continuously monitor the production process and alert operators to potential defects as they occur, allowing for timely and accurate detection and correction.

In summary, the use of machine learning and AI techniques for defect detection has shown great promise in a variety of industries, including manufacturing, construction, and agriculture. These techniques have been applied to a range of data types, including images, sensor readings, and audio signals, and have been shown to be effective at identifying defects with high accuracy. While there are challenges to the adoption of these techniques, such as the need for large amounts

of labeled data and the potential for bias in the data and models, the potential benefits of improved efficiency and reliability make it an active area of research in the scientific community. Overall, the use of machine learning and AI techniques for defect detection has the potential to significantly improve the efficiency and reliability of the process, leading to improved product quality and reduced costs associated with repairs and replacements.

Steps for our defect detection model, which uses deep learning to find defects on PVC profiles includes:

1. Data collection: The first step in the methodology is to collect a sufficient amount of data for training and testing the deep learning model. This data includes images of PVC profiles with and without defects, as well as the corresponding labels indicating the presence or absence of defects. It is important to have a balanced dataset with a similar number of images with and without defects to avoid bias in the model.

2. Data preprocessing: The collected data is preprocessed to ensure that it is ready for use in training the deep learning model. This includes tasks such as resizing the images to a consistent size, converting the images to a suitable format (e.g., grayscale or RGB), and splitting the data into training, validation, and testing sets.

3. Model training: The next step is to train the deep learning model using the prepared data. This involves selecting a suitable deep learning architecture (e.g., convolutional neural network, autoencoder) and optimizing the model's hyperparameters (e.g., learning rate, batch size). The model should be trained using the training and validation data, with the performance monitored using the validation data.

4. Model evaluation: Once the model has been trained, it is evaluated using the testing data to assess its performance on unseen data. This involves calculating metrics such as accuracy, precision, and recall to measure the model's ability to correctly identify defects.

5. Model deployment: If the model performs well on the testing data, it can be deployed for use in detecting defects in real-world PVC profiles. This involves integrating the model into a production line or using it to manually inspect samples.

The early results of our autoencoder based deep learning model have shown great promise in the detection of defects in PVC profiles. Our model is able to analyze large amounts of data and identify patterns and features that may indicate the presence of defects. Our model has been shown to be effective at detecting defects with high accuracy and can

outperform traditional machine learning techniques in some cases. One advantage of using the proposed is that it can be automated and integrated into the production process, allowing for real-time detection of defects. This can significantly improve the efficiency of the defect detection process and reduce the need for manual inspection, which can be time-consuming and prone to human error.

However, there are also challenges to the use of the model, including the need for large amounts of labeled data for training and the potential for bias in the data and models. It is important to carefully consider these challenges and take steps to mitigate them, such as using a balanced dataset and evaluating the model's performance on a diverse set of data.

Overall, the use of deep learning for defect detection has the potential to significantly improve the efficiency and reliability of the process, leading to improved product quality and reduced costs associated with repairs and replacements. However, it is important to carefully consider the specific needs and constraints of the task and choose an appropriate deep learning approach to ensure optimal performance.

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- ✦ विगत ३ वर्षदेखि ऊर्जा खबरको छापा संस्करण खोज अनुसन्धानमूलक अर्धवार्षिक म्यागजिन समेत प्रकाशित हुने गरेको छ ।



अनलाइन तथा छापा संस्करणमा आफ्ना महत्वपूर्ण लेख प्रकाशनका लागि पठाउनु हुन इच्छुक विद्यार्थी, प्राध्यापक तथा अनुसन्धाताहरूमा अनुरोध छ ।



ER. SUSHANT RAJ GIRI

Head of Department, Industrial Engineering
Thapathali Campus, IOE.



“Our vision for the Industrial Engineering Department is to create a renowned center of academic excellence, innovation, and industry collaboration.”

Mr. Sushant Raj Giri is the Head of the Department of Industrial Engineering at Thapathali Campus, IOE, TU. He holds a Bachelor in Industrial Engineering, an MBA, and an M.Sc. in Mechanical Design and Manufacturing. Mr. Giri is known for his innovative and energetic activities and is actively working to bridge the gap between academia and industry.

You’ve seen the industrial department from ground up as a student, teacher, and Head of Department (HOD). How did you experience the transition from being a student to taking on the responsibilities of an educator? What emotions and insights did you gain during this transformative journey?

Starting my journey in industrial engineering back in 2005 as a student marked the beginning of a fulfilling path that eventually led me to become a faculty member in 2011. Over time, I embraced the role of Head of Department (HoD) about a year ago, a responsibility that has been both challenging and rewarding. Reflecting on this journey, it has truly been a wonderful experience. We were the pioneer batch, laying the foundation for subsequent students on our campus. Despite encountering numerous gaps, we viewed them as opportunities for growth and improvement. Throughout this journey, the support and guidance of our teachers were invaluable. Drawing from these learning experiences, both as a teacher and now as HoD, I have been able to contribute to the enhancement and organization of our department, ensuring a better academic environment for all involved.

Throughout the years, our department has undergone significant positive transformations. From its inception as the first batch of industrial engineering students on campus to its current state, we have continuously evolved and improved. The gaps we initially encountered were seen as opportunities for innovation and enhancement. With the support of dedicated teachers, we implemented changes that not only addressed these gaps but also elevated the overall quality of our department. As a result, we have witnessed a remarkable improvement in various aspects, including curriculum development, student engagement, research initiatives, and administrative efficiency. By leveraging our

collective experiences as both students and educators, we have cultivated a more dynamic and well-organized department that is better equipped to meet the evolving needs of our students and the industry. This positive change is a testament to our commitment to excellence and continuous improvement.

What do you think are the most important roles to perform as the Head Of Department, What issues did you encounter, and what expectations did you have for the department, And as the HOD, How have you been prioritizing them?

As the Head of Department (HoD), the primary focus revolves around leadership, academic excellence, faculty and staff management, student engagement, research promotion, administrative efficiency, and stakeholder engagement. Challenges such as budget constraints, faculty turnover, curriculum alignment, and administrative hurdles have been encountered. To prioritize these responsibilities, We’ve implemented strategic and operational planning which will be helpful in achieving our short and long term goals towards our focus stakeholder engagement strategies. Activities like Stakeholders Engagement which includes students, faculties and job providers have borne fruit in form of good teaching learning environment, MoUs regarding student's entrance to the job market different stakeholder's sessions have pinned this department on the broader map. By proactively addressing these areas and challenges, we aim to lead the department towards fulfilling its mission of academic excellence and innovation, while also strengthening relationships with industry partners, alumni, and other stakeholders.

What is your vision for the Industrial Engineering Department, and how do you plan to align it with the broader goals of the institution?

Our vision for the Industrial Engineering Department is to create a renowned center of academic excellence, innovation, and industry collaboration. We aspire to produce graduates who possess cutting-edge knowledge and practical skills, empowering them to excel in various industrial sectors while contributing to societal advancement through impactful research and problem-solving. To align with the institution's broader goals, we plan to cultivate strategic partnerships

with industry leaders, enhance academic programs to meet evolving industry needs, promote a culture of research and innovation, support student success through mentorship and career development initiatives, foster diversity and inclusion, and ensure continuous improvement through ongoing assessment and evaluation. By pursuing these objectives, the department will not only strengthen its reputation but also contribute significantly to the institution's mission, impact, and relevance in the field of higher education and industrial engineering.

IOE has recently undergone revisions and modifications on BE syllabus after a considerable period, and you were also involved as an expert in this change. How do you anticipate these course changes will prepare students for the future career in industry?

The recent revisions and modifications to the Bachelor of Engineering (BE) syllabus at the Institute of Engineering (IOE), with our involvement, hold significant potential in preparing students for future careers in the industry. The updated syllabus is designed to be more market and student-friendly, aligning closely with industry demands and contemporary trends. By streamlining and optimizing the course workload, students are provided with more flexibility to engage in extracurricular activities, internships, and research opportunities that complement their academic journey. However, the effectiveness of these changes ultimately depends on the students' initiative and dedication to making the best use of their time. It is essential for students to actively seek out meaningful experiences, apply theoretical knowledge in practical settings, and develop relevant skills that will enhance their employability and readiness for the dynamic challenges of the industry. Thus, while the revised syllabus sets the foundation, it is the proactive engagement and initiative of students that will truly shape their future career prospects in the industry.

How do you envision the role of industrial engineering evolving in the next 5-10 years, and how are you preparing your department for these changes?

In the upcoming 5-10 years, we foresee industrial engineering evolving to encompass a wider spectrum, integrating traditional principles with emerging technologies and interdisciplinary approaches. Industrial engineers will play a crucial role in optimizing complex systems across various industries, leveraging advancements in automation, artificial intelligence, data analytics, and sustainability practices. To prepare the department for these changes, we're enhancing our curriculum with interdisciplinary coursework and real-world case studies, emphasizing smart manufacturing, supply chain optimization, and sustainability. We're fostering a friendly environment, strengthening industry collaborations for relevance, and offering experiential learning opportunities through internships and industry-sponsored projects. Additionally, we're investing in faculty development to ensure they remain updated with the latest trends. Through these initiatives, we aim to equip our graduates with the skills and knowledge to excel in the dynamic landscape of industrial engineering, contributing to innovation and efficiency across diverse sectors.

What steps can be taken to promote diversity and inclusion within the field of industrial engineering, ensuring that it is accessible and welcoming to individuals from all backgrounds?

Promoting diversity and inclusion within industrial engineering necessitates deliberate actions to ensure accessibility and a welcoming atmosphere for individuals from diverse backgrounds. To achieve this, efforts must focus on diverse representation among faculty, staff, and students, actively recruiting and retaining individuals from underrepresented groups. The curriculum should be inclusive, incorporating diverse perspectives and examples to reflect the experiences of all individuals. Cultural competency training for faculty, staff, and students is essential to create an environment free from biases and conducive to learning. Support services, including mentorship programs and counseling services, should be available to support students from underrepresented backgrounds and foster a sense of belonging. Outreach and recruitment initiatives should target diverse groups, and scholarships and financial aid opportunities should be provided to support their academic pursuits. Additionally, promoting diversity in leadership roles within the department and industry organizations can serve as a model for students and contribute to a more inclusive environment. By implementing these measures, industrial engineering can become a more diverse, inclusive, and vibrant field, benefiting from a wide range of perspectives to drive innovation and excellence.

As we navigate the changing educational landscape, have you observed any shifts in student preferences when it comes to join engineering programs in general? How do you envision rekindling interest in engineering among students?

In navigating the evolving educational landscape, there has been a noticeable shift in student preferences regarding engineering programs. While traditional engineering disciplines such as mechanical, computer, and civil engineering continue to attract students, there has been a growing interest in interdisciplinary fields such as environmental engineering, biomedical engineering, and data science. Additionally, there has been an increased emphasis on programs that integrate engineering with other disciplines such as business, healthcare, and sustainability. To rekindle interest in engineering among students, it is crucial to highlight the relevance and impact of engineering in addressing global challenges, promoting innovation, and improving quality of life. This can be achieved through targeted outreach efforts, including interactive workshops, hands-on projects, and guest lectures from industry professionals. Furthermore, showcasing the diverse career opportunities available to engineering graduates, from traditional engineering roles to emerging fields such as renewable energy, artificial intelligence, and sustainable development, can inspire students to pursue engineering as a rewarding and impactful career path. Additionally, emphasizing the importance of creativity, problem-solving, and teamwork in engineering education can appeal to students' interests and aspirations, fostering a renewed enthusiasm for the field.

In recent trends, a growing number of Industrial Engineering (IE) graduates are pursuing further studies abroad. Do you believe this scenario will lead to a shortage of IE professionals in the local market, or is it providing valuable exposure to the international market?

The growing trend of Industrial Engineering (IE) graduates pursuing further studies abroad presents a dual perspective regarding its impact on the local market.

On one hand, the migration of IE graduates for further studies abroad can lead to a temporary shortage of professionals in the local market, especially if a significant number of talented individuals choose to pursue opportunities overseas. This shortage could potentially impact local industries and organizations that rely on IE professionals for optimizing processes, improving efficiency, and driving innovation.

On the other hand, the exposure gained by IE graduates through international education can be immensely beneficial for the local market in the long term. Studying abroad exposes students to diverse perspectives, innovative practices, and advanced technologies that may not be readily available in the local market. This exposure can enhance their skills, knowledge, and global network, making them more competitive and valuable assets when they return to the local market or contribute remotely from abroad. Additionally, these graduates may bring back new ideas, best practices, and international connections that can stimulate innovation and growth in the local IE sector.

In summary, while the trend of IE graduates pursuing further studies abroad may lead to a temporary shortage of professionals in the local market, it also provides valuable exposure to the international market, ultimately benefiting the local market through enhanced skills, knowledge, and global perspectives brought back by returning graduates. Therefore, it is essential for local industries, educational institutions, and policymakers to support and leverage this trend by creating opportunities for international collaboration, knowledge exchange, and talent retention.

The Industrial Engineering department deserves applause for its proactive approach in establishing valuable connections with stakeholders, industries, research organizations. Could you shed light on the department's strategic plan to leverage these connections for the benefit of students, encompassing opportunities such as internships, jobs, trainings, and orientations? How can SOIES Nepal aid department on this regard.

The Industrial Engineering department has implemented a strategic plan to leverage its valuable connections with stakeholders, industries, and research organizations for the benefit of students. This plan encompasses various opportunities such as internships, jobs, trainings, and orientations to enhance students' academic and professional development. The department actively collaborates with industry partners to offer internship opportunities that provide students with hands-on experience and exposure to real-world industrial engineering challenges. Additionally, the department facilitates job placements by connecting students with industry professionals through networking events, career fairs, and alumni networks. Furthermore, the department organizes training sessions and orientations conducted by

industry experts to supplement students' academic learning with practical insights and skills relevant to the industry.

In this regard, the Society of Industrial Engineering Students (SOIES) Nepal can aid the department by providing support in several ways. Firstly, SOIES can facilitate partnerships and collaborations between the department and industry stakeholders, leveraging its network and expertise to identify potential opportunities for students. Secondly, SOIES can assist in organizing industry-focused events, workshops, and seminars that bring together students, faculty, and industry professionals to exchange knowledge and explore collaboration opportunities. Thirdly, SOIES can support the department in implementing mentorship programs that pair students with industry mentors to provide guidance and support throughout their academic and professional journey. Overall, the collaboration between the Industrial Engineering department and SOIES Nepal can create a conducive environment for students to access valuable opportunities, develop relevant skills, and establish meaningful connections that enhance their career prospects in the field of industrial engineering.

Lastly, Do you want to say something to SOIES Nepal and the magazine team?

I would like to express my sincere gratitude for your dedication and commitment to promoting excellence in the field of industrial engineering. Your efforts in fostering collaboration, knowledge exchange, and professional development opportunities are invaluable in shaping the future of our industry and empowering the next generation of industrial engineers. I am inspired by your passion and vision for advancing the field and am honored to be a part of this vibrant community. Together, let us continue to innovate, collaborate, and inspire positive change in the field of industrial engineering. Thank you for your tireless efforts and dedication.

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Industry 4.0

Technologies

IoT (Internet of Things)

The Internet of Things (IoT) refers to a network of interconnected physical devices and objects that can communicate and share data through the Internet. These devices, equipped with sensors and actuators, collect and exchange information in real-time, enabling them to make intelligent decisions without human intervention. It enhances efficiency, automation, and decision-making by providing valuable insights based on the data generated by these connected devices. IoT aims to create a more interconnected and efficient world by seamlessly integrating the digital and physical realms.



Big Data Analytics

Big Data Analytics involves the examination and interpretation of large, complex datasets to uncover patterns, trends, and insights that can inform decision-making. It goes beyond traditional data processing methods, utilizing advanced algorithms, statistical models, and machine learning to extract valuable information from massive volumes of data. In essence, transforming raw data into actionable knowledge enables a more informed and strategic approach to problem-solving and planning.

Artificial Intelligence

In Industry 4.0, Artificial Intelligence (AI) is the tech powerhouse that brings intelligent decision-making, learning capabilities, and automation to manufacturing processes. It optimizes production, enhances efficiency, and enables smart, adaptive systems through machine learning and predictive analytics, marking a significant leap in the evolution of industrial technology.



Autonomous Robots

Autonomous robots are cutting-edge technology designed to perform tasks without direct human intervention. These robots are equipped with advanced sensors, AI, and machine learning, allowing them to navigate and adapt to their environment. It contributes to the smart factory concept by enabling flexible and adaptive production lines, reducing the need for manual labor, and increasing productivity. This technology exemplifies the transformative impact of Industry 4.0 by ushering in a new era of intelligent, self-guided machines in industrial settings.



Cloud Computing

Cloud computing in Industry 4.0 facilitates efficient data management, analysis, and sharing among interconnected devices, contributing to enhanced decision-making, agility, and cost-effectiveness. It forms the backbone for the digital transformation of manufacturing, allowing businesses to leverage the benefits of smart, interconnected systems in the modern industrial landscape.

Blockchain Technology

Blockchain technology is a revolutionary tool that ensures secure, transparent, and tamper-resistant transactions and data sharing across interconnected devices and systems. It operates as a decentralized and distributed ledger, where information is stored in a chain of blocks, each containing a timestamp and a link to the previous block. This technology enhances the integrity and trustworthiness of data exchanges in supply chains, logistics, and manufacturing processes. By providing a decentralized and immutable record, blockchain fosters transparency, reduces fraud, and streamlines complex transactions, making it a key enabler of trust in the digital era of smart manufacturing.

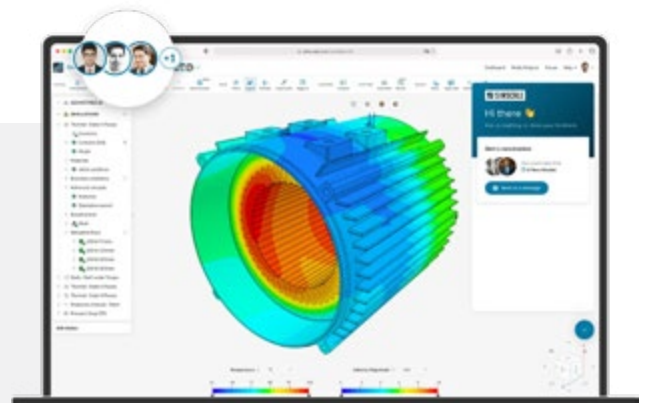


5G connectivity

5G technology is the next generation of mobile connectivity, providing faster speeds and lower latency than 4G. Although it is a reality in some countries, we still consider it as the next generation, because it is currently in the process of being adopted by nations around the planet. In Industry 4.0, 5G is used to connect devices and equipment in real-time, enabling faster and more reliable communication between machines and people, which can be essential to increasing results and the competitiveness of a business.

Simulation Systems

Simulation is a technology that allows you to create a virtual model of a process or system to test and optimize it before it is implemented in real life. In Industry 4.0, simulation systems are used to test new production processes, train employees, and improve the efficiency and quality of products before they go to market.





Early Development

In the 1990s, a team of engineers from NASA's Marshall Space Flight Center developed a revolutionary rocket known as the DC-X, which performed the world's first successful vertical takeoff and landing of a reusable rocket. Despite a relatively small team of 100 engineers and a budget of only \$60 million, the DC-X program demonstrated the feasibility of reusable rockets. Unfortunately, NASA ended funding for the program in 1996. However, the engineers behind DC-X did not give up on their vision of reusable rockets. They continued to develop new technologies, which



eventually gave rise to modern reusable rockets such as SpaceX's Falcon 9 and Blue Origin's New Shepard. Today, these reusable rockets are heavily utilized in launching commercial satellites, transporting astronauts to and from the International Space Station, and even promoting space tourism. The cost-effectiveness and sustainability of reusable rockets have greatly benefited the space industry, providing nations with the opportunity to establish their space programs and allowing small companies and students to launch satellites for research and commercial purposes.

