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INDUSTRIAL VISION

INNOVATION. INDUSTRY. PROSPERITY

VOLUME 11.0 | 2026

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Enabling The Future Of Modern Industry

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Executive Committee Member, FNCCI
Owner & Chairman, Lumbini Lions

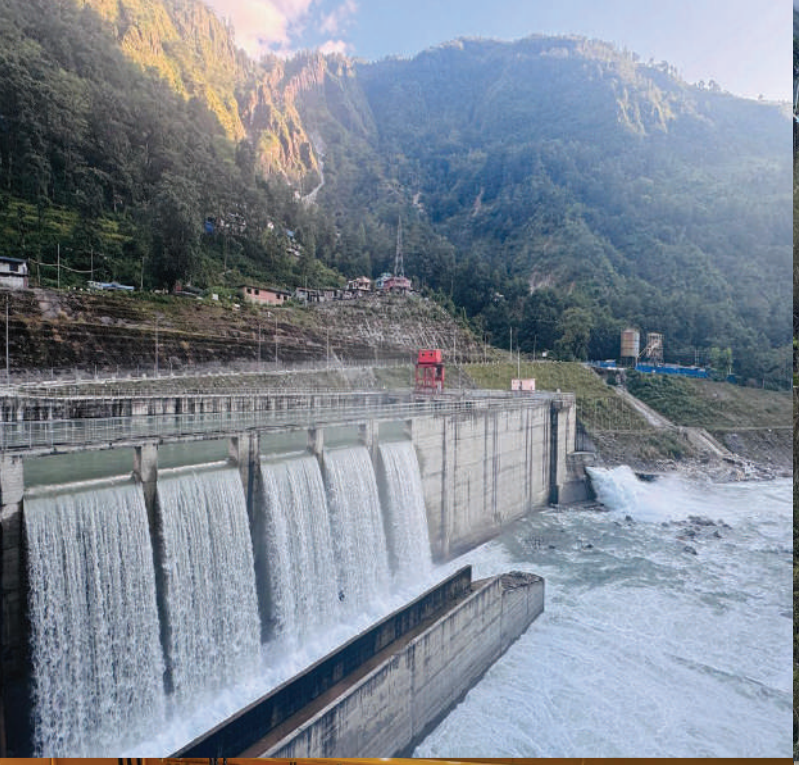
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Tribhuvan University
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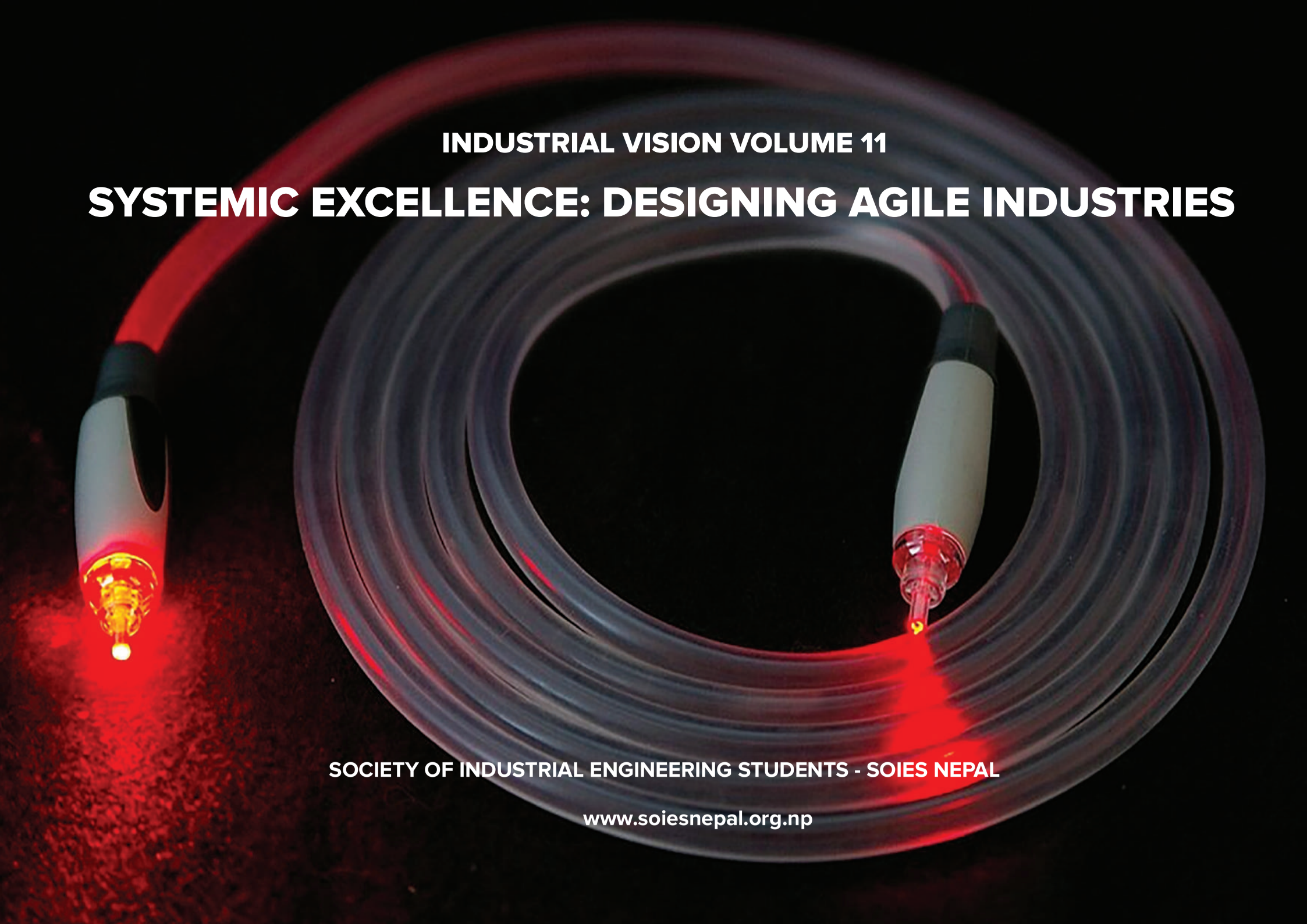