Reusable Rocket

Have you ever seen a rocket launch and marveled at the engineering behind it?

- Dhan Prasad Pradhan

Have you ever seen a rocket launch and marveled at the engineering behind it? It's no wonder they're considered marvels - it takes a lot of precision and high-quality components to safely launch a payload into orbit. But all that top-notch technology comes with a hefty price tag. The recent Artemis-I mission cost around \$4.8 billion, which is about 14% of Nepal's GDP in 2021. And that's just for a successful mission - the cost only goes up if something goes wrong. It's no wonder that for many countries, rockets and space programs are financially out of reach. But there's another problem with traditional rockets: once the payload or spacecraft is sent into orbit, the most expensive parts of the rocket, the boosters, are just left to crash back down to Earth. It's like throwing away a jumbo jet after every flight. This wasteful approach to space

travel has led some brilliant engineers to come up with a solution: reusable rockets. Reusable rockets have the potential to change the way we explore space by significantly reducing the cost of launches. They can be used multiple times, meaning the cost is spread out over multiple missions instead of being incurred all at once. Plus, they're designed with reliability in mind and can be tested and refined over multiple launches. While there are still challenges to overcome, like wear and tear on the rocket's components and the initial cost of building and maintaining reusable rockets, they represent an exciting step forward in space exploration. By lowering the cost and increasing the reliability of launches, reusable rockets could make it possible for more people to reach for the stars.

“

With a staggering number of launches, a low cost per kg, short intervals between consecutive launches, and operational efficiency made possible by the use of reusable rockets.

”



Dhan Prasad Pradhan, Mechanical design engineer, Yatri Motorcycles

Economics Of Reusing

In 1968, NASA introduced the space shuttle program to regularly visit the International Space Station (ISS) for maintenance and resupply. The program consisted of four different space shuttles - Columbia, Challenger, Discovery, and Atlantis - which were essentially spaceplanes attached to rockets and were only recovered and reused. These spaceplanes were responsible for a total of 138 successful missions, but unfortunately, two of them also failed. Despite their reliability, the cost of the space shuttle program remained high due to its complex design. Each launch cost around \$450 million, and the entire program cost a staggering \$211 billion. Later, NASA dropped the space shuttle program due to financial and other reasons.

In the early days of space exploration, launch vehicles such as Vanguard had a high cost per kilogram of payload, at around \$1 million. The Space Shuttle program was able to decrease this cost to around \$55,000 per kg. However, despite advancements in technology, the cost of launching payloads into space remained relatively unchanged. This began to change in 2013, with the advent of SpaceX's reusable rockets. According to SpaceX, the cost per kg of payload for launching with the Falcon Heavy and Falcon 9 rockets is \$1,400 and \$2,700 respectively, which is significantly lower than previous launch costs. This cost reduction is largely due to the reusability of the rocket boosters. As a result of SpaceX's success, other private companies and national space agencies have begun to focus on reusable rocket technology. The trend of decreasing launch costs per kg of

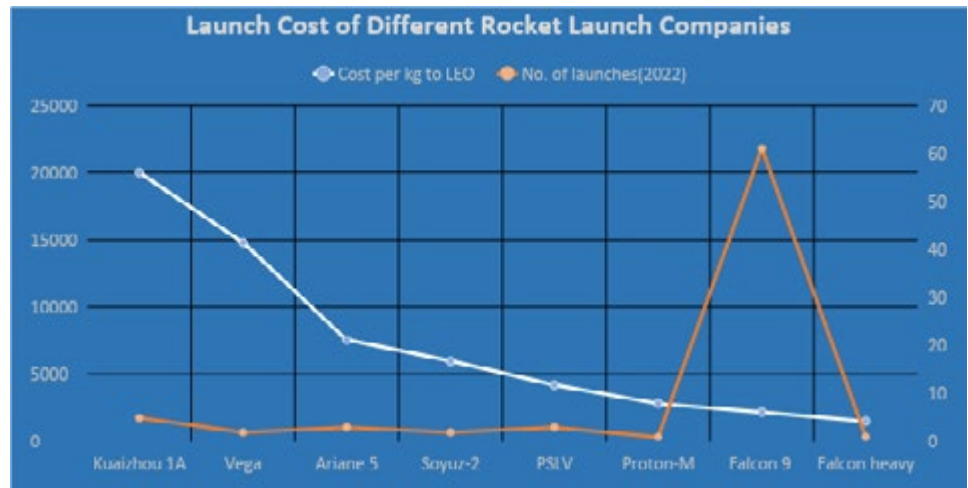


Fig: Graph

payload can be visualized in the accompanying graph. This graph illustrates the current state of the space industry, and it's clear to see that SpaceX is leading the charge in the race to make space accessible and affordable for all. With a staggering number of launches, a low cost per kg, short intervals between consecutive launches, and operational efficiency made possible by the use of reusable rockets.

It is important to note that while SpaceX's Falcon 9 rocket has been successful in many launches and has played a major role in the company's success, it is not the only player in the space industry. Other private companies like Blue Origin, Virgin Galactic, and Rocketlab, as well as national agencies in countries like China, Russia, the European Union, and India, are also working on reusable launch systems and making strides in the industry. The space industry is expected to see even more advancements and innovations in the future with reusable rockets, as the number of players in the field increases. This is likely to lead to more frequent launches, lower costs, and greater accessibility to space for a wider range of customers.

In conclusion, reusable rockets are revolutionizing the space industry and changing the way we access space. With companies like SpaceX leading the way, and others following suit, the future of space travel is looking bright, as reusable rockets make space travel more frequent, affordable, and accessible to all.



Top Manufacturing Companies

in Nepal

Business Haunt 2023

Nepal Lever Ltd

Nepal Lever Ltd., the Nepalese subsidiary of the British consumer products company Unilever, was established in 1992 and operated in Nepal for over 20 years, providing a variety of products such as food, beverages, personal care items, and household cleaning supplies. The company continues to be a significant player in the Nepalese consumer products industry, supplying popular names like Lipton, Surf, and Pepsodent, among others. Its transportation method is efficient, and a significant presence in both urban and rural areas of the country.



Chaudhary Group



Chaudhary Group, a global conglomerate headquartered in Nepal, operates in various sectors including banking, finance, hospitality, real estate, energy, and education. Established by Lunkaran Das Chaudhary, who passed away in 1933, it is now managed by his son, Binod Chaudhary. The company has significant operations in Nepal, India, Sri Lanka, Bangladesh, and the Middle East, and is present in over 30 countries. With over 15,000 employees, it is one of Nepal's largest private companies.

Himalayan Snacks Pvt. Ltd.

Founded in 2015 by Nepali businesspeople, Himalayan Snacks Pvt. Ltd. aims to promote healthful snacking in Nepal. The company produces snacks using traditional Nepali recipes and locally sourced ingredients, without artificial flavors, additives, or gluten. Their goal is to offer delicious, wholesome, and eco-friendly food choices. Popular products include roasted legumes, roasted peanuts, and baked lentil snacks.



Himalayan Snax & Noodles (P) Ltd.



Nepal Distillery Pvt. Ltd.

Nepal Distillery Pvt. Ltd. specializes in the production of alcoholic beverages, particularly whiskey and rum. It is renowned for its traditional and high-quality brewing techniques.



Unitech Nepal Pvt. Ltd.

A Nepal-based information technology (IT) company called Unitech Nepal Pvt. Ltd. offers a variety of IT services and solutions to businesses and organizations. The business was established in 2002, and it has its headquarters in Kathmandu, Nepal. Unitech Nepal Pvt. Ltd. offers a variety of products and services, some of which are software development, web development, mobile application development, e-commerce development, digital marketing, and IT consulting.

Shree Pashupati Steel Industries Pvt. Ltd.

Shree Pashupati Steel Industries Pvt. Ltd. is a business with headquarters in Nepal that focusing the manufacture and sale of steel goods. Shree Pashupati Steel Industries Pvt. Ltd. manufactures a wide array of steel products, including steel ingots, steel sheets, steel pipelines, and wire rods. The company prides itself on crafting high-quality steel goods that meet global standards, employing state-of-the-art machinery and technology in its production processes.



Jagdamba Steel Industries Pvt. Ltd.

Situated in Nepal, Jagadamba Steel Industries Pvt. Ltd. specializes in steel manufacturing. Established in 2001, the company has established itself as one of Nepal's leading steel producers. Jagadamba Steel Industries Pvt. Ltd. manufactures a wide range of steel products, including TMT bars, wire rods, angles, channels, and billets. Utilizing modern tools and technology, the company ensures the highest standards for its products.

Star Chemicals and Catalysts Pvt. Ltd.

Star Chemicals and Catalysts Pvt. Ltd. produces a range of chemical products, including industrial and laboratory chemicals. It is known for its innovation and commitment to quality in the chemical industry.



Gorkha Brewery Pvt. Ltd.

Gorkha Brewery Pvt. Ltd. is known for producing popular beer brands such as Tuborg and Carlsberg. It maintains high standards in brewing quality beverages, making it a leader in the Nepalese beer market.

Surya Nepal Pvt. Ltd.

Surya Nepal Pvt. Ltd., part of ITC Limited, manufactures and markets cigarettes and has diversified into garments and safety matches. The company plays a significant role in Nepal's tobacco and garment industries.





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Manufacturing process:

1. Collecting raw material:

The fallen leaves are gathered by farmers and sheaths are separated from the leaf. After separating, the farmers deliver the sheaths to merchants who deal in Areca leaves.

2. Drying the areca sheath:

As the following phase in the procedure, areca sheaths are to be dried. The sheaths are further dried by the merchants once they gather them from the farmers and stacked in bundles.

Cleaning the areca sheath
After coming into the factory, the manufacturers soak the sheath in freshwater for 20 minutes making them pliable. In order to get rid of the dust and sand particles, the sheaths are also washed with a soft brush.

3. Heat press and plate forming:

The Areca leaf plate making machine has two pressing heads: the upper pressing head and a lower pressing head. The upper head is fixed to a channel and the lower head of the machine moves up and down. The up and down movement of the machine helps in pressing the areca leaf sheaths. Both the pressing heads have a heating coil. After turning on

LEAF PLATES: AN ECOFRIENDLY DINING

- Prajita Ghimire

Sustainable, Biodegradable, and eco-friendly are the age-old words used to define the quality factors of Areca Palm Leaf Plates (Supaari ko paat). It's astounding to see how minutely they affect the environment in all the good ways. Areca leaf plates are a sustainable alternative to single-use plastic tableware, manufactured from the fallen sheaths of areca or betel palm trees.

Areca palm plants (scientifically known as Areca catechu) are extensively cultivated in the lower belt of Terai. There are 38 million areca nut trees in Eastern Nepal. Areca plant takes seven years to fully establish itself and can last up to eighty years in the field and even beyond. Throughout its life cycle, areca plant not only produces the primary product (Betel nut) but also yields by-products (leaf sheath and areca nut husk). Each areca palm produces on an average 10 leaf sheaths per year which is either burned for cooking or basically wasted. Thus, every

year around 380 million leaves are getting wasted as an agro waste. Due to the advances in technology, it has now been possible to utilize the leaf sheaths for manufacturing of plates, bowl or spoons of variety of shapes and sizes. Each leaf can be utilized to produce an average of 3 plates. Thus, there is a potential to produce up to 1.2 Billion areca leaf plates in Nepal by utilizing those leaves. [1]

Unique features of areca leaves plates:

- Microwaveable and safe for oven use
- Holds liquid both hot and cold
- Compostable and Biodegradable
- Strong and light weighted
- Versatile
- Natural, wood-like appearance with its beautiful grains and textures
- Hygienic and food safe
- Cultural and traditional appeal

“ Each leaf can be utilized to produce an average of 3 plates. Thus, there is a potential to produce up to 1.2 Billion areca leaf plates in Nepal by utilizing those leaves. ”



the machine, the pressing heads start heating. The heat of these heads is controlled by a thermostat.



Prajita Ghimire, Batch of 2076, Bachelors in Industrial Engineering
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After the heating of the sheaths with the Areca leaf plates making machine, the next step is the pressing of the plates. We place the sheath between the hot-pressing heads and press them tightly. The heads are tightly pressed against each other to get the desired shape.

The pressing heads also contain cutting blades in the edge with which you can easily cut the sheath into a proper shape.

4. Grading and Surface finishing:

The last step is to grade the Areca Leaf Plates which is done manually.

After the grading, the Areca leaf plate's edges are smoothed with the help of sandpaper. This process provides the plates with a beautiful finishing and a clean surface and edges. Additionally, the process also helps in removing all the dust and debris from the leaf plates.

5. Packaging:

In the end, the leaf plates are left to dry. Before packaging, it is made sure that there is no moisture in the plates. [2]

Case study of Leaf plus

Areca leaf plates are produced by a number of manufacturers in Nepal, Leaf Plus Private Limited being one of the examples.

LeafPlus is a socio-economic enterprise that aims to impact the environment & society by producing and promoting areca leaf products manufactured with direct engagement of women, marginalized & farmer groups in the production chain. Registered in 2017, the venture is expanding in the Nepalese market as we can find these products across the nation from profound online stores like Daraz to the street market.

On a very informal conversation between three high school friends Kobit Singh Baniya (Graduate of Electronics and Communication Engineering), Swaviman Acharya (Mechanical Engineer from Pulchowk Engineering campus) and Bidhan Pokhrel (Graduate of Electrical and Electronics Engineering from KU) at a local momo shop, the idea of making those leaf plates better, reliable and leakage proof inspired them towards establishing a company, Hence Leaf plates.

The manufacturing industry is based in Jhapa where they discovered that a significant amount of these leaves was wasted and there would not be any shortage of the raw material. With 19 employees, 2000+ farmers benefited and 4 million+ plastic plates replaced, Leaf Plus has been making an impressive move in the Nepalese market.

In the early stages of the company's establishment, the company's production capacity was 15,000 to 20,000 pieces month. It is now producing between 200,000 and 250,000 pieces each month. They have been getting impressive attention in B2B sales- Bhatbhateni Supermarket to Soaltee Hotel. Leaf plus has signed an agreement with BuyEcoGreen, a company based in Australia to ship their products and is expanding their business into other countries as well. [3]

Not always, your academic line reflects your business move but A multidisciplinary Field as Engineering teaches students engineering management skills such as accounting, leadership, international relations, quality management, and research all vital skills for being an entrepreneur and establishing and running your own business. With its upside there are downfalls, but a sustainable vision always works. Leaf plus and the engineering alumnis founding it certainly reflect upon that.



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An overview on Industrial Hemp

Reviving an ancient crop.

- Kusum Raj Tamang

Introduction:

Begun in Central Asia, hemp, experimentally named *Cannabis sativa* L. has been developed for fibre, nourishment, and therapeutic properties. (Vasantha Rupasinghe et al., 2020). In 2018, the USA passed The Farming Change Act, which authorized the generation of hemp and its subsidiary items. It moreover characterized mechanical hemp as any hemp propagules seeds, takes off, fibre, and CBD having delta nine THC substance of less than 0.3 percent.



Fig. Marijuana

Difference between hemp and marijuana

Even though there are huge genome-wide contrasts between cannabis and hemp, it is outwardly troublesome to foresee whether it is pot or mechanical hemp. (Sawler et al., 2015). Chemically pot contains more than 0.3 delta 9 THC, but we cannot say based on field perception. Not one or the other such progressed commercial gear has been created for testing THC at a field level. But a few key perceptions might be made to guess the contrasts. For case, mechanical hemp plants are tall, a few cultivars like Jinma, Yuma, and Panther indeed surpass 12 ft. in tallness (LU trial). However, marijuana plants are brief and bushy. Bushiness is additionally a vital characteristic of the pot. Since most of the mechanical hemp uncommonly developed for seeds does not have

auxiliary branching, even though ready to visually tell the contrast between fibre and seed hemp. To distinguish between CBD hemp and pot is indeed more challenging.



Nepal has excellent conditions for hemp cultivation, but legal restrictions currently limit its production.



Importance of Hemp:

Although hemp has colossal potential as an elective source of protein, they have been utilized exceptionally small and the hemp inquiry has fairly started. Hemp contains a great sum of protein, specifically edestin, vicilin, and egg whites which

can be utilized as an elective to animal-based protein nourishment (Liu et al., 2022 Shen et al., 2021) In expansion, the hydrolyzed peptides have a few positive wellbeing impacts, counting antioxidant, antihypertensive, and hypoglycaemic activity. (Shen et al., 2021) Terpenes dependable for the fragrant character of hemp are the fundamental oils that have synergic or escort impacts (making you feel great but not tall) on the consumers. (Sommano et al., 2020). Hemp incorporates terpenophenolic components counting cannabidiol (CBD) and cannabigerol (CBG), which are associated with cannabinoid receptors to emphatically control a run of physiological, immunological, and metabolic forms in people. Due to CBD and CBG's effect on the cytokine digestion system, cannabinoids are being explored for their potential role in the treatment of viral maladies like COVID-19. (Deguchi et al., 2020).

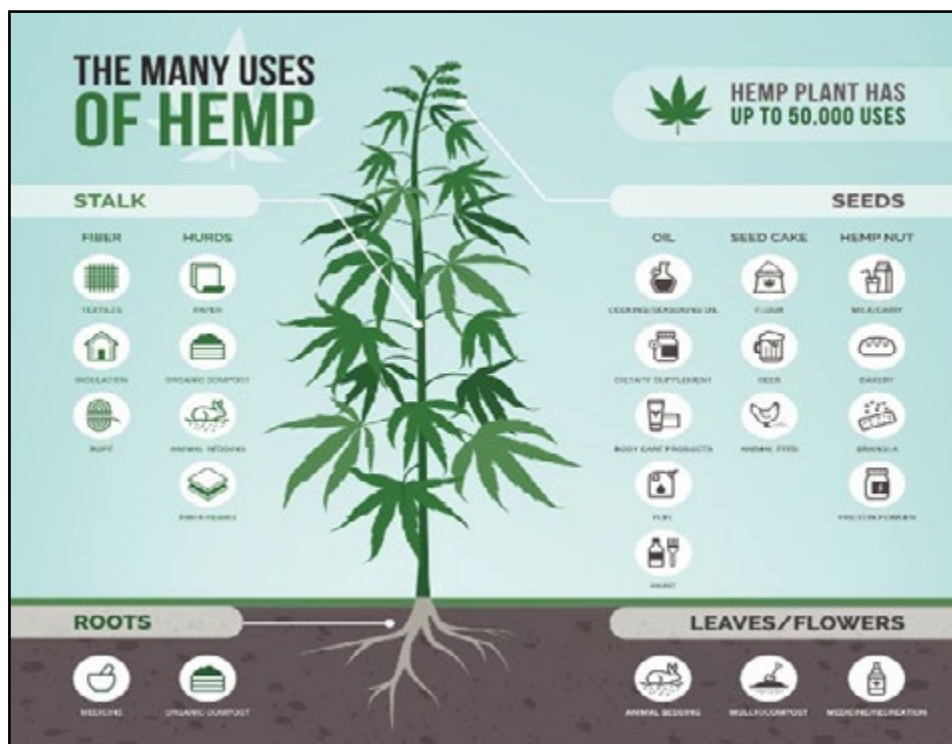
In expansion to cannabinoids and nutritive values, mechanical hemp has been plan utilized in fibre and its subordinate items. The thermoplastic bundling and paper businesses can advantage of the more noteworthy quality of hemp filaments, which are composed of cellulose derivatives. (Promhuad et al., 2022). Hemp-based articles of clothing are becoming even more popular within the



Fig. Hemp



Kusum Raj Tamang is a graduate research assistant and industrial hemp researcher at Lincoln University Hemp Institute, US. He completed his bachelor's from the Institute of Agriculture and Animal Science (IAAS), and he was the founder of The Narke Rabbit and Meat Production Farm, one of the pioneering rabbit farms in Nepal.



Joined Together States and all parts of the globe. Indeed, well-known companies like Nike, Patagonia, and Levi's have begun to utilize hemp-based materials in their materials, giving amateur business visionaries positive thinking. In addition, hemp woods and hemp concrete can be made from hemp filaments which are maintainable choices for wood and ordinary concretes.

Current research trend in Industrial Hemp:

The Marihuana Tax Act, of 1937, passed by Congress began the boycott on hemp within the USA. Harry Anslinger, the Charge Act's primary advocate, began progressing anti-marijuana legislation globally. This brought about the worldwide prohibition of hemp development and handling. Hemp cultivars were burnt down, and all the hemp processing plants were shut down. This was driven by the misfortune of all the information base of hemp hereditary qualities and agronomic hones.

In 2014, President Obama marked the Cultivate Charge, empowering

scholarly teachers to dispatch test industrial hemp programs. Ever since, researchers have been attempting to think about and revive this antiquated trim. The inquiry about mechanical hemp is still within the fledgling organized investigative being centric on hemp generation, preparation, and therapeutic utilization. Cornell College is investigating the microbiome, hemp atomic hereditary qualities, and stressors on THC in hemp. Additionally, Oregon State College is investigating the potential of hemp seeds as a ruminant count calorie. Too, they have been researching the vegetative proliferation of hemp, hemp seed preparation, and restorative utilization. Similarly, the College of California, Davis is working on translating the hemp genome. Similarly, they are testing by concocting the finest water system hones and agronomic hones for developing hemp. Lincoln College of Missouri as of late gotten a whopping 5 million give for inquiries about hemp. It has been investigating the varietal screening

of mechanical hemp for Missouri. Additionally, it is also working on agronomic investigations and the atomic perspective of hemp hereditary qualities.

Hemp in Nepal

Nepal is one of the roots of industrial hemp and offers a long history of hemp generation. In any case, with the US undertaking on war against drugs, the generation of mechanical hemp was confined in Nepal. Nepal possesses excellent physiographic conditions for hemp development. Hemp adores sloppy arrive and abhors outright water stagnation which makes most of the arrive appropriate for hemp generation. Able to witness this prove from the wild hemp inclining within the Western portion of Nepal. As of now, offering hemp-based items is permitted in Nepal. Be that as it may, developing mechanical hemp is still denied. In 2019, Nepal imported hemp strands for \$46,900 (Danielle, Hemp, and Trust). Envision how numerous work openings it would have created had it been developed in Nepal. In 2020 the law was ordered stating

that it would be lawful to resume the generation of hemp. In any case, the law has not been implemented as of presently. The great portion of this proposed law is that there would not be a necessity to authorize hemp developed for foods as licensing has been one of the major issues within the USA. Nowadays hemp has still been edited at a juvenile arrange. And each nation is investigating acing this edit and developing patents. In this way, Nepal ought to too inquire about standards with its worldwide partners and create valuable products and breeds that might elevate the national economy.

Challenges of Hemp and potential for entrepreneurs:

One of the essential challenges of hemp generation is the lack of information base. The worldwide forbidding of hemp has driven the annihilation of all the information base and hemp cultivars. Therefore, there's a need for appropriate hemp cultivars for a given agroclimatic locale. In expansion, the nonappearance of a gifted workforce has thwarted the development of this industry.

Another challenge is the ambiguity in-laws and arrangements. Even though the law has been ordered permitting hemp cultivation, they are shapeless because of the insufficient specialized information in cannabis science.

There's a need to create an economical advertising channel and expand the product. Hemp may well be easily grown, but without the correct development of the showcase and coordination, an increment in grounds would not be beneficial.

On 9th November 2022, Lincoln College Hemp

Established with the Jointed Together State Department of Farming (USDA) gave a workshop to agriculturists related to Hemp cultivators permitting. One of the essential issues indicated was the need for THC testing labs. So, establishing a THC testing lab would be an entrepreneurial opportunity.

Lincoln College is conducting varietal screening of hemp cultivars for Missouri. Amid its inquiry about mechanical hemp, a few of the challenges watched were seed diffusing, unsteady genetics, and weeds.

Hemp filaments are troublesome to prepare as per the co-founder of Midwest common filaments working in fibre preparation in Missouri. Amid LU Hemp Day 2022, he recommended that the thickly stuffed filaments within the hemp biomass made it troublesome to extricate the fibre strings for advanced preparation.

The public's conclusion on mechanical hemp is another issue we have right now. Numerous individuals continue to see hemp as a sedate with no clear positive uses.

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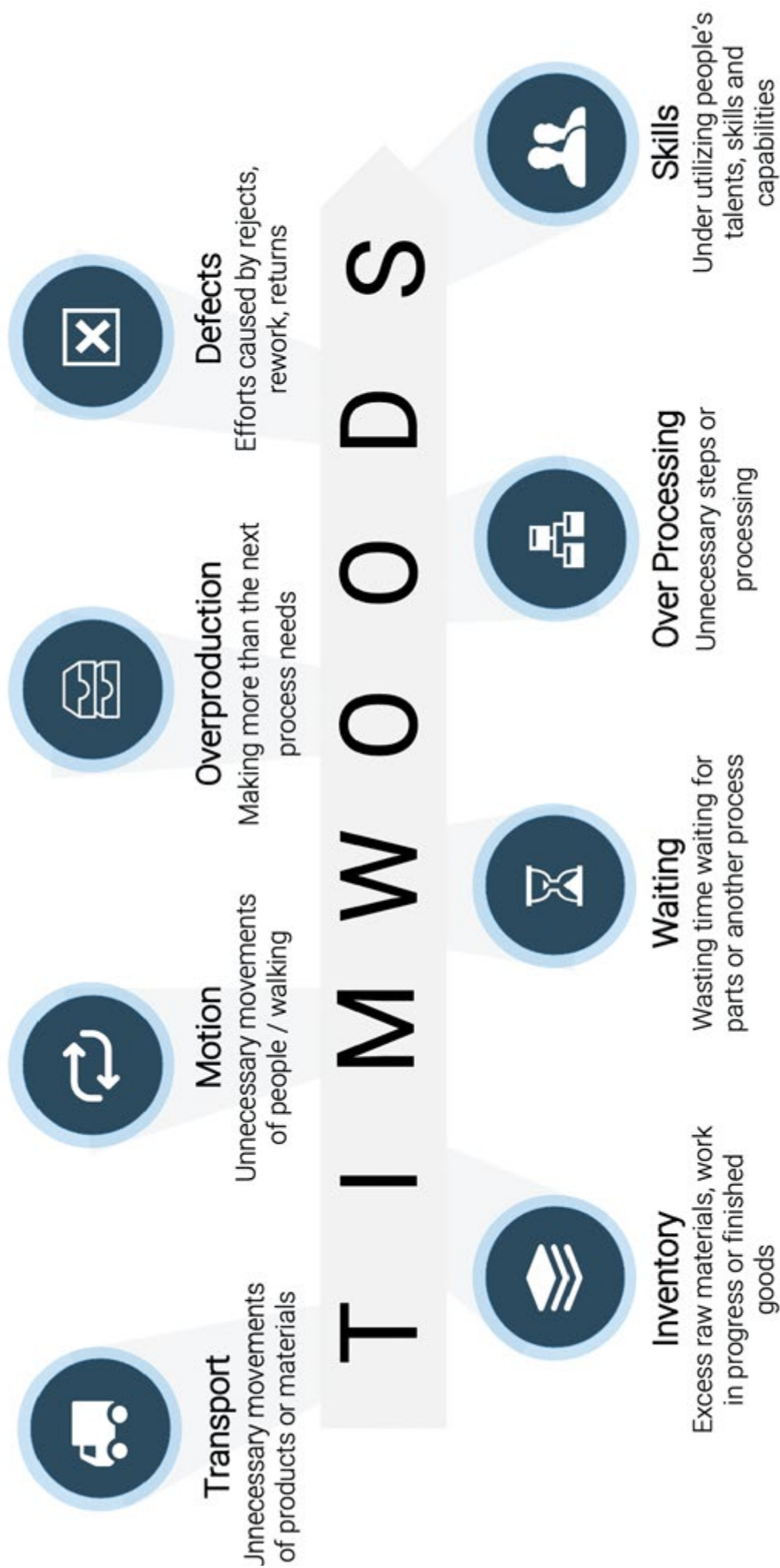
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A Comprehensive Analysis Of Emerging Additive Manufacturing In The Aerospace Sector

- Subash Dhakal

Abstract- Additive manufacturing is a fast-emerging technology that is extensively used all over the world. The purpose of this comprehensive Additive Manufacturing or 3D printing technology analysis is to identify the roles and applications of various 3D printing materials, types, and processes in the design and development of fabrication in the aerospace industry. 3D printing technology allows you to create complex shapes with fewer materials than conventional methods. It has been used for the mass customization and production of any type of design and development in the fields of the aerospace industry, aviation industry, and automobile sector as well. One of the methods of additive manufacturing, which is rapid prototyping, is a time-saving 3D printing process applied in the aviation and aerospace sectors. It is a fast and

cost-effective solution in whichever field it is used. In this paper, we will look at how the 3D printing process has impacted the aerospace industry. The applications of AM or 3D printing technology are expanding all the time in the field of aerospace, and it's proving to be a very exciting technology for today's manufacturing industries.

I. INTRODUCTION

3D printing technology, also known as additive manufacturing (AM) is a process that uses a digital design to create three-dimensional solid objects layer by layer[1]. Additive manufacturing (AM) enables unrivalled flexibility in component design and production in comparison to traditional methods of production therefore the difficulties during manufacturing are easily attained[2].

Nowadays, advanced manufacturing processes like rapid prototyping process have a wide range of applications in various fields of human activity: research, engineering, aerospace engineering, aviation, military, construction, architecture, and many others. Using 3D printers for these purposes is called rapid prototyping. Rapid prototyping is the fast fabrication of a physical part, model, or assembly using 3D computer-aided design (CAD). This is due to the simplicity of the use of 3D printing technology, which requires only sketching and setting the data in the machine-printed so that 3D things can be manufactured [3].

Aside from rapid prototyping, 3D printing is also applied for rapid manufacturing. Rapid manufacturing is a new manufacturing approach in which businesses employ 3D printers for short-run or small-batch custom manufacture [4]. It has evolved into a fully developed process for fabricating end-user products in a variety of industries. The creation of the part, model, or assembly is usually completed using additive manufacturing commonly known as 3D printing. To summarize, 3D printing technology has developed as a versatile and strong tool in the advanced manufacturing business in recent years. This technique has been widely used in many nations, particularly in the industrial sector. As a result, this article provides an overview of the many types of 3D printing technologies, their applications, and, finally, the materials utilized for 3D printing technology in the manufacturing business.

“Engineers can also utilize a 3D printer to create repair parts, sophisticated engine structures, and complex engine components on demand for individual aircraft.”



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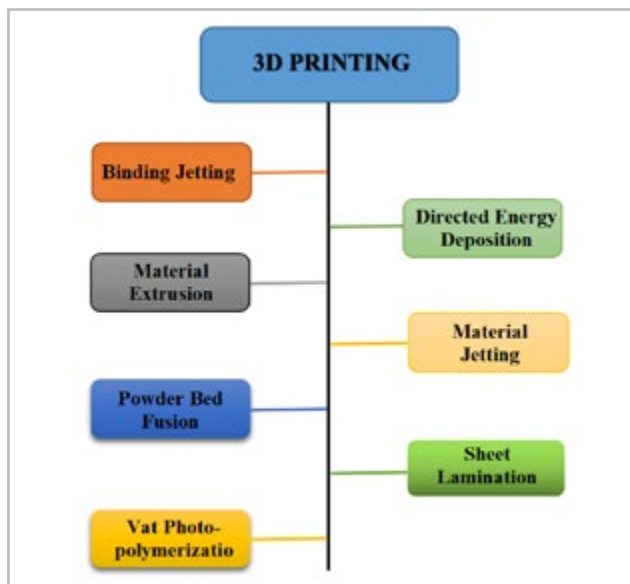


Figure 1. Types of 3D Printing Technology

II. TYPES OF 3D PRINTING TECHNOLOGY

The term 3D printing refers to a series of manufacturing technologies that manufacture parts layer by layer. There are several types of 3D printing methods with distinct functions that have been accessible.

According to ASTM Standard F2792 [5], 3D printing technologies are classified into seven categories, which include binding jetting, directed energy deposition, material extrusion, material jetting, powder bed fusion, sheet lamination, and vat photo-polymerization. 3D printing technologies are no longer restricted to prototypes nowadays[6]. They are most widely used in the aerospace and aviation industries for development and research.

1.1 Binding Jetting

Binder Jetting (BJ) is one of seven additive manufacturing processes that involves selectively deploying a binding liquid to combine powdered material to make a 3D component. Binder jetting commonly employs granular materials such as metals, composites, sand, stainless steel, nickel-based alloys, and ceramics. It is unique among today's additive manufacturing technologies because it does not require heat to fuse the material like other additive manufacturing processes[7]. Binder jetting is widely used in areas like aerospace and heavy industry, where thermally stable and wear-resistant parts are required. It can be suitable for producing low-cost, complex metal parts that do not require extremely high mechanical properties.

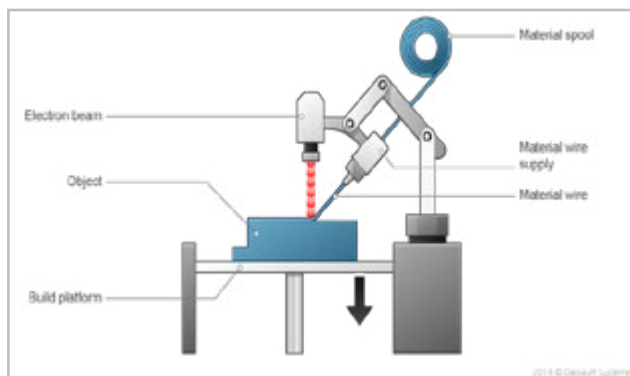


Figure 2. Binding Jetting process

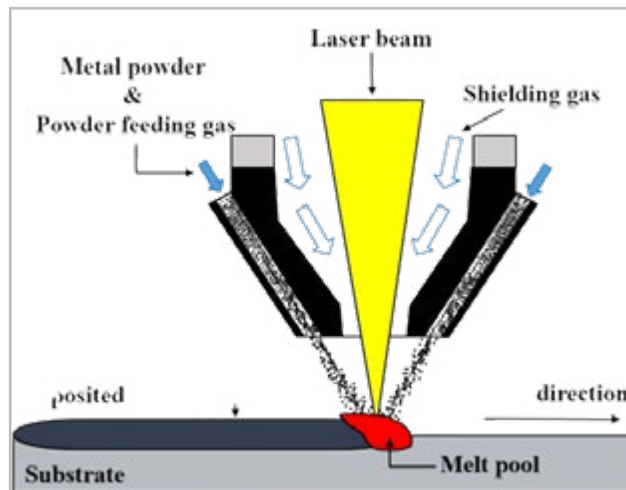


Figure 3. Directed Energy Deposition process

1.2 Directed Energy Deposition

DED is a 3D printing technique that uses a directed energy source such as a plasma arc, laser, or electron beam, to melt a material that is deposited by a nozzle [8]. A typical DED machine is made up of a nozzle mounted on a multi-axis arm that drops melted material onto the desired surface, where it sets. The process is similar in principle to material extrusion, except that the nozzle is not bound to a certain axis and can travel in any direction. This method is mostly applied to ceramics or polymers, but it is most commonly applied to metals and metal-based hybrids in the form of wire or powder.

Laser deposition and laser net shaping (LENS) are two examples of this technology[9]. Directed energy deposition is used in aerospace manufacturing to remove the layer from solid metals and specific compounds, making them more suitable for industrial processes. The advantage of directed energy deposition is the ability to control the grain structure, which allows the method to be used for the repair of high-quality functional parts.

1.3 Material Extrusion

The Material extrusion technique deposits the material through the nozzle, where it is heated to build 3D parts layer by layer[5]. It offers a wide selection of printing materials such as Polymers, ABS plastics, and Nylon, with low set-up and running

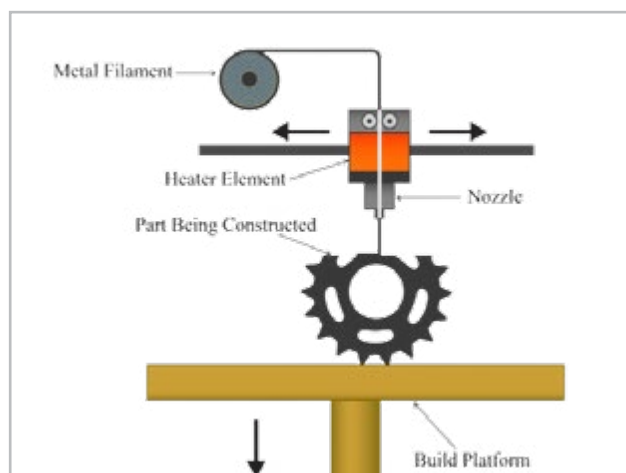


Figure 4. Material Extrusion Process

costs. Fused filament fabrication (FFF) and fused deposition modeling (FDM) are two significant examples of material extrusion technology. Materials extrusion is widely used in research and by hobbyists because of its low complexity, ease of implementation, and commercially available materials. Applications include the development of functional engineering prototypes and systems, including those for aerospace applications.

1.4 Material Jetting

Material jetting (MJ) is one of the seven types of Additive Manufacturing (AM) technologies in which drop by drop of build material is selectively deposited onto the build platform and cured by UV light or heat to produce a 3D object. MJ uses thermoset photopolymers (acrylics) as a material that comes in liquid and is dispensable from a print head [10]. Material jetting 3D printing produces high-dimensional-accuracy products with a very smooth surface finish for models of aerospace design. It is ideal for visual prototypes and industrial tooling useful in the fabrication of anatomical medical models for pre-surgical and suitable for casting patterns.

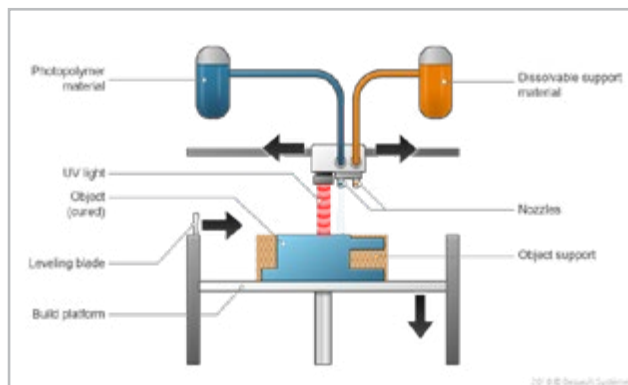


Figure 5. Material Jetting Process

1.5 Powder Bed Fusion

The Powder bed fusion technique in laser-based additive manufacturing has gained significant interest in the research and development of innovative engineered materials due to their greater cooling rate and superior surface smoothness when compared to other additive manufacturing processes [11].

The Powder bed fusion process uses any powder-based material, although the most typically used metals and polymers include Nylon DMLS, Stainless Steel, Titanium, Aluminium, Cobalt Chrome, Copper, and so on [12]. In comparison to other AM processes, it can integrate technology into small-scale, office-sized machines and a wide variety of material alternatives. The aerospace sector, which was an early adopter of powder bed fusion for metal components, works at the cutting edge of material science and engineering technology to push the boundaries of what is feasible. Powder bed fusion is employed to combine the numerous elements of a rocket engine combustion chamber into a single component, decreasing part complexity significantly.