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SOCIETY OF INDUSTRIAL ENGINEERING STUDENTS - SOIES NEPAL

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Industrial Vision is an 155N 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 delighted to witness another remarkable milestone achieved by the Society of Industrial Engineering Students (SOIES Nepal) at Thapathali Campus, with the publication of the latest volume of Industrial Vision. Over the years, this magazine has become a meaningful platform where students present insightful articles, innovative ideas, and thoughtful perspectives on Industrial Engineering and diverse contemporary issues. It is inspiring to see young minds continuously contributing knowledge, creativity, and fresh thinking through this publication. I sincerely appreciate the dedication of the editorial team and every contributor for maintaining this valuable tradition of academic excellence.

I extend my heartfelt congratulations and best wishes for the continued success of Industrial Vision. May this edition inspire curiosity, encourage meaningful discussions, and motivate readers to pursue innovation, collaboration, and lifelong learning. I hope the magazine continues to grow as a source of knowledge and inspiration, empowering future engineers to contribute positively to society and the nation's industrial development.

Prof. Dr. Sushil B. Bajracharya
Dean, Institute of Engineering, Tribhuvan University

Congratulations on the successful publication of the 11th edition of Industrial Vision!

What a proud moment this is for everyone involved. Publishing another edition is a remarkable achievement, and it reflects your dedication, creativity, and collective effort over the years. Industrial Vision has continued to grow as a platform for exchanging ideas, inspiring innovation, and strengthening the academic spirit of Industrial Engineering.

This year's theme, "Systemic Excellence: Designing Agile Industries," is both timely and meaningful. As industries navigate rapid change, the focus on systems thinking, agility, and continuous improvement is more relevant than ever. I am confident this edition will spark meaningful conversations and encourage fresh perspectives. This is a matter of pride for IOE Thapathali Campus. Wishing you all continued success as Industrial Vision keeps inspiring minds and shaping the engineers and leaders of tomorrow.

Dr. Khem Gyanwali
Campus Chief, Thapathali Campus,
Institute of Engineering, Tribhuvan University





On behalf of the Department of Industrial Engineering, I extend my heartfelt congratulations to everyone involved on the successful release of the 11th edition of Industrial Vision. Reaching this significant milestone is a true testament to the continuous hard work, passion, and collaborative creativity demonstrated by the entire team at SOIES Nepal.

This year's theme, "Systemic Excellence: Designing Agile Industries," comes at a crucial time for our profession. It highlights the growing importance of building adaptable, efficient, and resilient systems that can thrive within an ever-evolving industrial landscape. The effort put into curating content around such a relevant topic reflects a deep commitment to modern engineering practice and forward-thinking leadership.

We take great pride in the initiative, dedication, and high standard of professionalism displayed by the editorial team and contributors. I am confident that Industrial Vision will continue to serve as an inspiring platform for sharing knowledge and shaping the next generation of industrial leaders and innovators. I wish this new volume immense success and a wide readership.