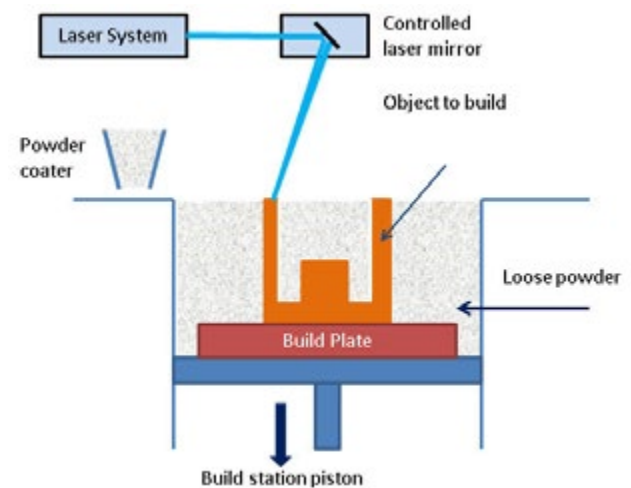


Figure 6. Powder Bed Fusion Process

1.6 Sheet Lamination

According to ASTM definition, sheet lamination is the 3D printing process in which sheets of materials are bonded together to produce a part of an object. Sheet lamination processes include bonding, ultrasonic welding, and brazing, with the final form created by laser cutting or CNC machining. As compared to the other seven AM processes, sheet laminate creates the product with the least additive resolution [13]. However, because of its low cost and shorter manufacturing time, it allows product designers to make low-fidelity prototypes using common, readily accessible low-cost materials.

Although sheet lamination may be done with a broad range of materials, including paper, polymer, ceramic, and metal, each material

has a unique binding process. The most common sheet lamination material is paper with pre-applied adhesive, which is activated by heat and pressure. Sheet lamination techniques are employed for a variety of applications, each of which is closely related to the unique procedure. For full-color printing, paper-based processes such as LOM and SDL are employed, whereas metal-based sheet lamination is used in hybrid production.

1.7 Vat Photo-polymerization

The most common 3D printing technology is photo-polymerization, which generally refers to the curing of photo-reactive polymers with a laser, light, or ultraviolet light (UV) [14]. It uses a vat of liquid photopolymer resin, out of which the model is fabricated layer by layer. The

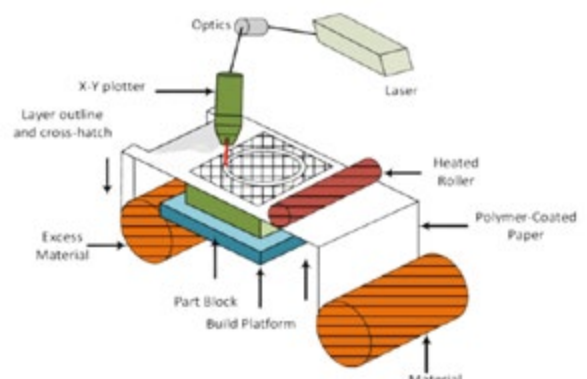


Figure 7. Sheet Lamination Process

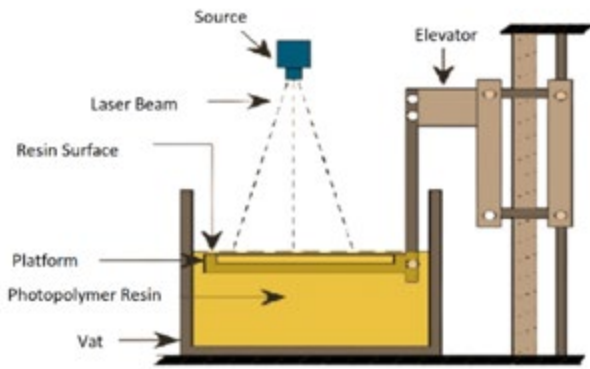


Figure 8. Vat Photo-Polymerization Process

VAT photo-polymerization process uses plastic and polymer materials to construct the model. Vat photopolymerization is classified into three types: stereolithography (SLA), digital light processing (DLP), and continuous digital light processing (CDLP).

A high level of accuracy and a good surface finish are obtained from this method. As a result, they're ideal for jewelry, low-run injection molding prototypes, and a wide range of dental and medical applications. One of the primary restrictions of vat polymerization is the brittleness of the produced fragments.

III. MATERIAL AND APPLICATION

The 3D Printing technology has evolved immensely since its early days. Technology has advanced not only in terms of machines but also in terms of the materials used to manufacture products. This advancement has greatly improved technology [15]. Today, the materials used in 3D printing are quickly growing, and material manufacturers are inventing new types of materials to meet a variety of industrial needs [16]. 3D printing technology can create completely functioning components out of a variety of materials such as ceramic,

metallic, nylon, aluminum, polycarbonate, titanium, and their hybrid composite or functionally graded materials (FGMs) [9]. Early research resulted in the development of a variety of conventional materials such as polymers, metals, and composites, but as more common materials are developed, the list of unconventional materials is constantly expanding. Let's look at some of the materials used in 3D printing, which is mostly employed in aerospace production.

1.1 Metals

Metal 3D printing technology is gaining popularity in the aerospace, automotive, medical, and manufacturing industries due to the benefits it provides [17]. A variety of metals in powder form can be utilized to make components using 3D printing. Titanium, stainless steel, aluminum, copper, cobalt chrome, tungsten, and nickel-based alloys are all available in powdered form for 3D printing to make aerospace components. A titanium-based alloy is suitable for use in 3D printing to make rocket engine components [18]. The other material, stainless steel, provides excellent corrosion resistance, making it perfect for printing pipes, valves, and steam turbine parts.

Furthermore, 3D printing technology can create aircraft parts out of nickel-based alloys. 3D-printed nickel-base alloys can be utilized in hazardous conditions. This is due to its strong corrosion resistance and hot temperature tolerance of up to 1200 °C. These distinct metals have various qualities that make them acceptable for a wide range of uses. For example, Super-alloys based on nickel High-temperature-resistant metals, such as Inconel, may also be 3D printed at temperatures as high as 1100°C. These nickel-based superalloys are also extremely strong and corrosion-resistant, making them perfect for use in the aerospace and energy industries [18]. Furthermore, because of their superior processability, parts may be produced reasonably easily utilizing various 3D printing techniques such as SLM and DED.

1.2 Polymers

3D printing technologies commonly use polymers for the production of components, from prototypes to functional structures with complex geometry in the aerospace field as well as for the biomedical industry. The most common materials used in 3D printing are Acrylonitrile Butadiene Styrene (ABS) and Polylactic Acid (PLA) [19]. Its widespread use may be attributed to its ease of availability, robust features, widespread application in industries, and low cost. The primary benefit is that it is biodegradable. It is also available in a variety of colors and even in clear form. Polymer Matrix Composites (PMCs) are also used to fabricate components in the aviation industry due to the benefits of shorter component manufacturing, rapid turn-around time for complicated parts, and lower cost of production [20].

1.3 Ceramics

Along with the constantly evolving science of ceramics, 3D printing is rapidly expanding the boundaries of what is possible in the future [21]. Ceramics are used in aircraft because they are lighter than metals, allowing for quicker speeds, lower fuel consumption, greater payloads, and longer space missions for exploration vehicles. Oxides, non-oxides, glass-ceramics, and ceramic matrix composites are examples of ceramic-based materials for aerospace applications. For example, silicon carbide composites, alumina, carbides, and borides. These materials provide dimensional stability across a wide temperature range and are tailored for mechanical strength and chemical resistance.

Ceramics are largely used in engine and exhaust systems, thermal protection shields, and structures for ultra-high-speed flying objects in aerospace. Parts of the exhaust system that improve acoustic attenuation and have a long life because of their abrasion and corrosion resistance, as well as lightweight turbine components like vanes, blades, nozzles, and combustion liners, are made of ceramics and ceramic matrix composites that can withstand temperatures as high as 1,600°C.

1.4 Composites

Composites are extremely adaptable, being applied for structural purposes as well as components in all aircraft and spacecraft, from hot air balloons and gliders to passenger jets, fighting planes, cargo, and the Space Shuttle. The Composite materials reduce the weight of components significantly. Carbon fiber-reinforced polymer composites [22] and glass fiber-reinforced polymer composites are two examples of composite

materials. Since 1987, the usage of composites in aircraft has increased every five years, with new composites appearing regularly. The kinds differ in mechanical qualities and are employed in many aspects of aircraft production. Carbon fiber, for example, has a distinct fatigue behavior and is fragile, as Rolls-Royce learned in the 1960s when the revolutionary RB211 jet engine with carbon fiber compressor blades broke catastrophically owing to bird attacks.

Alumide material which is used in the 3D printer is a polyamide mix with a trace of grey aluminum powder. Laser sintering is a process for producing robust and reasonably stiff complex, concept, functional, or series models. Alumide models can also absorb minor shocks and withstand moderate pressure under bending circumstances. It is an excellent material for beginning designers looking for low cost, maximum creative freedom, and increased printing capabilities. Furthermore, it provides better rigidity than polyamide alone and has an aluminum look. The surface is slightly porous and has a sandy, granular look. It can be left in its original grey matte form or dyed with a variety of colours.

1.5 Smart Material

Smart materials are materials that respond to environmental impulses and possess one or more qualities. They might also be referred to as responsive materials. These things can alter shape or behavior when exposed to hot water, pressure, chemicals, light, or heat. Form-memory alloys and shape-memory polymers are examples of group smart materials. Some shape-memory alloys, such as nickel-titanium, can be employed

in biomedical implants and microelectromechanical systems [13]. Transformation temperatures, repeatability of microstructure, and density are critical issues in the fabrication of 3D-printed objects employing nickel-titanium. Combining standard construction materials with smart materials might be an excellent method to produce structures that can quickly expand, self-repair, or adapt to their environment [2]. Airbus SAS is experimenting with a 4D-related "smart" material that reacts to temperature to cool aircraft engines and a wing that morphs according to aerodynamic circumstances to reduce air resistance. Having equipment that automatically adjusts to external conditions might be a huge benefit to a variety of sectors.

IV. THE APPLICATION OF 3D IN AEROSPACE TECHNOLOGY

In general, the aerospace industry was one of the early adopters of 3D printing technology, with early use dating back to the late 1980s. It is still regarded as the industry with the highest rate of adoption of 3D printing technologies today. Many prototype and end-use applications in the aerospace and aviation industries are a perfect choice for 3D printing. 3D printing technology has been used in a wide range of industries and it is also being used to produce car and airplane parts [23]. Many aircraft manufacturers now prefer to 3D-print components and parts rather than build them in contrast to conventional production techniques, 3D printing allows for the quick assembly of parts for both current and future aircraft models. Additionally, it enables engineers to test new materials while fabricating complex

engine components or fixing upcoming airplane components. Engineers can also utilize a 3D printer to create repair parts, sophisticated engine structures, and complex engine components on demand for individual aircraft.

Boeing has been experimenting with 3D printing for a long time. It began using 3D printing for satellite manufacture a few years ago, and in 2019 it built the first 3D-printed metal satellite antenna. NASA is also employing additive printing to further space exploration in a variety of ways, and it is working on many fascinating initiatives with the San Francisco-based start-up Made In Space. There are significant advantages for numerous more commonplace 3D printing applications, such as the manufacturing of jigs and fixtures. Companies have hundreds of fixtures, guides, templates, and gauges 3D created for each specific aircraft, often with 60 to 90 percent cost and lead time savings compared to traditional production techniques [24]. The challenge is increased for complicated designs with undercuts and overhanging features, which are produced by relatively few traditional production techniques [25]. Material Jetting 3D printing can create multicolor patterns with a surface polish equivalent to injection molding. These visually appealing models enable designers to gain a better knowledge of a part's shape and fit before making critical manufacturing decisions. Due to additive manufacturing more is possible because it is a manufacturing method that doesn't limit your creativity. Fast prototyping, rapid iteration design, and a full rethinking of components and assemblies enable you to develop in new ways

and get to something new faster. Engineers typically search for ways to lower fuel consumption and improve energy efficiency by reducing the aircraft's mass while designing and building airplanes. Engineers can use 3D printing technologies to minimize aircraft bulk by experimenting with various lightweight and high-strength materials. Engineers may utilize the correct industrial 3D printer to create lightweight components and parts with low waste. Furthermore, 3D printing technologies allow them to test lightweight materials by generating a range of components on demand.

V. FUTURE SCOPES OF 3D PRINTING TECHNOLOGY IN THE AEROSPACE INDUSTRIES

3D printing of greater size and larger dimension aircraft and space components, which are required for installation and use in compliance with future needs, is crucial. In the future, 3D printing technology will be able to use multiple material alloys to increase strength, reduce weight, and provide better solutions for aviation components. 3D printing at the nanoscale is also conceivable by using various types of nanomaterials to create sophisticated items that can be employed in space programs and aircraft industries. Companies such as SpaceX and NASA are employing 3D printing technology on a global scale to create societies on other worlds such as Mars. Many further advancements in 3DP technology and its applications in the aircraft sector are possible in the future.

VI. CONCLUSION

This comprehensive analysis paper demonstrates how Additive Manufacturing (3D printing) is growing and gaining traction in the aerospace industry. The number of patent applications in the industry surprisingly surged when 3D printing in aerospace improved due to speedier manufacturing methods and easier access to advanced materials. This implies that companies are still discovering new approaches to improve 3D printing in aircraft and will continue to do so in the future. More knowledge of 3D printing technology will assist the industry in upgrading and improving the architecture of 3D printing technology. Thus, the purpose of this analysis is to provide an overview of the many types of 3D printing technologies, the materials used for 3D printing technology in aerospace manufacturing, and finally, the applications of 3D printing technology and future possibilities.

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Privatization of Public Enterprises in Nepal

- Shistata Thapaliya

Privatization refers to the process of transferring ownership and management of state-owned enterprises, industries, and services to the private sector. This movement towards privatization in Nepal began in earnest in the early 1990s, influenced by the global trend of neoliberal economic policies. The initial push for privatization was formalized with the introduction of the Privatization Act in 1994, which provided the legal framework for transferring ownership and management of state-owned enterprises to private entities. The underlying rationale was to enhance the efficiency of public enterprises, many of which were underperforming, and to reduce the fiscal burden on the government. Historically, Nepal's public enterprises (PEs) had been plagued by inefficiencies, mismanagement, and substantial financial losses, making them a drain on national resources. The

push for privatization was also driven by international financial institutions like the International Monetary Fund (IMF) and the World Bank, which advocated for structural adjustments, including privatization, to foster economic liberalization and growth. However, the privatization initiative faced significant challenges, including labor disputes, corruption, political interference, and inadequate regulatory frameworks. These issues often hampered the expected benefits of privatization, leading to mixed outcomes in terms of economic performance and public acceptance. The process remains a contentious and complex aspect of Nepal's economic policy, reflecting broader struggles in balancing state control and market-driven growth.

Bhrikuti Paper and Pulp
Bhrikuti Paper and Pulp Nepal Limited was

established in 1982 with substantial assistance from the Chinese government, aiming to make Nepal self-reliant in paper production. The factory began production in 1986 and was officially

“The privatization case of BPP serves as a cautionary tale, emphasizing the importance of holistic planning and transparent governance in privatization efforts to mitigate risks and maximize long-term socio-economic benefits.”

handed over to the Nepal government in 1987. Initially, it played a pivotal role in the Nepalese paper industry,

fulfilling approximately 35-60% of the country's paper demand and even exporting pulp used for currency production to Japan. In 1992, the government privatized the factory as part of a broader strategy to enhance efficiency and productivity by transferring state responsibilities to the private sector. Despite the privatization efforts, the factory faced severe mismanagement and financial instability, leading to its eventual closure in March 2011. The factory was officially declared completely shut down on January 5, 2013.

The privatization involved selling the mill, including its land and assets, to a consortium of private companies—Golchha Organization, Kabra Group, and Concraft. Initially valued at around 17 crores, the mill was controversially sold for approximately 12.98 crores, a move seen by many as undervaluing a national asset. Bhrikuti Paper and Pulp (BPP) was a cornerstone of Nepal's industrial sector, fulfilling nearly 60% of the nation's paper demand at its peak. The factory utilized domestic raw materials, contributing significantly to the local economy and reducing the need for imports. BPP provided employment to thousands, supporting local families and fostering regional socio-economic development. However, the factory struggled with outdated machinery, financial mismanagement, and inefficiencies in production processes.

Post-privatization, BPP experienced a brief period of improved performance. The new management invested in modernizing the factory, upgrading machinery, and implementing more efficient production processes. Production capacity initially increased, and the factory regained some market share. Technological advancements,



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such as the switch from coal to rice husks for energy, were implemented to reduce costs and improve environmental sustainability. However, these improvements were short-lived. Financial mismanagement and operational challenges soon resurfaced, leading to a decline in production and market share. The factory faced stiff competition from imported paper products, leading to financial instability and eventual decline.

The privatization of Bhrikuti Paper and Pulp initially promised improvements in production capacity and efficiency, accompanied by technological upgrades and workforce expansion. These developments hinted at potential economic revitalization for the enterprise and its surrounding community. However, the short-lived gains soon gave way to significant challenges. Mismanagement of finances and insufficient reinvestment in operations undermined the initial successes. Operational inefficiencies, exacerbated by external factors like labor disputes and resource shortages, further eroded the factory's viability. The eventual closure of BPP not only led to substantial job losses but also triggered economic downturns in the local economy. The closure highlighted the critical need for effective management, strategic foresight, and robust regulatory oversight in privatization initiatives to ensure sustainable socio-economic benefits.

While the privatization initially sparked optimism with increased production and employment opportunities, the subsequent decline of Bhrikuti Paper and Pulp underscored the complexities and risks involved. The adverse impacts included severe economic hardship for workers and their families,

environmental degradation due to neglected infrastructure, and broader economic repercussions for local businesses. This case serves as a cautionary tale, emphasizing the importance of holistic planning and transparent governance in privatization efforts to mitigate risks and maximize long-term socio-economic benefits.

The closure of Bhrikuti Paper and Pulp Ltd. can be traced to a complex interplay of multiple detrimental factors that severely undermined its operational viability. From its inception, the enterprise grappled with pervasive political interference, characterized by frequent government changes and appointments driven more by political affiliations than merit. This instability fostered an environment of mismanagement and operational inefficiencies, hindering long-term strategic planning and investment. Financial mismanagement compounded these challenges, resulting in significant debt accumulation and the misallocation of crucial funds. Despite attempts at privatization, the process lacked transparency and effective oversight, failing to address the entrenched issues plaguing the company. The transition to private management under Golchha Organization was fraught with inherited debts, operational inefficiencies, and difficulties in securing essential working capital. Internal strife, including labor disputes and union issues stemming from unpaid wages and poor working conditions, further destabilized production. Externally, BPP struggled against market pressures, including stiff competition from cheaper imports and adverse economic conditions. Moreover, infrastructural deficiencies and supply chain disruptions, such as shortages of raw materials and logistical challenges,

compounded the factory's woes. Ultimately, the cumulative impact of political interference, financial mismanagement, ineffective privatization, labor unrest, market competition, and infrastructural deficiencies culminated in the inevitable closure and decline of BPP, marking the end of an era for the once-promising enterprise.

As of 2024, Bhrikuti Paper and Pulp (BPP) in Gaindakot-2, Nawalpur epitomize a poignant tale of industrial decline and socio-economic distress. Once a cornerstone of Nepal's paper manufacturing industry, BPP now lies abandoned and dilapidated. The factory grounds, once bustling with activity, are now overrun with weeds, while the buildings stand as reminders of neglect with collapsed roofs, crumbled walls, and rusted, unusable machinery. With only 15 security guards left to watch over the vast site, the contrast to its former bustling workforce is stark. Financially crippled by substantial debts to major banks like Nepal Bank Limited, Rastriya Banijya Bank, and Himalayan Bank, BPP faces insurmountable operational challenges, exacerbated by unpaid wages owed to its former employees, many of whom are still grappling with financial uncertainty after the abrupt closure that stripped away their livelihoods. The closure has dealt a severe blow to the local economy, which relied heavily on BPP for jobs and economic stability, causing ripple effects felt by surrounding businesses and suppliers. Despite intermittent governmental efforts and assurances, concrete strategies for revitalizing or repurposing the mill have failed to materialize, prolonging uncertainty about its future and leaving the local community in a prolonged state of limbo. The absence of definitive plans has underscored the challenges

in navigating the complex aftermath of industrial closure, highlighting ongoing struggles to restore economic activity and stability to a once-vital industrial site. BPP's fate stands as a stark reminder of the intricate challenges and socio-economic ramifications of industrial privatization, showcasing the enduring struggle to rejuvenate once-thriving industrial assets in the aftermath of closure.

To ensure the successful privatization of public enterprises in Nepal, it is crucial to adopt a balanced and strategic approach that includes robust regulatory frameworks, effective management practices, and stakeholder engagement. Privatization should be based on a planned strategy with a long-term vision, strong commitment, and dedication from privatized entities. Alternatives to outright privatization could include selling shares, encouraging public-private partnerships, and maintaining government ownership of major portions. Regular auditing, timely reporting, and creating policies that incentivize private sector participation, ensuring mutual market competition, and creating an investment-friendly environment are also necessary to achieve the best outcomes from privatization. The Government of Nepal should prioritize thoughtful consideration over haste in pursuing privatization and should aim for harnessing the economic benefits of privatization while safeguarding public interests and fostering sustainable growth.

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Damodar Bhandari

Minister for Industry, Commerce and Supplies
Government of Nepal



Addressing the challenge requires a multifaceted approach to create more job opportunities within the industrial sector



Congratulations on your appointment as the Minister of Industry, Commerce, and Supplies. How does it feel to lead the ministry, and what are your insights and observations over these past months?

Thank you. It is an honor and a privilege to assume the responsibility of serving through the policymaking realm in the domain of industry, commerce, and supplies. Over the past few months, I have believed that this sector is paramount for the nation's journey toward prosperity and the overall well-being of its populace.

Since the outset of my tenure, our ministerial team has been diligently engaged. We have meticulously crafted our action plan, encompassing all departments, divisions, and sections. Key policies such as the Start-Up Innovation Policy and SMEs Policy have been approved and are presently undergoing implementation. Additionally, our significant contribution to legal reforms is evident, with the government of Nepal having already amended eight different Acts and legal provisions considering the recent Investment Summit. Thus, our focus extends beyond policy formulation to actively supporting domestic and foreign investors during the implementation phase.

What plans and policies does the ministry have for the industrial development of the country? What opportunities and hurdles do you foresee in this direction?

Turning to the opportunities at hand, it's worth noting that the Ministry of Industry is not alone in its endeavors. The Prime Minister and cabinet have directed their attention toward entrepreneurship, industrial development, and employment. Securing one billion funds for Interest-Subsidized Start-Up loans for newly established businesses represents a notable achievement. Furthermore, efforts are underway to revise and enact new industrial and trade policies. These developments underscore the effectiveness of our motivated and energized joint team of political and bureaucratic stakeholders, successfully advancing annual objectives through various feasible programs this year.

However, it's important to acknowledge the challenges we face. The decrease in our budget ceiling for this fiscal year has resulted in resource scarcity. Moreover, stakeholder collaboration poses difficulties during the preparation and approval of directives, working policies, and procedures.

Nepal is in its 16th periodic plan with the vision of "Good Governance, Social Justice, and Prosperity." How does your ministry plan to synchronize its policies and actions with the goals outlined in the 16th Periodic Plan?

To align with the overarching vision of "Good Governance, Social Justice, and Prosperity" outlined in Nepal's 16th periodic plan, our ministry is strategically integrating its policies and actions. We focus on several key areas to ensure synchronization including policy alignment, program implementation, and stakeholder engagement.

We are reviewing and revising existing policies to ensure they align with the goals of good governance, social justice, and prosperity. This involves assessing the impact of our policies on various segments of society and making necessary adjustments to promote inclusivity and fairness.

Our ministry is actively implementing programs that directly contribute to the objectives of the 16th periodic plan. This includes initiatives aimed at promoting economic growth, reducing poverty, and improving access to essential services, among others.

We recognize the importance of engaging stakeholders at all levels to achieve the goals outlined in the periodic plan. This involves consulting with civil society organizations, private sector entities, and marginalized communities to ensure their voices are heard and their needs are addressed in our policies and programs.

Overall, our ministry is fully committed to aligning its policies and actions with the vision of "Good Governance, Social Justice, and Prosperity" outlined in Nepal's 16th periodic plan. Through strategic planning, implementation, and monitoring, we aim to contribute significantly to these goals to benefit all Nepali citizens.

With the rapid development of technology and the advent of Industry 4.0, what preparations is the ministry making to keep pace with global advancements?

This year, we have proposed a support program and budget for Industry 4.0. We will collaborate with private sector agencies such as FNCCI, CNI, NCC, and FNCSI to streamline global advancements in our industrial developments. Our data shows IT exports of around 60 billion this year, highlighting the potential of ICT development as a key industry in Nepal. To further this progress, we have introduced collaborations for advancements in intellectual property protection and promotion, including an MOU with the US Patent and Trademark Office.

In various other areas, we are implementing advanced technological means and methods across the industry sectors.

Are there any plans to revive dormant government-held industries during your tenure to contribute to the country's economic development?

Yes, there are plans to revive sick public enterprises during our tenure. We recognize the significant potential these industries must contribute to the country's economic development. By leveraging modern technologies and implementing strategic partnerships with private sector agencies, we aim to rejuvenate these industries, making them competitive and sustainable. This initiative is part of our broader strategy to boost industrial growth, create jobs, and enhance the overall economic landscape of Nepal.

What should the role of educational institutions be for them to contribute effectively to the vision of the 16th Plan?

Educational institutions play a crucial role in human capital development, and the upcoming 16th Plan aligns with this objective. To achieve this broader goal, institutions should focus on curriculum alignment, research and innovation, skill development, and promoting entrepreneurship.

Updating the curriculum to include skills and knowledge relevant to Industry 4.0 and other emerging sectors is essential to ensure graduates are well-prepared for the evolving job market. Encouraging research and development activities

that address local challenges and promote innovation is also crucial. Institutions should foster partnerships with industries to create practical solutions and technological advancements. Additionally, offering specialized training programs and vocational courses will equip students with the technical skills needed for high-demand industries, ICT, engineering, and advanced manufacturing. Promoting entrepreneurship through incubation centers and providing resources and support for startups will help cultivate a culture of innovation and business creation.

By focusing on these areas, educational institutions can significantly contribute to the vision of the 16th Plan and support the overall development of Nepal.

What are your expectations from organizations such as SOIES Nepal to help achieve the ministry's visions and targets?

Organizations like SOIES can collaborate with the ministry on studies and research relevant to the industrial sectors. They can provide valuable policy input during the drafting of new policies, as we are currently in the process of revising our industrial and trade policies.

We can also establish partnerships for providing support or funding to academia, provided these proposals are made at the appropriate time. Engaging in debates and interactions with industrial engineers is crucial for retaining quality engineers in Nepal, which will have a direct and positive impact on the country's industrial development.

As the Minister of the relevant sector, do you agree that Nepal faces significant unemployment, particularly among the youth? How do you envision creating more job opportunities within the industrial sector? What initiatives are being undertaken to promote skill development and vocational training to meet industry demands? Furthermore, what strategies can Nepal implement to foster a business-friendly ecosystem that attracts entrepreneurs, startups, and investors?

Nepal faces significant unemployment, particularly among the youth. Addressing this challenge requires a multifaceted approach to create more job opportunities within the industrial sector.

To create more job opportunities, we will focus on revitalizing dormant government-held industries and encouraging private-sector investments.

We are undertaking several initiatives to promote skill development and vocational training to meet industry demands. In addition, to foster a business-friendly ecosystem that attracts entrepreneurs, startups, and investors, we are implementing major policy reforms.

Is there anything you would like to convey to our team and industrial engineers?

We are committed to working with all stakeholders in preparing policies, plans, and programs. We welcome policy input and are eager to collaborate on program implementation.

Thapathali Campus has a faculty of industrial engineering, which is an asset. Developed countries have a long history of producing industrial engineers, and this is fundamental for any developing country striving to become prosperous. Therefore, I extend my hand in collaboration on research, development, and policy formulation to achieve our shared goals.

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ENERGY MANAGEMENT FOR SUSTAINABLE INDUSTRIALIZATION

-Saurav Khadka

Introduction

Have you ever thought about how valuable is a Single drop of Oil? To regard its worth, Oil Leakage at one drop every second means a loss of over 2000 liters in a year. Considering the market price of Cooking oil, the loss is worth more than 10 lakh Nepalese rupees in a year.

The wastage and misuse of energy from small household to big Industries have become common issues in the present time. There are large varieties of Energy available but the lack of core management and understanding of Energy Management has resulted in the haphazard exploitation of energy.

Energy management can be termed the backbone of Global Industrialization with effective Sustainable goals. It is the foundation of saving energy at the industrial and Organizational levels and is the most important aspect of Sustainable industrialization.

Energy Management(EM) is simply the effectual use of energy to maximize profit and minimize cost and waste. Energy management is the proper study, planning, and operation of Energy production and Energy Consumption units followed by distribution and Storage. It simply is the process of monitoring, controlling, and preserving energy in an industry and organization. Energy Management equally focuses on minimizing Environmental effects and promoting Sustainability. EM helps to reduce requirements per unit of output in industry and improve energy efficiency and productivity.

Why Energy Management?

Energy management is Vital for Environmental welfare, national security, Economic Productivity

Energy management is core for Cost saving and is Cost effective. By the proper monitoring of Energy consumption, Industries

can effectively reduce consumption and save money. With the growing demand and decreasing supply of Non-Renewable Energy, the cost of energy is increasing rapidly. EM deals with the most effective management of cost and focuses on Renewable energy.



The development of use and proper management of renewable energy sources can help to create jobs and stimulate energy growth, thus contributing to sustainable industrialization.



The proper Management of Energy reduces Carbon emissions and improves environmental quality. The primary culprit of every

industry is Carbon dioxide which greatly affects in Environment.

2.27 pounds of CO₂ is produced for every pound of Methane combusted. So EM reduces the Consumption of Methane. Less Energy Consumption leads to less thermal energy and less use of petroleum products leads to less On-site pollution.

Energy management is a crucial aspect of sustainable industrialization. Sustainable Industrialization refers to a process of industrial development that meets the needs of the present without compromising the ability of future generations to meet their own need. One of the major ways of Energy management that helps in sustainable industrialization is energy efficiency. The development of use and proper management of renewable energy sources can help to create jobs and stimulate energy growth, thus contributing to sustainable industrialization. Effective Utilization of Unused Renewable energy such as hydropower, solar energy, and Wind energy. Developing countries become independent, Growth in GDP, and Employment opportunities.

A Process on Energy Management:

To effectively manage energy, organizations need to have a clear understanding of their energy consumption and the associated costs

1. Energy Assessment:

We need to find out the current condition of energy Consumption, wastage, and availability of Energy. Industrial organizations can engage in energy audits and assessments to identify areas where energy is being misused or wasted. These Assessments can help organizations identify various opportunities for



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energy savings and help prioritize their efforts toward the most effective measures. An Energy Audit is the Depth and Proper Study to determine the utilization of energy and Conversion from one form to another. Global Manufacturing production grew by 7.2% in 2021, surpassing its pre-pandemic level which eventually led to growth in Energy consumption on different scales, if the same ratio continues, a lack of proper assessment will lead to major energy haphazardness.

2. Goal setting and proper planning:

By highlighting the aim of Production, Suitable and Measurable goals should be set to reduce energy consumption and increase efficiency. A sustainable way of setting goals will lead to proper management of energy. There must be proper skill development courses and industries need to educate employees on the importance of energy management and involve them in the process.

3. Proper Implementation and Management:

Identifying the Situation of Energy Consumption and limiting all the obstacles to proper utilization of energy through a Suitable plan, must be implemented carefully with the appropriate monitoring. There must be the recruitment of Capable and suitable manpower in every field. Proper Machines should be used and operated properly. Important management includes

- Facility management: It is the Organizational Function that integrates people and processes within the built environment to improve sustainability, efficiency, safety, and productivity. There

must be proper Facility Management.

- Logistics: Logistics is the management of the flow of resources from one point to another. I.e. transportation of goods. Proper Logistics tasks can help in the management of costs and protect the environment through proper Energy Management. Major Logistics tasks include
- Duration of transportation: Green Logistics including eco-friendly transport carriers is necessary.
- Energy Procurement: It simply refers to acquiring Energy. Poor Energy Procurement decisions can be a great loss for the Organization. Industries and Organizations can reduce the cost and effectively utilize the budget with the proper and efficient approach to buying energy. And the buying of Eco-friendly Energy can be beneficial to the environment.
- Production Planning and Control: production is the area with the largest energy consumption. So proper study and, Operational planning, control, and management of all the processes is necessary for the production in every industry and Organization

4. Regular Evaluation and continuous improvement

There must be proper management and Monitoring of the process involved and energy consumed and daily reports should be maintained to highlight improvements. The evaluation of equipment, machines, and manpower

must be done properly. Every flaw obtained while carrying out the process must be corrected instantly and every improvement possible must be operated under the guidelines of the Goals and regulations.

There must be suitable and long-term Energy Management Strategies prepared by every local to multinational Company and be included in the plans of Governments all over the globe.

Energy management and sustainable industrialization are connected through the importance of cooperation and collaboration between different stakeholders including businesses, industries, governments, and individuals.

Many Manufacturing industries like General Motors, Volkswagen, and many more have been preparing strategies highlighting Climate Change.

The Strategy of General Motors (GM) is based on continuous improvement having principles including restoring and preserving the environment, reducing waste, and educating the public about Environmental Conservation.

There are many Governments all around the globe which focus on promoting Renewable Energy. The Most Famous Strategy includes the strategy of the Swiss Federal Council which decided to shut down all the nuclear power plants at the end of life and not be replaced. So, every small and major act and action by small households to big multinational Companies in Energy management promotes the best utilization of energy and overall environmental conservation. Eventually, proper

functioning of Energy management will result in the reduction of cost and an increase in profit in every industry and organization, a large-scale reduction in CO₂ emission helps to protect the environment and pursue a sustainable way of running industries from everyday to day activities, norms, and machinery applications. This will lead to local awareness of energy issues with the proper supply of energy in every household to big industries. And eventually, lead to sustainable ways of development in every sector.

Hence, for a sustainable future, the proper management of Energy is mandatory. By implementing energy-efficient technologies and practices, using renewable energy sources with effective energy management systems, and conducting energy audits, industries and organizations can significantly reduce their energy consumption and minimize their impact on the environment. It simply is understanding the worth of a single drop of oil and moving forward effectively for the best utilization of every energy possible. With the great development and advancement of every sector across the world, and leading towards a more globalized community with innovative industrialization, energy management will become the backbone of Sustainable Industrialization and a Sustainable Future.

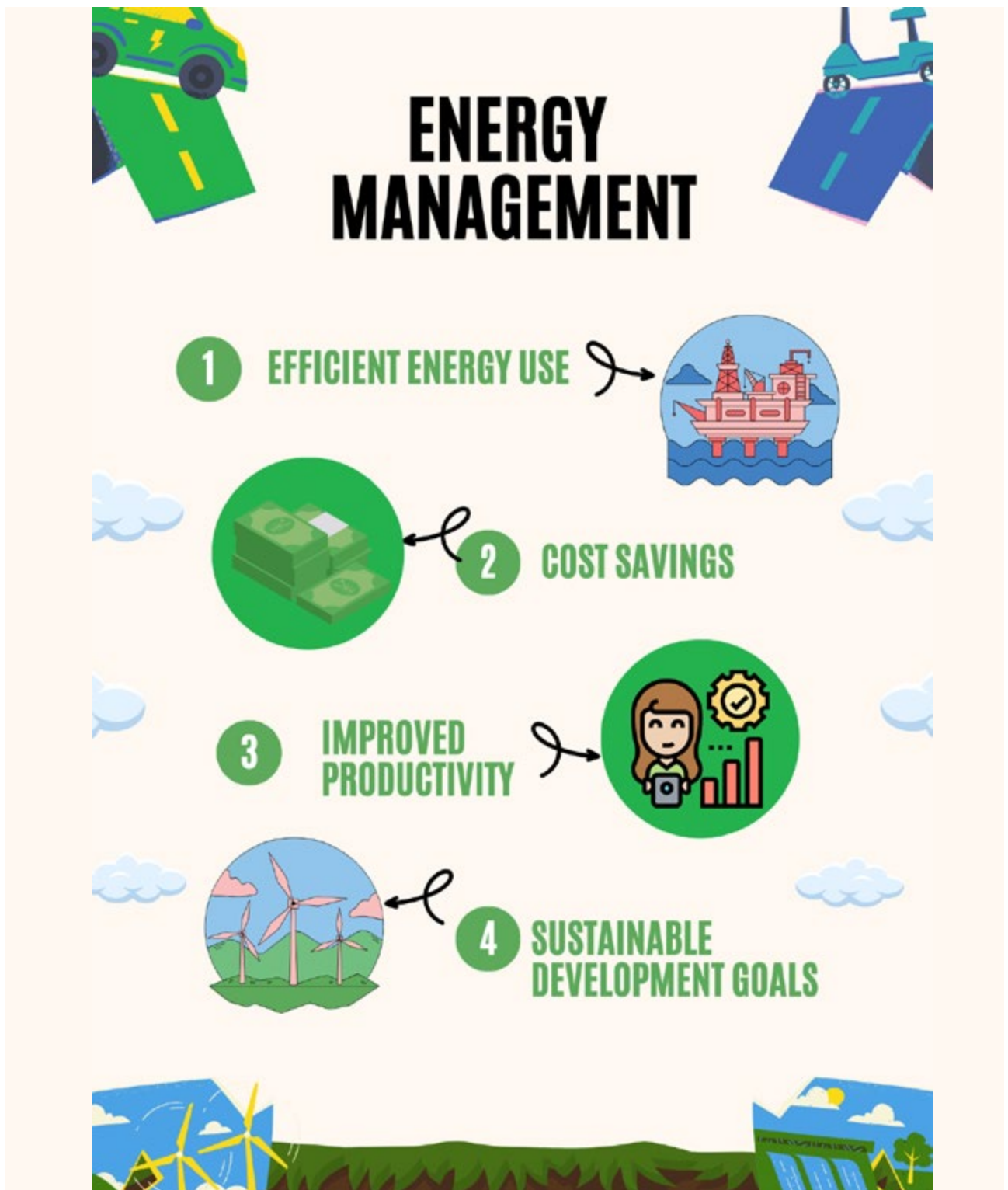
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<https://eaguk.org/energy-services/energy-management/>

<https://www.en-trak.com/resources/what-is-energy-management-how-can-you-use-it/>





Dr. PRANAY SHRESTHA

Postdoctoral Fellow in Clean Energy | University of Oxford

winner of several honors including, Vanier Canada Graduate Scholarship and the Gold Medal of the Canadian Society of Mechanical Engineering

“

I have focused on the concept of heterogeneity which is a major factor affecting the performance of a fuel cell.