Asst. Prof. Kamal Pokharel
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Message from the Vice-Chancellor

It is my pleasure to congratulate the **Society of Industrial Engineering Students (SOIES)**, Tribhuvan University Thapathali Campus, on the successful publication of the 11th volume of **"Industrial Vision."**

This year's theme, *"Systemic Excellence: Designing Agile Industries,"* addresses a vital need in our rapidly changing world: building resilient, efficient, and adaptable systems. It is inspiring to see our young engineers tackling these modern industrial challenges head-on. It reflects the dedication, creativity, and academic enthusiasm of the students and serves as a valuable platform for sharing ideas, research, and innovative perspectives in industrial engineering.

I extend my sincere appreciation to the editorial team for their hard work and wish SOIES continued success in its academic and professional endeavors.

Prof. Dr. Bhola Thapa
Vice-Chancellor

Aug 03, 2026

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President's Message



You hear it everywhere in daily life: when a bus is late, when a form gets rejected at a government office for reasons nobody can explain, when the internet drops in the middle of something important. "The system is broken." It is one of the most common complaints people make, and one of the vaguest. Nobody quite explains what system they mean. That question is where this issue's theme came from: **Systemic Excellence: Designing Agile Industries.**

Volume 11 was, deliberately, built from the ground up. The layout, the interview questions, the cover concept, and even our approach to sponsors were all debated, revised, and rebuilt more than once. A considerable number of sleepless nights went into these pages, the kind that leave no visible trace in the final print but remain the actual reason it exists.

None of this happens without people willing to trust a student committee with real responsibility. My deepest thanks to our faculty, especially the Department of Industrial Engineering, our alumni, contributors, sponsors, and every member of SOIES Nepal who gave their time to this. You made a team of students believe this was worth doing properly, and that belief is the real system behind everything in these pages.

This is also the last **Industrial Vision** I get to write as President. I've thought about how to say that without turning this into something bigger than it should be, and I don't think there's a clean way, so I'll just say it plainly. Leading this committee has been the most demanding and most worthwhile thing I've done here, and closing that chapter with this issue in particular, on a theme about looking past the surface of a problem, feels right.

To every committee member who worked through this tenure with me, the ones who stayed till midnight before an event and the ones who quietly kept the unglamorous work running without needing credit for it: thank you. And to everyone who has picked up an issue of **Industrial Vision** and actually read it, not just flipped through it: you're the reason we kept doing this properly instead of just doing it.

If there's one thing I hope we carry forward, it's this instinct: ***don't just name the system, go find it.***

Happy reading.

Anish Panthi
President, SOIES Nepal
18th executive committee

Editor's Note



All industries eventually ask themselves the same uncomfortable question. Not "are we growing?" but "what happens the next time something goes wrong?" Last year, our magazine focused on putting industries back on their feet. This year, we wondered what keeps them standing once they're there.

That gave rise to this year's theme: Systemic Excellence: Designing Agile Industries. Revival is the easy part of the story. The more interesting and difficult half is agility; the capacity to bend without breaking when conditions change, and it is the one this volume spends its pages on. You'll come across it in a proposal for a closed-loop tensioning system to prevent yarn from breaking mid-spin, and in a piece on Ilam's tea sector, in which the question is asked: what happens when an entire industry leans on one export market for too long?

We look at this across four levels, from the bottom up. The System Level approaches agility as an engineering problem: workflows, machines, and process control on the shop floor. At the Organizational Level, it becomes a human problem how teams and structures hold together under pressure. The Economic and Policy Level pulls the lens back even further into trade, regulation, and national forces that every industry operates within but rarely controls. And the Idea Level goes deeper still, into the philosophies and mental models that silently shape the way engineers and leaders think before they pick up a tool.

About halfway through the process of putting this volume together, I had a realization. Drafts came back to us time and time again, not because they were weak, but because our writers were happy to rebuild an argument as soon as a better version of it became clear. It took two revisions of an article about workspace design to get it right, and a conversation none of us expected to have resulted in a governance piece being completely rewritten. This volume is the theme unfolding in real-time. This year, we haven't just written about agility; it's something our own editorial process had to practice, one revision at a time.

We hope that one thread becomes visible as you read from level to level: agility is not one big decision. It's made of smaller ones, made on factory floors, inside organizations, across policy tables, and in the ideas we choose to carry into a room.

Thanks to every contributor who was patient through those extra rounds, to every reviewer who read as closely on the third pass as on the first, and to every hand that touched this volume before it reached yours. This magazine exists because of you.

Here's to the systems we build and the people we build them with.