”

About Pranay Shrestha

I was born in Germany and brought up in Nepal. I studied at St. Xavier's Jawalakhel till grade eight. After that, I went to a boarding school in Mussoorie, India. Professionally, my interest has always inclined towards Science and Math and that was my driving force for pursuing engineering. I did my undergrad at the University of Victoria, Canada. They had a co-op program every four months, we used to alternate between courses and studies. During that time I joined internship programs and research activities. One of my internships was in a fuel cell company and there I was introduced to electrochemistry and electrochemical devices that covered batteries and fuel cells. It included the mechanical side, chemistry, and electrical and to scale it up you need the industrial side so I found it quite fascinating and that's what I have been following until now. During my master's and PhDs, I worked in electrochemical devices, and now as a postdoc at Oxford, I'm continuing the same. My field has shifted from fuel cells to batteries, similarly, my interest has shifted from mechanical engineering to fuel cells, that's what I like about electrochemistry; there's so much expertise that you need and you can switch between fields and it's good to know more and that's what keeps my interest alive.

Can you provide a brief overview of your current role as a Postdoctoral Research Fellow at the Faraday Institution at the University of Oxford and the specific focus on your ongoing projects?

The project I'm involved with in Oxford is called SolBate. My team is working towards solid-state batteries. It's not commercialized but we believe it to be the next generation of batteries. Most commercial batteries have a liquid component called electrolyte which is mostly used to transport lithium ions. The liquid electrolyte does work but has problems regarding safety, toxicity, etc. Also, liquid electrolyte batteries are hitting the ceiling currently, which is the theoretical limit to how good they can be in terms of let's say, energy density, but solid-state batteries promise to have higher energy density and have a high regard for safety.

One of the big ones that I'm looking at is degradation. These batteries degrade quicker than the currently available commercial ones. If you want to put it in a car, for example, it

will not work because you will have to charge and discharge it quite a few times for it to be feasible. So we're trying to look into "why" that happens. At this point, the focus is on what is fundamentally wrong with the battery and how we can make it better.

How do you envision your work contributing to the broader goals of achieving clean energy solutions, and what impact do you believe your findings could have on the transition to a cleaner and more sustainable energy landscape?

Sustainable energy is a big task for all of humankind right now. My current focus is on characterizing these electrochemical devices in realistic environments. I want to understand how they work on a microscopic scale. My work includes developing tools to look inside the fuel cell or the battery while it's running to observe processes that occur in real time. The reason I focused on characterization is because that gives us a lens into that device and we can figure out how it works. If we can figure out how it works in realistic environments then we can have a better chance of finding out why they fail and try to design them in a more rational way rather than a random trial and error process. I would say my contribution right now is still like a drop in the ocean but I try to focus on trying to understand. Once we can understand, we can have a ripple effect.

Can you provide insights into the importance of your research in unraveling degradation mechanisms within fuel cells and how your findings contribute to the advancement of next-generation fuel cell designs?

I have focused on the concept of heterogeneity which is a major factor affecting the performance of a fuel cell. Heterogeneity exists in fuel cells because of the components and the way it is set up. The current manufacturing processes, assembly processes, and operating processes inherently lead to heterogeneity in fuel cells. In my Ph.D., I tried to characterize this heterogeneity and develop tools to do it. I'm trying to see more clearly how heterogeneous the fuel cell is and how that impacts the performance. More importantly, once we know that we can look into how we can fine-tune this heterogeneity. So instead of it being present because of the way the cells are, we want to see if we can engineer that heterogeneity and if we can fine-tune it more rationally to our advantage. That's something I would like to focus on more as I continue. It is to leverage heterogeneity to our advantage.

Looking ahead, what are your aspirations in sustainable energy innovation, and how do you see your work contributing to broader environmental and community sustainability?

In terms of sustainability and especially energy sustainability, there is a big shift going on. There is a huge shift towards sustainable energy practices and sustainable energy technologies and I think there is a lot of work to be done. We need the government, policymakers, businessmen, and marketing experts. We need these people to be on the side and say “Okay, let’s try to fix this problem, let’s try to accelerate this transition to sustainability”. I believe there is a lot of work to be done and as I said before, what I’m doing is just a drop in the Ocean. Even though it’s a drop I hope that if you do good work, even if it’s a small contribution, it might ripple on to more effects. Let’s say if I’m able to characterize something better and have a better understanding, hopefully, that leads to better design and things that are beyond just my effort but then, I think it is a complex problem and we need more people working together. At this scale, it’s less about the individual and more about “How do we work together to solve this problem?”

I aspire to keep doing this work and collaborate with people and get them together to solve this problem because, again, no individual can solve the problem on their own. We need everyone.

Can you elaborate on how your work, particularly in fields of sustainable energy, aims to positively impact developing countries, such as Nepal, and contribute to addressing energy challenges and fostering sustainable development in those regions?

I think developing countries have immense opportunities to adopt sustainable technology as a development strategy, rather than as an afterthought because these sustainable technologies are developing almost alongside developing countries. Some of these technologies are mature enough to be adopted, and some of these technologies are cost-competitive or nearly cost-competitive sufficient that they can be adopted on a country-wide scale. And I think that is where a lot of times, say, education or support from the government or even just initiatives of people play a big role because a lot of things can be changed during this transition phase.

For example, in fuel cells, we have lots of talk about green hydrogen, a lot of countries are pushing green hydrogen, developing their waste-produced green hydrogen; if Nepal incorporates that in their development strategy and they have a big production capacity of green hydrogen within the next ten years; Within the next ten years the demand for green hydrogen will grow and if Nepal has an advantage in that strategy already then when the time comes they can scale up even more or they can provide green hydrogen for the economic benefit of the country. So, I think there’s almost no doubt that we are transitioning into sustainability, it is better to be a step ahead and try to incorporate that in the planning itself rather than afterward.

Could you kindly share the pivotal moment when you decided to pursue Industrial Engineering? Additionally, what were your initial expectations upon joining the course, and did your experience align with those expectations?

After completing high school, I decided to take industrial engineering, it had practical implementation and satisfied my liking for science and math a lot. A few things aligned with my expectations, and a few were surprises. For example, growing up I used to say “I aspire to be a scientist” but I never really knew how to get there once I did engineering, I took some research projects and some courses, and I started to get a better idea and I think engineering is still a key foundation as I do more research. Engineering has been a practical foundation so I’m glad I chose Engineering. I didn’t know what to expect but I just went in because I liked a few things. I’m glad that I did it.

With your academic background encompassing both a Master’s and Ph.D. in Mechanical and Industrial Engineering, how do you see the principles of industrial engineering playing a role in your research, and how has this interdisciplinary approach influenced the outcomes of your projects?

Even in research, Engineering is still at the core. I was drawn to science from the beginning but once I was trained in engineering, it has helped a lot. When I approach problems, I try to approach them in a more practical way which helps. Even now, when I’m approaching some fundamental questions about, let’s say, why a battery fails in a certain way, I still have Engineering at my core. When I’m designing setups for experiments, what I need to do is design miniature cells that replicate large-scale environments. In that, I bring in a lot of engineering concepts of pressure, and temperature and how to precisely maintain them. Just general design concepts in engineering have helped quite a bit. I would not be able to answer a lot of these fundamental questions if I could not design my experiments properly. So engineering is essential to my scientific career.

Exploring the potential of industrial engineering in the Nepalese context, do you believe there is a need for heightened awareness and education about this field among students, professionals, and the general public, considering its significant prospects and benefits on a global scale?

I agree. I think awareness is the key, if students who are about to choose what they want to do are not aware of engineering and its possible benefits, they won’t choose engineering. And also, engineering can be foundational to a lot of different things. Even if you were to go into policy-making or government, engineering can be quite a foundational platform because it’s a way of thinking. I think awareness is the first step. the first step.

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PROJECT RETROSPECT



The Bamboo Slicing Machine

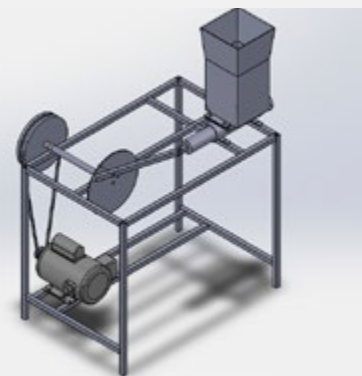
The Bamboo Slicing Machine project introduces an automated solution to the slow and imprecise manual process of bamboo slicing, significantly enhancing efficiency and accuracy in bamboo processing. Capable of accommodating various sizes and types of bamboo, the machine features adjustable rollers for precise control over slice thickness. Operating akin to a sugarcane juice making machine, it utilizes a pulley system and motor to drive bamboo pieces through sharp-edged blades, resulting in uniform and precise bamboo strips. With a daily production capacity of 160 kg of slices and an operating cost of Rs.1571, the machine surpasses manual methods in productivity and cost-effectiveness. Powered by a 1HP single-phase electric motor at 600 rpm, it efficiently produces thin bamboo strips while offering adaptability through adjustable slides for varying strip shapes and sizes. In summary, the Bamboo Slicing Machine offers a financially sound and efficient

solution for bamboo processing, promising significant improvements in productivity and quality compared to traditional manual methods.

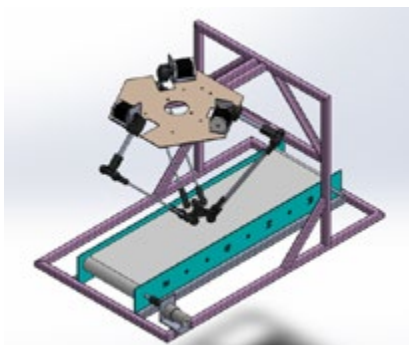
Team members: Bir Bahadur Tamang, Dil Bahadur Kunwar, Laxman Amgai, Rupesh Budha, Ujjwal Pathak

Can-Crusher Machine

Generally, empty beverage cans thrown in trash are to be crushed in order to reduce the space they consume within a container of trash. Crushing can be done using our feet as well but when it comes to crushing hundreds of cans within a certain time, the work becomes a burden. With the mindset of reducing the amount of force required to crush cans and to hopefully automate the process, the can-crusher machine was designed. The machine follows the slider-crank mechanism which is a principle that governs the conversion of rotational motion into linear motion. It consists of a motor (0.75Hp) and is driven by a pair of pulleys. Based on the slider-crank mechanism, the machine is able to convert rotary motion from the pulley system into linear (back-and-forth) motion. The linear motion aids in the motion of a piston - that is responsible to crush cans - along a hollow cylinder, called the guide. Cans are fed through the feeder/hopper which is fabricated with a series of obstructions on the inside so as to make empty cans fall horizontally onto a cavity in the guide. The crushed cans fall off the guide through another cavity.



Team member: Dipesh Dahal, Nabin Poudel, Oliver Tamrakar, Prajita Ghimire, Ramesh Panth

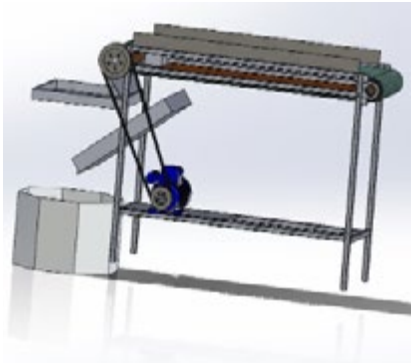


A camera equipped delta robot for advanced tomatoes grading in conveyor system

The 'Delta Robot' project introduces a novel parallel arm structure for unparalleled precision in pick-and-place tasks, particularly in tomato sorting. It integrates high-tech camera sensors and a suction gripper to achieve seamless object identification and sorting on conveyor systems. Advanced computer vision and deep learning algorithms enable real-time tracking and grading of tomatoes based on predefined criteria. Synchronized parallel arm movements and high-resolution camera sensors ensure swift and accurate sorting. An Arduino-based electronic control system orchestrates the operation, seamlessly synchronizing sensors, gripper, and conveyor for cohesive functionality. The user-friendly Graphical User Interface (GUI) empowers operators to make real-time adjustments for optimized

performance. Beyond Nepal's tomato industry, this innovation promises enhanced sorting accuracy, distribution efficiency, waste reduction, and quality control. It sets a precedent for broader industrial applications, showcasing the potential of sensor-integrated robotics to revolutionize global manufacturing, packaging, and logistics.

Team members: Bishal Adhikari, Gokarna Budhathoki, Madan Shrestha, Madhav Bhandari, Nabin Dhungel



Eddy current separator

The core functionality of the ECS lies in its ability to sort non-ferrous metals, such as aluminum and copper, from a stream of waste material. This not only streamlines the recycling process but also significantly reduces the amount of waste sent to landfills.

The working principle of the ECS is based on the interaction between magnetic fields and conductive materials which is given by Faraday's law of Em induction and Lenz Law. The repelling force is produced as Lorentz Force. As the waste material passes over the ECS's conveyor belt, a high-speed rotating magnetic rotor generates eddy currents in the non-ferrous metal components. These currents produce a magnetic field opposite to the original field, exerting a force that repels the non-ferrous metals away from the rest of the material. This separation process

is highly efficient and operates without direct contact, minimizing wear and tear on the machine. Environmentally, it contributes to sustainable waste management by enabling more effective recycling of metals. Economically, it offers the recycling industry a cost-effective solution to recover valuable materials. Moreover, the ECS we've developed is designed to be user-friendly, ensuring that it can be easily integrated into existing waste management system.

Team Members: Abhishek Wasti, Grishma Bhandari, Prajit Adhikari, Rush Pradhan, Santosh Pd. Rimal

AUTOMATION OF HANDLOOM MACHINE

The project aims to automate handloom weaving by integrating science and technology, particularly through the use of motors, actuators, and Arduino programming. By experimenting with four heddles in a single row instead of one, the project seeks to produce patterned fabrics efficiently. The system automates tasks such as reed movement, heddle control, and shuttle propulsion, reducing physical and time demands for weavers. The primary goal is to enhance productivity in manual handlooms, leading to faster weaving, lower labor costs, and improved usability. A servo motor drives heddle motion, controlled by Arduino code. Four sets of heddles move in opposition to create patterned fabrics. Shuttle pickers slide and beat the shuttle, compressing the weft across the warp. A linkage mechanism connects the reed frame to ratchet gears, facilitating the rolling of the cloth beam. The project combines various fields of study to innovate in handloom weaving automation, reflecting not only on discoveries but also on exploration and innovation processes. Overall, the project represents a significant step towards revolutionizing the handloom industry through automation and technological integration.



Team members: Roshan Dani, Sadikshya Gautam, Samarpan Silwal, Santosh Pokharel, Susil Bhattarai



Automatic Sanitary Pad Dispensing Machin

The Automatic Sanitary Pad Dispensing Machine project aims to address menstrual hygiene challenges by developing an efficient and cost-effective solution. Through iterative design phases, it integrates a three-bar mechanism, servo motor, ultrasonic sensor, and Arduino microcontroller to facilitate touchless and efficient dispensing. Emphasizing user-friendly interfaces, the machine undergoes rigorous testing to ensure accuracy, hygiene, and reliability. The objectives include enhancing the capacity-to-cost ratio of existing machines and addressing menstrual hygiene resource inadequacies. The chosen design incorporates a three-bar mechanism for simplicity, cost-effectiveness, and maintenance ease. Key components comprise servo motor, ultrasonic sensor, Arduino microcontroller, inner box, guide channel, clamp mechanism, hinge

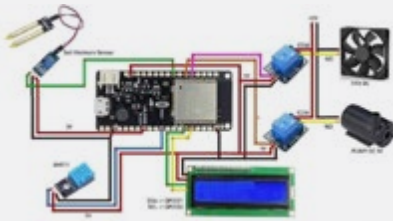
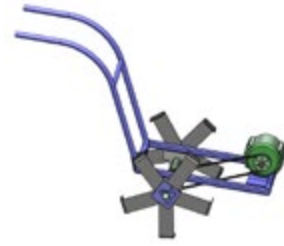
mechanism for refilling, LCD screen, and a metal frame for structural support. The machine operates through dispensing and return processes, ensuring a seamless user experience.

Team members: Avinash Gauli, Girbana Gyawali, Rojit Shrestha, Ronish Phuyal, Sezal Gaire

Sharp Cultivator Tiller Machine

The Sharp Cultivator Tiller Machine boasts a wheel design engineered for superior soil gripping, facilitating efficient tilling. Powered by an electric motor via direct electricity, it eliminates the need for batteries. With four cultivator forks, it ensures precise and effortless tilling, catering to farming needs. Its lightweight, portable construction enables easy maneuverability and control. Operational simplicity and low maintenance make it an attractive option for agricultural tasks. The machine's functionality relies on the motor's power, transmitted via a belt drive system to the tiller wheels. A meticulously crafted supporting frame maintains constant voltage output, enhancing stability during operation. Incorporating a regulator and sensor mechanism ensures energy efficiency, with the sensor preventing excess energy consumption. Overall, its benefits include adjustable tines, efficient soil breaking capabilities, user-friendly operation, and minimal maintenance requirements, offering a smart, fuel-free solution for farm and garden tilling needs.

Team members: Aaradhana Shree, Ankita Bhujel, Manisha Pradhan, Samikshya Tamang



Greenhouse Monitoring and Control System using IoT.

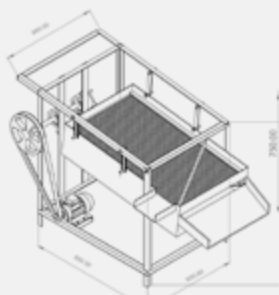
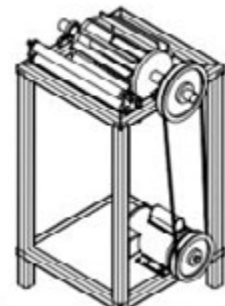
The project titled "Greenhouse Monitoring and Control System using IoT" aims to efficiently manage soil moisture and automate the watering process within a greenhouse environment, ensuring optimal conditions for plant growth. The system incorporates soil moisture sensors to detect moisture levels in the soil. When the moisture level falls below a predefined threshold (set at 40%), the system automatically initiates the watering process until the moisture level reaches the threshold. Once the desired moisture level is attained, the watering process ceases, ensuring optimal soil moisture conditions for plant growth. Additionally, the system employs a DHT11 sensor to monitor humidity and temperature levels within the greenhouse. If the humidity falls below 50% or the temperature drops below 18°C, the system activates a fan to regulate and balance the temperature and humidity levels, creating an optimal environment for plant growth. In the experiment, garlic plants were cultivated within this controlled environment over a period of 14 days. Data on the growth of garlic plants under these conditions was collected, demonstrating that the implemented system effectively supported the growth of garlic plants by maintaining appropriate soil moisture, temperature, and humidity levels within the greenhouse environment.

Team members: Shistata Thapaliya, Pratikshya Thapa, Swastika Bardewa, Aakarshan Pradhan

Banana Fiber Extractor Machine

This project was designed with an aim of revolutionizing the extraction process of banana fiber and promoting sustainable resource utilization. This machine mechanizes the extraction process efficiently. It consists of two feed rollers which rotate to squeeze the stem and remove moisture and third feed roller transports the squeezed stem to the drum roller, which decorticates the stem, removing scrap and separating fiber. Manual force is required to pull out the separated fiber that is washed with water and dried in sunlight for further processing. After successful fabrication of the project and multiple times testing it was concluded that high clearance (more than 3mm) between drum roller and feed roller results presence of scrap, using high rpm drum roller (more than 400rpm) results in fiber breakage, only lower part of each blade needs to be sharpened, attaching 12V DC motor to one of the feed roller decreases the operator fatigue. We have also tested for other plant sample (Ketuke) which results high strength fiber, more fiber yield. Our testing also includes Fiber Extraction Analysis such as 35kg stem gives 1kg fiber, 8hrs of stem feeding (i.e 960 kg stem) gives 27 kg of fiber (per day).

Team member: Aastha Dhungel, Aayusha Malla, Anjana Tamang, Garima Joshi



Sieving Machine for multiple agricultural crops

A sieve is a device that uses a screen, such as a mesh or net, to separate necessary elements from unnecessary material. The basic principle involves the transformation of continuous rotary motion provided by the crank into reciprocating linear motion of the slider, also called the slider-crank mechanism. When the machine is turned on, the material to be sieved is placed on the sieve deck and the vibrations produces back and forth movement. Two layers of sieve are provided. The sieve tray is connected using nut and bolts which allows sieves with various types of holes to be used depending on the types of particles that is to be separated. The vibrating motion of the sieve causes the particles to move and stratify. Larger particles tend to stay on top, while smaller particles work their way down through the openings in the sieve. The separated particles are then collected through a discharge system, while the oversized particles continue to be sieved until the desired separation is achieved. The single phase DC motor is connected to the shaft that rotates the crank which causes the chamber, where sieve tray is connected, to pick up the speed.

Team members: Ankit Raj Rijal, Dipesh Khatiwada, Iliya Adhikari and Kundan Nyaupane.



Questioning the Quantum:

What Does Superposition and Entanglement Mean for AI's Future?

- García-Barrios, David Andrés

Introduction

Artificial Intelligence (AI), with its extraordinary growth and transformative potential, has already started to redefine the landscapes of various sectors. From healthcare to finance, AI has demonstrated its power in harnessing large amounts of data to make accurate predictions, automate processes, and even mimic human cognition (A. & R., 2023). Yet, for all its current capabilities, AI stands on the brink of an even more dramatic leap forward as it begins to intersect with another cutting-edge field: quantum computing. This new frontier opens up a world of possibilities previously considered to be the exclusive realm of science fiction, creating a profound fusion of AI and quantum physics. At the heart of quantum computing lie the mysterious and

often counterintuitive principles of quantum mechanics - superposition and entanglement. Superposition allows quantum bits or 'qubits' to exist in multiple states at once, providing an exponential increase in computational potential. Entanglement, on the other hand, intricately links qubits in such a manner that the state of one instantly influences the state of the other, regardless of distance, thus introducing a new dimension of synchronization and correlation in computation (Yum & Choi, 2022).

These quantum phenomena, when applied to AI, hold the potential to fundamentally enhance its capabilities, propelling it into new domains and enabling solutions to some of the most complex problems we face today. Yet, our understanding of

these principles and how best to apply them within the realm of AI is still in its infancy, making this field both an enigma and an



The quantum phenomena of superposition and entanglement provide a key to unlock an unprecedented realm of computational power, setting the stage for a new generation of AI that transcends the limitations of today's models.



exciting area of exploration (Ying, 2010). The objective of this article is to elucidate

the enigma of quantum physics in a beginner-friendly approach, beckoning readers to understand the revolutionizing potential of principles such as superposition and entanglement. It also encourages them to envisage the future these concepts could chart for the field of Artificial Intelligence. As we stand on the cusp of this groundbreaking era, quantum physics possesses the potential to radically alter the contours of AI, ushering us into a future where the line between science fiction and reality becomes progressively indistinct.

The Quantum Phenomena

The principles of superposition and entanglement are the bedrock of quantum mechanics and the key drivers behind the awe-inspiring potential of quantum computing. To fully grasp how these principles can revolutionize AI, it is crucial first to understand their underlying mechanisms and implications (Jadhav et al., 2023). Superposition, one of the most fascinating concepts in quantum physics, is the ability of a quantum system to be in multiple states at the same time.

While a classical bit in a computer can be either a 0 or a 1, its quantum counterpart, the qubit, can be in a superposition of both states simultaneously, thanks to this principle (Yum & Choi, 2022). It's as though a coin, when spun, isn't just heads or tails but is spinning where it's effectively both heads and tails at once. This ability to be in several states at the same time is what gives quantum computers their inherent parallelism and allows them to process an enormous amount of information concurrently. For AI applications, this could translate into a drastic reduction in computation time, enabling the processing of large volumes of data and complex



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computations much more effectively than traditional computers (Jadhav et al., 2023).

Entanglement, the other cornerstone of quantum mechanics, is a phenomenon wherein qubits become interlinked, and the state of one immediately influences the state of the other, irrespective of the distance separating them. This strange but powerful property enables an extraordinary level of synchronization and correlation between qubits, creating a quantum system where the whole is far more than just the sum of its parts. The entanglement of qubits leads to a collective quantum state, with each qubit inextricably linked to the others (Fang & Chang, 2003). This entanglement enables a quantum computer to perform many calculations simultaneously, opening the door to vast computational speed-ups. In the context of AI, this could mean more sophisticated pattern recognition, higher prediction accuracy, and the capability to solve complex problems that are currently beyond reach.

This, superposition and entanglement, when coupled together, form the foundation for quantum computing's vast potential. However, harnessing these quantum phenomena is not without its challenges. Quantum states are fragile and easily disturbed by their environment, a problem known as decoherence (Mannone et al., 2023). Moreover, creating and managing entangled qubits poses significant technical hurdles. Despite these challenges, the potential benefits that superposition and entanglement could bring to AI are significant, making the quest to overcome these obstacles a key priority in the ongoing journey of technological advancement. In the context of AI, this ability of

qubits to hold vast amounts of information and perform multiple calculations concurrently could result in a profound reduction in computational times. Complex tasks that would take traditional computers years, or even centuries to complete, could potentially be performed in seconds. This ability to process and analyze large volumes of data rapidly and efficiently is particularly relevant in the field of AI, where the capacity to handle big data is often the difference between a functioning model and a superior one (Jadhav et al., 2023; Ying, 2010).

Furthermore, even once these challenges are surmounted, there will be considerable work to adapt our existing AI algorithms and models to exploit the unique properties of quantum computing fully. However, these obstacles do not diminish the promise that superposition and entanglement hold for the future of AI. They simply underscore the magnitude of the scientific and technological journey we are embarking upon. The marriage of these principles with AI has the potential to completely redefine what is possible within the realm of computational problem-solving. As we delve deeper into these phenomena and continue to unfurl the quantum enigma, we stand at the precipice of a future where the limitations of today's AI are transcended, and a new era of unimaginable computational power begins.

Implications for AI

The fusion of AI and quantum computing also brings with it a set of unique challenges. Quantum systems are inherently fragile and prone to errors, and the management of quantum data requires new methods and systems.

Moreover, quantum computers that are powerful enough to outperform classical computers—a stage known as quantum supremacy—are still in development (Khrennikov, 2021). Despite these challenges, the potential implications of quantum AI are too significant to ignore. By harnessing the unique properties of quantum mechanics, we have the opportunity to push the boundaries of AI and usher in a new era of technological innovation. As we continue to explore and navigate this exciting frontier, we can expect to see a transformation in the way we conceptualize and implement AI systems. Quantum computing promises not only to enhance the speed and capacity of AI but also to introduce entirely new capabilities that could revolutionize fields such as healthcare, finance, cybersecurity, and more (Viggiano & Brin, 2022).

For instance, in healthcare, quantum-AI algorithms could enable more personalized treatment plans by analyzing a patient's unique genetic makeup and lifestyle data (Davids et al., 2022). In finance, quantum computing could improve risk assessment models, enabling more accurate predictions of market trends, while in cybersecurity, quantum encryption methods could provide unprecedented levels of security (Viggiano & Brin, 2022). In the realm of natural language processing, a field of AI that seeks to enable machines to understand and generate human language, quantum computing could allow for the development of models that better understand context, subtleties, and nuances in language (Ganguly et al., 2022). This could lead to more sophisticated digital assistants, more accurate sentiment analysis

tools, and more effective automated translation services, to name a few applications.

Also, complex systems, like global climate models, intricate biological systems, or large-scale economic systems, are characterized by their vast number of components and the intricate, non-linear interactions between those components. The immense computational power of quantum computing, combined with AI's ability to learn from data, could allow us to create more accurate, detailed models of these systems than ever before. This could lead to significant breakthroughs in a variety of fields. For instance, climate science could enhance our ability to predict long-term climate patterns and understand the impact of various interventions. In biology, it could revolutionize our understanding of complex biological processes, leading to advances in drug discovery and personalized medicine (Cordier et al., 2022).

Real-time analytics is another area that stands to benefit significantly from quantum AI. Many industries rely on the ability to process and analyze data in real-time to make informed decisions. For example, financial institutions need to analyze market data in real time to make trading decisions, while healthcare providers need to monitor patient data continuously to provide timely care. However, the volume and velocity of data generated today can overwhelm traditional computing systems, leading to delays and inaccuracies. The ability of quantum computers to process large amounts of data simultaneously, combined with AI's predictive capabilities, could drastically improve

the speed and accuracy of real-time analytics, enabling faster, better-informed decisions across various industries (A. & R., 2023; Jadhav et al., 2023; Ying, 2010).

Lastly, the area of optimization problems, where the goal is to find the best solution among a set of possible options, could see tremendous improvements with the advent of quantum AI (Abd El-Aziz et al., 2022; Jadhav et al., 2023). Many of these problems, such as route optimization for logistics, portfolio optimization in finance, or supply chain optimization in manufacturing, involve several variables and constraints, making them computationally expensive, if not impossible, to solve with classical computers. Quantum computers, with their ability to explore multiple solutions at once through superposition and to find optimal solutions more efficiently through quantum interference, could significantly reduce the time it takes to solve these problems. When paired with AI techniques like reinforcement learning, which can learn and improve from experience, the potential to find optimal solutions more quickly and accurately becomes even greater.

In essence, the union of quantum computing and AI heralds a new era of technological potential. As we push the boundaries of what's possible, we stand to not only improve upon current AI capabilities but also unlock entirely new applications that were previously beyond our reach. The path forward is complex and fraught with challenges, but the promise of quantum AI makes this a journey worth embarking upon. As we embark on this journey, it's also essential to consider the ethical implications of

quantum AI. With increased power comes increased responsibility, and the advent of quantum AI raises new questions about data privacy, algorithmic fairness, and the societal impacts of ultra-intelligent systems. These are issues that the AI community and society at large must grapple with as we navigate the future of quantum AI.

Conclusions

The convergence of quantum computing and artificial intelligence (AI) presents a revolutionary paradigm shift that could redefine the contours of technological innovation. This short article has sought to illuminate the transformative potential inherent in this intersection and the far-reaching implications it holds for our understanding of AI. Throughout this exploration, we've delved into the intricacies of the two quantum phenomena that underpin this transformation—superposition and entanglement. Superposition, with its ability to expand computational potential exponentially by allowing quantum bits (qubits) to exist in multiple states simultaneously, stands poised to elevate the processing speed and capacity of AI systems. This phenomenon offers a pathway toward a dramatic reduction in computational times, which, in turn, could boost AI's efficiency in handling large and complex data sets. This capability could be particularly instrumental in areas like complex system modeling, real-time analytics, and optimization problems.

Quantum entanglement, the other quantum marvel, adds an unprecedented degree of synchronization and coherence to quantum systems. By allowing qubits to exist in a state where the modification of one instantaneously

influences the other, regardless of distance, quantum entanglement presents an opportunity to radically improve pattern recognition and decision-making capabilities within AI systems. The immediate correlation facilitated by entanglement could boost the efficiency of information processing, with potential applications spanning from real-time language translation to instant global financial transactions and furthering our understanding of complex biological systems and climate models. Yet, the fusion of these quantum phenomena with AI is not without significant challenges. Quantum decoherence, the instability and interference from the environment that quantum states are susceptible to, presents a prominent hurdle. Additionally, creating and managing entangled qubits introduce substantial technical obstacles that the research community must surmount. Furthermore, adapting our existing AI algorithms and models to harness the unique properties of the entire quantum computing is an arduous task that necessitates substantial further research and development.

However, the immense promise and transformative potential of quantum AI far outweigh these hurdles. The myriad of applications that could benefit from quantum AI underscores the value and significance of ongoing efforts to navigate these challenges. With the dawning of the quantum era, we are bearing witness to the early stages of a revolution that could reshape our perception of computational problem-solving and redefine the limits of AI capabilities. The ethical implications and considerations surrounding quantum AI are equally crucial. The arrival of

quantum AI introduces an array of pressing questions surrounding data privacy, algorithmic fairness, and societal impacts. As we stride further into this new era of quantum AI, it becomes increasingly important to integrate these considerations into our journey, ensuring that the development of this technology aligns with ethical standards and societal needs.

In summation, the marriage of quantum computing and AI ushers in a future teeming with possibilities. The quantum phenomena of superposition and entanglement provide a key to unlock an unprecedented realm of computational power, setting the stage for a new generation of AI that transcends the limitations of today's models. While the path towards fully unfurling the quantum enigma remains filled with scientific and technical challenges, the prospect of a future characterized by more efficient, accurate, and advanced AI systems propels us forward. As we stand on the precipice of this exciting frontier, we are obliged to not just marvel at the transformative potential of quantum AI but also to engage deeply with the questions and challenges it poses. In so doing, we can ensure that this technological revolution is not just about advancing computational capabilities, but also about fostering a future where technology serves humanity's broader needs and aspirations in an ethically sound and socially responsible manner. The quantum future is not just on the horizon—it is here and ours to shape. on the horizon—it is here and ours to shape.

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श्रम तथा रोजगार कार्यालय भद्रपुर, भापाको जनहितमा जारी सूचना

- बालश्रम अन्त्य गरौं ।
- रोजगार सम्झौता गरेर मात्र काममा लगाऔं ।
- न्यूनतम पारिश्रमिक कार्यान्वयन गरौं ।
- व्यवसायजन्य सुरक्षा तथा स्वास्थ्य सम्बन्धी व्यवस्था लागू गरौं ।
- असल औद्योगिक सम्बन्ध कायम गरौं ।



नेपाल सरकार
श्रम तथा रोजगार कार्यालय
भद्रपुर, भापा

Laws Relating to the Engineering Profession in Nepal

Introduction

The engineering profession in Nepal is guided by a comprehensive set of laws aimed at ensuring regulation, standardization, and advancement of engineering practices. Among the key is the Nepal Engineering Council Act 2055 (1998), which was established by the Nepal Engineering Council (NEC) to manage the registration and professional standards of engineers. In addition, laws covering labor rights, environmental protection, contract management, and intellectual property further support the engineering sector. These regulations promote ethical practices, maintain safety and quality standards, and facilitate the growth of engineering, which is crucial for Nepal's infrastructure and socio-economic development.

1. Engineering Professional Related Laws

• Engineering Council Act 2055

The Nepal Engineering Council was established to register engineers' identities according to their qualifications and to effectively and methodically activate the engineering profession in Nepal. There are a total of nine different chapters in this act, that make provision for the prohibition of practicing the engineering profession without getting registered with the NEC. Further, it made provisions on the application to be made for the registration of the names of licensed engineers, which follows inquiry, examination, and recommendation, and the name registration certificate to be issued is clearly mentioned in various sections. Similarly, this act empowers the council to strike engineers off the registration book if found guilty of breaching the professional code of conduct or convicted in a criminal court. Also, it outlines penalties for offenses, including fines up to three thousand rupees, imprisonment for up to three months, or both.

• Professional Code of Conduct for Engineers

The professional code of conduct to be followed by the registered engineers of the council, subject to the provisions of the Nepal Engineering Council (NEC) Act, 2055 (1998) and the Nepal Engineering Council Regulation, 2057 (2000) includes discipline, honesty, and dignified practice. Engineers must treat customers with politeness and confidentiality, avoiding discrimination based on religion, race, sex, or caste. They are to work within their expertise, referring tasks outside their scope to qualified experts. Financial integrity is emphasized, prohibiting improper financial gains. Engineers are personally responsible for their work and must clearly state their name, designation, and NEC registration number on all professional documents. Publicity and advertisements that might unduly influence customers are discouraged. Unregistered engineers, including those from unapproved programs, face legal penalties.

2. Related legal provisions (Special Industrial Engineering Profession)

• Industrial Enterprises Act 2076

The Industrial Enterprise Act 2076 aims to enhance the industrial sector by emphasizing import substitution and export promotion. There are overall 9 different chapters which make provision for efficient utilization of domestic resources to increase production, generate employment,

and cultivate an investment-friendly atmosphere. The Act is structured into eight chapters, covering aspects from industry registration to regulation to cancellation of the registered company. It has made provisions on classifications and fixed capital of various industries, incentives, exemptions, and concessions. Additionally, provisions for addressing sick industries, punishments, and appeals are outlined, ensuring comprehensive management and regulation of industrial activities.

• Labor Act, 2074

The Labor Act 2074 serves as a comprehensive framework to protect the rights of workers, define employer obligations, and combat labor exploitation. It encompasses various essential provisions, including those pertaining to minimum standards, the prohibition of forced labor, and the prevention of discrimination in employment. The Act addresses diverse forms of employment, from regular to part-time arrangements, while offering detailed provisions for apprentice and trainee programs as well as part-time labor. Additionally, it regulates the issuance of work permits for foreign workers and establishes rules governing working hours, including overtime. Ensuring fair remuneration, the act mandates annual increments and prohibits unauthorized deductions from workers' salaries. In Chapters 8 and 9, it outlines provisions for employee welfare, encompassing leave entitlements and schemes such as the Provident Fund, Gratuity, and Insurance, underpinning a commitment to fostering a fair and supportive work environment.

• Proprietorship (Private Firm) Act 2014

This act is expedient to provide for provisions on registration of private firms engaged in trade and industry and other related provisions there with in order to maintain the convenience and economic interest of the general public. It has 11 sections, which include provisions regarding the submission of an application for the registration of a private firm and registration. It also addresses the validity period of the certificate of a private firm and the method of renewal, and it also makes provision that there won't be any valid transaction carried out in the name of a private firm that is not registered under this act.

• Partnership Act 2020

This act is expedient to provide for legal provisions on partnerships for the interest and convenience of the general public. It consists of six chapters that address the registration of a firm in the concerned department and the issuance of a certificate within a period of six months from the date when the associates enter into the agreement of partnership pursuant to this act. To renew a firm registered under this act, submit an application in the prescribed format with the required fee to the concerned department within 35 days of the fiscal year-end. It also includes provisional relations with third parties, dissolution of the partnership after expiry of the terms and conditions, or failure of one partner under specific circumstances. Various provisions related to liability and penalties are clearly stated in this act.

- **Contract Related Provisions provided on National Civil Code, 2074 (Amendment of Contract Act 2056)**

The National Civil Code, 2074, sections 521-534, outlines essential aspects of contract law, including 18 provisions that cover general principles, time periods, validity, and compliance of contracts. These sections also address compensation for breach of contract and detailed procedures for such breaches. The updated provisions are organized into different chapters of the Civil Code Act, 2074, addressing various types of contracts such as goods sales, bail agreements, negotiable instruments, mortgage agreements, agency contracts, goods transport agreements, lease contracts, hire purchase agreements, labor contracts, and torts. Section 517 specifically details the conditions under which contracts are deemed void. Additionally, the Code provides rules for contracts involving collateral or deposits and outlines the rights of individuals obtaining collateral or deposits.

- **Environmental Protection Act, 2076**

The Federal Parliament has enacted this Act to safeguard the fundamental right of every citizen to live in a clean and healthy environment and to mitigate adverse impacts on the environment. The act comprises of nine different chapters, which outline the requirements for submitting an Initial Environmental Examination (IEE) report for development and construction projects. It details the procedures for scoping, scheduling work, and obtaining approval from relevant authorities. Additionally, the act addresses pollution control measures to prevent significant harm to public life, health, and the environment, and it prohibits actions that violate government-established standards. Furthermore, it includes provisions for the protection of national heritage sites and environmental protection areas, as well as stipulations for fines and compensation for projects undertaken without proper approval from the concerned authorities.

- **Patent, Design & Trademarks Act, 2022**

This legislation underscores the process of obtaining patent, design, and trademark rights for new methods, shapes, symbols, words, and images associated with a business. There are altogether 5 chapters which outline the application process and investigation by relevant authorities for acquiring these rights. Similar procedures are provided for designs and trademarks. Moreover, the legislation includes provisions for the classification of goods and services for trademark registration, prohibitions on trademark use, and time limits for trademark usage.

- **Copy Right Act, 2059**

This legislation permits the citation of copyrighted works without the author's authorization, allowing for fair use. It has seven different chapters which outline the economic rights of the copyright owner, including reproduction, modification, sale, distribution, and rental of the work to the public. Infringement of these rights, such as unauthorized use, reproduction, distribution, or adaptation of copyrighted material, is addressed comprehensively. Punishments for importing unauthorized copies and infringing on protected rights are also detailed. Additionally, it specifies that copyright ownership can be transferred through a written agreement or authorization, with or without specifying terms.

- **Public Procurement Act, 2063**

This legislation has 10 different chapters that mandates before procuring any goods, construction work, or services, a public body must first prepare comprehensive specifications, plans, designs, and special requirements.

Additionally, a detailed cost estimate must be prepared for each procurement. The methods for procurement by public entities are determined based on specific conditions and purchase prices for the necessary goods, works, or services. The legislation outlines the entire bidding process, including prequalification, documentation, and an invitation to bid. It also details the procedures for bid evaluation to identify any deviations from specifications, including provisions for bid rejection. Finally, the acceptance of bids and the formation of procurement contracts are thoroughly discussed, ensuring a clear and transparent process for all stakeholders involved.

- **Income Tax Act, 2058**

This tax system outlines annual tax obligations comprehensively, categorizing income into separate baskets for business, employment, and investment to determine the appropriate tax treatment. It consists of 24 different chapters that make provision for calculating the tax owed based on income from each category. To ease the burden, the system offers exemptions that reduce your taxable income, including specific amounts and certain expenses. Additionally, it allows for the deduction of specific costs, such as loan interest and maintenance, further decreasing your taxable income. Finally, it includes an in-depth approach to calculating the net profit for businesses managing property and liabilities, ensuring a thorough and precise determination of tax obligations.

- **Company Act, 2063**

This Act aims to amend and consolidate laws related to companies, fostering economic development by encouraging investment in industry, trade, and business. It comprises 21 chapters that govern company incorporation, with applications to be submitted and registration to be completed within 15 days. The Act establishes limited liability for shareholders and specifies the number of shareholders and company obligations. It addresses the conversion of private companies to public, detailing requirements for the Memorandum of Association, Articles of Association, and prospectus. Additionally, it mandates the preparation of annual financial statements and board reports before the annual general meeting, along with the appointment of auditors in accordance with regulatory guidelines.

Conclusion

The acts relating to the engineering profession in Nepal provide a comprehensive legal framework that is essential for the regulation, standardization, and advancement of engineering practices in the country. Key legislation, such as the Nepal Engineering Council Act 2055, ensures that engineers are registered and held to high professional standards, fostering competence, ethical behavior, and accountability. This legal foundation is crucial for maintaining the safety, sustainability, and quality of engineering projects, which are vital for Nepal's infrastructure development and socio-economic growth. Moreover, these acts address critical aspects of industrial engineering, including labor rights, environmental protection, contract management, and intellectual property. By ensuring adherence to safety protocols, promoting innovation, and upholding ethical standards, the legislative framework supports industrial engineers in effectively managing labor relations, financial decisions, and contractual obligations. As Nepal continues to modernize and industrialize, these regulations will play a pivotal role in enabling industrial engineers to contribute significantly to the country's economic development and overall progress.



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Bharatpur Metropolitan City

Office Of Municipal Executive

Bharatpur, Chitwan, Nepal



अनुरोध

- ❖ अनिवार्यरूपमा नक्सा पास गरेर मात्र घर, कम्पाउण्डवाल आदिको निर्माण गरौं। सम्भावित विपदबाट बचाऔं।
- ❖ सडक मापदण्ड पालना गरेर मात्र भौतिक संरचनाहरू निर्माण गरौं। सडकमा जथाभावी निर्माण सामग्री नथुपारौं।
- ❖ हरियाली प्रवर्द्धनको लागि सडकको दायौँबायौँ वृक्षारोपण गरौं। रोपिएको विरुवाका संरक्षण गरौं।
- ❖ फोहरको उचित व्यवस्थापन गरौं। रोग लाग्नबाट बचाऔं। 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 तिर्औं। समृद्ध महानगर निर्माणमा सहभागी बनौं।
- ❖ महानगरले प्रदान गर्ने कर छुटको फाइदा लिऔं, म्याद नागेपछि लाग्ने जरिवानाबाट जोगिऔं। तिर्नु पर्ने कर रहरले तिर्औं, करले होइन।
- ❖ महानगरको अनुमति बिना कुनै पनि सार्वजनिक स्थानमा रोडक्रस गेट, ब्यानर, होर्डिङ बोर्ड, फ्लेक्स, पर्चा पम्प्लेट नराखौं, नटाँसौं। सुन्दर महानगर निर्माणमा जुटौं।
- ❖ कोरना कहरबाट बचाऔं, बचाऔं। नेपाल सरकारले तोकेका मापदण्ड पूर्णरूपमा पालना गरौं।
- ❖ "सूर्तोजन्य पदार्थको प्रयोग नगरौं, स्वास्थ्य रोजौ: सूर्तोजन्य पदार्थ होइन।"

थाप जानकारी तथा समन्वयको लागि नजिकको वडा कार्यालय वा महानगरमा सम्पर्क गरौं।

फोन नं. ०५६५२०१६७, ०५६५२१४६७, ०५६५२५७७१ दमकल ०५६५२१०८३

मोबाइल नं. ९८४५१४३८७८ टोल फ्री नं. १६६०५६५२२२२

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DC motor controller

Development & Testing of High Power DC Motor Speed Controller

-Nitesh Silwal

Introduction:

This article consists of the guidelines and documentation for building a high-power DC Motor Speed Controller using 555 Timer IC and two N-channel MOSFETs. The circuit holds a working capacity range as follows:

1. Voltage: 12V - 55V
2. Max. Current: 49A
3. Max. Power: 2700W

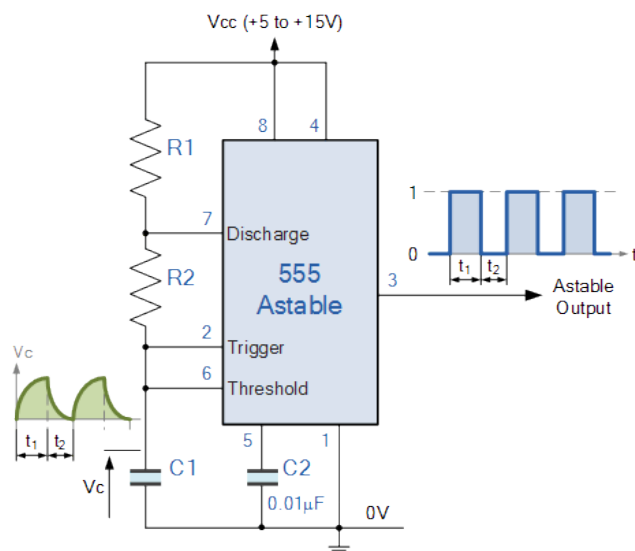
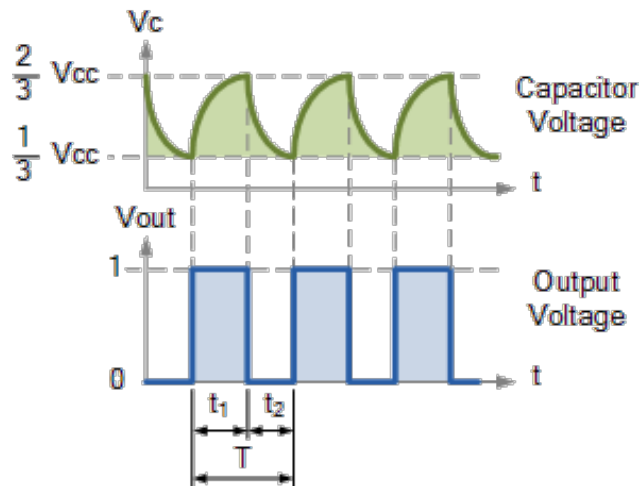
The main purpose behind the development of this circuit was to control the speed of 250W, 19A, 24V DC geared motor, for which it worked very well as expected. The circuit was later tested on a high torque 12V wiper motor and it performed well on this motor as well.

Working Principle

In the circuit, the NE555 Timer IC works as an astable multi-vibrator. In this mode, the IC produces a continuous High & Low PWM (Pulse Width Modulation) signal

from the output pin which can be adjusted by changing the value resistor and capacitor, attached to the IC. Here, I used Potentiometer so we can change the resistance value by rotating the knob.

The IC's output goes to the Gate terminal of the IRFZ44N MOSFETs. When we rotate the potentiometer knob, the IC's output value also changes. Here, the MOSFET works as an amplifier. So, when the NE555 timer IC output voltage goes Low to High then the IRFZ44N MOSFET voltage amplification rate also increases, and this amplified voltage goes to the motor then the DC motor Speed/RPM also increases and vice-versa.



List of the Components Used:

SN	Components	Quantity
1	NE555 Timer IC	1
2	LM7805 Voltage Regulator	1
3	MBR3045PT Schottky Diode	1
4	IRFZ44N MOSFET	2
5	1N4007 Zener Diode (5V)	2
6	B10K Potentiometer	1
7	104 Ceramic Capacitor	2
8	Resistor - 1K	2
9	Resistor - 10K	1
10	LED	1



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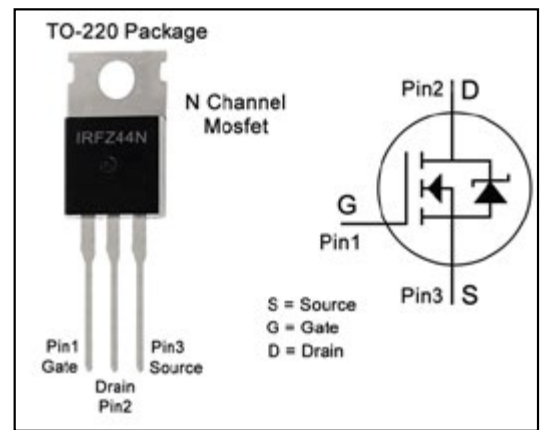
2. N-Channel MOSFET (IRFZ44N)

Features

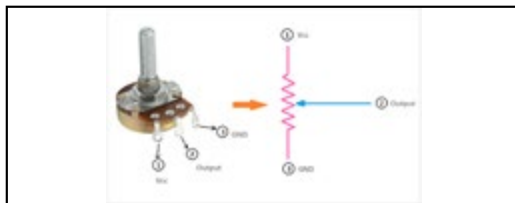
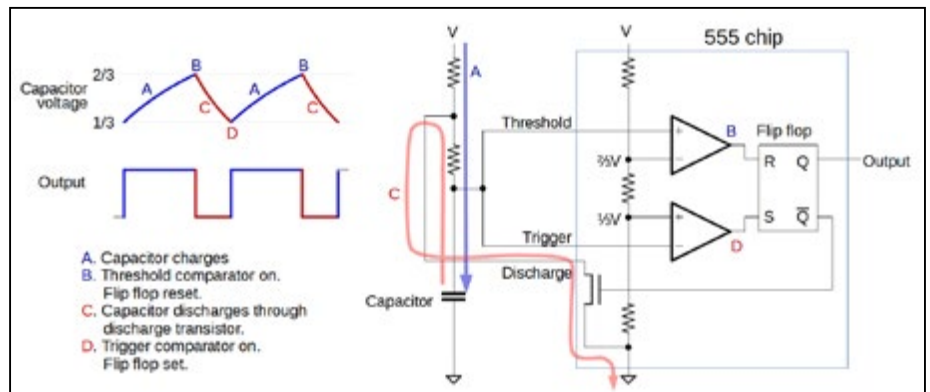
1. Drain Current $-I_D=49A$ @ $T_C=25^\circ C$
2. Drain Source Voltage : $VDSS= 55V$ (Min)
3. Static Drain-Source On-Resistance : $R_{DS(on)} = 0.032\Omega$ (Max)
4. Fast Switching

Description

Designed for low voltage, high-speed switching applications in power supplies, converters, and power motor controls, these devices are particularly well suited for bridge circuits where diode speed and commutating safe operating areas are critical and offer additional safety margin against unexpected voltage transients.



First, we have our source of energy a 24V DC battery. The output signal from 555 Timer IC is connected directly to the Gate of both the MOSFET. The Source pins of both the MOSFET are connected to the ground or negative terminal of the battery. When both sources are connected to the ground or negative terminal of the battery, we will have the output for our DC motor in the drain pin and source pin of two MOSFETs. Due to the switching actions of these MOSFETs, the motor receives the required negative supply from the Drain pins of both the MOSFETs connected in parallel.

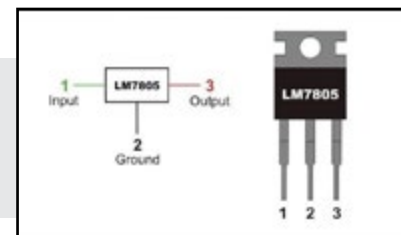


3. Potentiometer

In this circuit, to control the speed of the DC motor, I used a B10K ohm potentiometer to change the duty cycle of the PWM signal. Two Zener diodes are connected in series across the ends of the potentiometer, while the middle arm pin is connected to the threshold pin 6 of the 555 Timer IC.

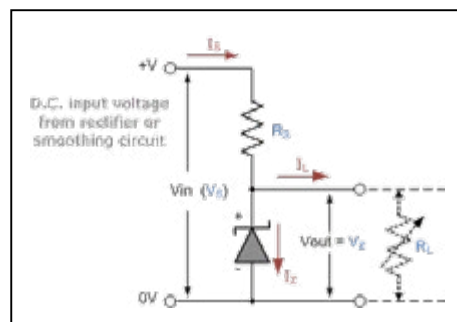
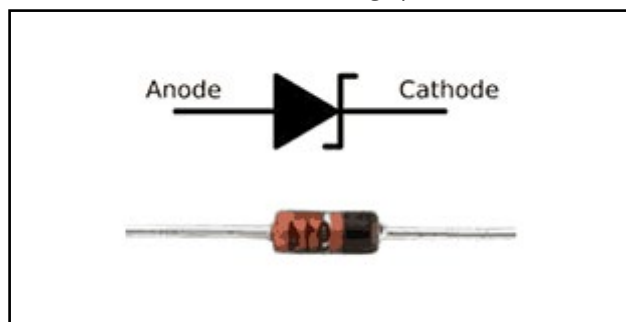
4. LM7805 Voltage Regulator

The 7805 voltage regulator is used to step down the input voltage (12V - 24V) to 5V, which powers up the 555 Timer IC through the +VCC supply at pin 8.



5. Zener Diode

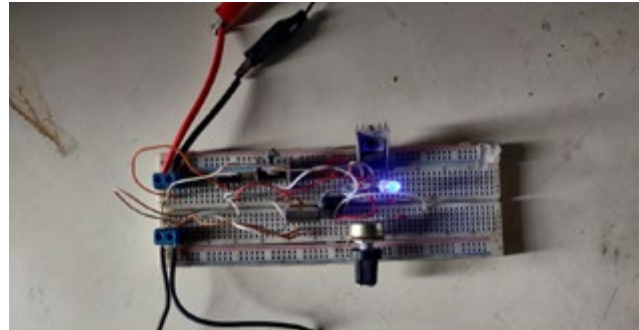
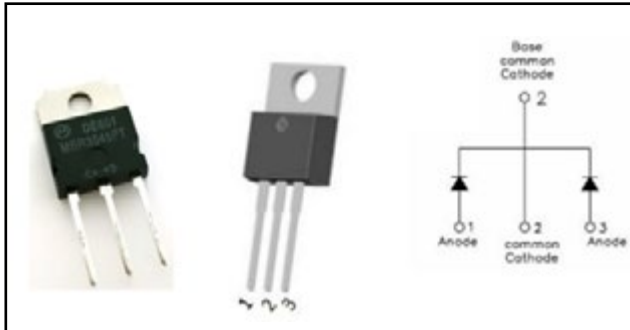
Two Zener diodes are used to regulate the voltage of any point inside the circuit. It is handy for obtaining a regulated voltage at the output. In the circuit, two Zener diodes are connected in series across pins 1 and 3 of the potentiometer to regulate the voltage across the speed controller circuit. The effect of the Zener diode after voltage regulation is fed to the 555 timer IC at the Discharge pin 7.



6. Schottky Diode

The characteristics of a Schottky diode make them well-adapted for power or circuit applications because of their low forward voltage drop. The presence of these diodes also prevents reverse current flow from one supply entering the other.

In the circuit, the Schottky diode (MBR3045PT), 30A 45V switch-mode power rectifier is connected across the positive supply and the negative output from Drain pins of the IRFZ44N MOSFET. The output from the diode is then connected to the motor, to prevent the reverse flow of current across the motor.



PWM Simulation of 555 Timer in MATLAB

To visualize the nature of the PWM signal generated by the 555 Timer through voltage controlled by the B10K potentiometer (P1), I made a Simulink model and simulated the circuit in MATLAB.

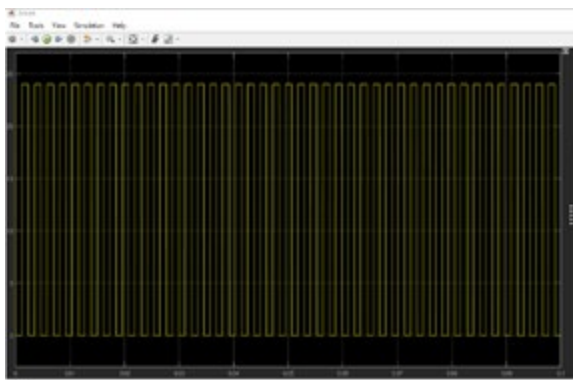
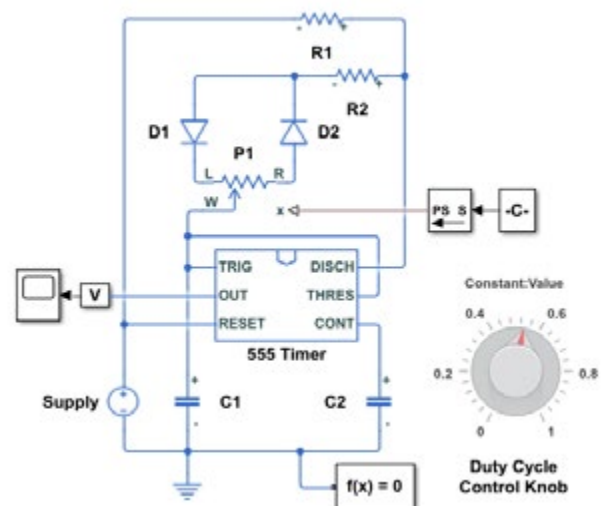
The components specifications during the simulation of the circuit are:

DC Supply: Constant 24V

C1 & C2 : 104 (0.1uF)

R1: 1K

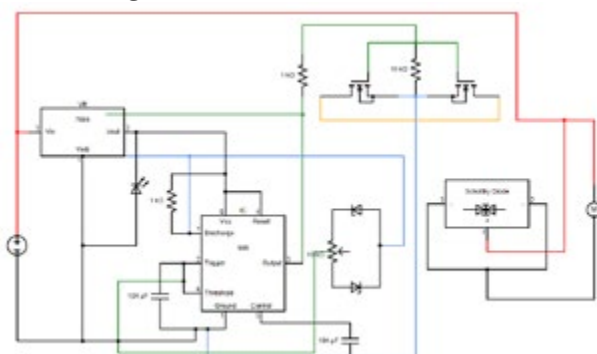
R2: 10K



Result :

As a result of the simulation, the nature of the waveform generated is square form PWM signals, with the amplitude ranging between 0V in minimum to 24V in maximum with a mean period of 0.042 seconds. The signal statistics and bilevel measurements of the generated signal are shown in Figure 11.

Circuit Diagram



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