Sambhav Pandit

Editor-in-Chief

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SUSTAINABLE DEVELOPMENT GOALS



SUSTAINABLE DEVELOPMENT GOALS

AGILE MANUFACTURING SYSTEM

Enabling The Future Of Modern Industry



Introduction

Manufacturing companies have been facing increasing challenges over the past few decades due to rapidly changing production environments and volatile market conditions. Customers today demand products that are not only affordable but also tailored to their individual preferences and delivered within shorter time frames. At the same time, intense global competition in terms of product quality, innovation, and customer service has placed significant pressure on manufacturers to become more flexible and responsive (Schuh et al., 2017).

To remain competitive in a globalized market, manufacturing companies must be capable of delivering customized products while maintaining low production costs, high quality standards, and short delivery times (Lamouri et al., 2020). Consequently, the ability to provide products that closely match customer needs has become a key success factor for modern manufacturing enterprises.

However, traditional production systems, which are primarily designed for mass production, often lack the flexibility and scalability required to cope with today's dynamic market demands. Their limited capability to accommodate product variety and fluctuations in production volume makes them increasingly inadequate in the era of mass customization. Therefore, there is a growing need for flexible and reconfigurable manufacturing systems capable of producing individualized products in high volumes (Petrafoith-Förster & Bauernhansl, 2019).

> ***"Agile manufacturing should not be viewed merely as a technological upgrade, but rather as a strategic transformation that integrates people, processes, and technology..."***

In response to these challenges, Agile Manufacturing Systems (AMS) have emerged as a promising manufacturing paradigm. Agile manufacturing refers to the ability of a manufacturing system to rapidly and effectively respond to changing customer demands, market conditions, and technological advancements while maintaining high levels of quality, productivity, and cost efficiency.

Product Design for Agile Manufacturing

To realize an agile manufacturing system, it is necessary to rethink the way products are designed. Product design plays a crucial role in determining the flexibility and responsiveness of a manufacturing system. In this regard, Koren et al. (2015) summarized the evolution of product design paradigms from mass production to mass customization and, more recently, to the emerging paradigm of mass individualization.

Mass Production

In the mass production paradigm, the product architecture is unified and standardized. Manufacturers design and produce products based on anticipated market demand and then offer them for sale, hoping that customers will purchase them. Customer involvement in the design process is minimal, and product variety is limited. The sequence of activities in this paradigm can be summarized as: **Design → Make → Sell**

Mass Customization

In mass customization, the product architecture becomes modular. Manufacturers design a variety of modules and provide customers with a set of predefined options. Customers can configure products according to their preferences by selecting among these modules. Once the customer places an order and completes the purchase, the product is manufactured and delivered. Dell computers represent a well-known example of this approach. The sequence of activities in mass customization is: **Design → Sell → Make**

Mass Individualization

Mass individualization represents the next stage in the evolution of product design. In this paradigm, customers actively participate in the product design process, enabling the creation of highly personalized products.



Ganesh Bahadur Rana Magar
Industrial Engineer
Vishay Siliconix Itzehoe GmbH

The process typically involves the following steps:

1. The manufacturer designs a product platform that incorporates a wide range of interfaces for integrating new modules and defines the standards for these interfaces.
2. The customer selects a suitable platform and searches for certified modules that are compatible with the chosen platform. These modules may be supplied by different vendors. Based on the selected modules, the customer designs a personalized final product.
3. The customer orders and pays for both the platform and the selected modules.
4. The modules are then assembled by the manufacturer to produce the final individualized product.

The sequence of activities in mass individualization can therefore be summarized as:
Design Platform → Customer Design → Order → Make

Characteristic	Industry 3.0	Industry 4.0
Processes	Automation	Autonomous decision making
Industry defining technology	Industrial robots	Collaborative robots
Production planning	Demand forecasting	On-Demand manufacturing
Alignment	Interconnection of production processes	Interconnection of the whole value chain
Variation	Delimited variation	Individually unique products
Goal	Efficiency	Flexibility
Base for revenue model	Selling products	Servitisation

Table 1 summarizes the characteristics of the different classes of product architecture.

The evolution from mass production to mass individualization demonstrates that product architecture is becoming increasingly customer-centric, modular, and adaptable, thereby creating the foundation for agile manufacturing.

Transformation of Manufacturing Systems

Manufacturing systems have undergone significant transformations over the past centuries. The first three industrial revolutions were driven by major technological breakthroughs: mechanization through hydro and steam power, mass production enabled by electrical power, and automation supported by electronics and Information Technology (Mogos et al., 2019). These revolutions fundamentally changed the way products were designed, manufactured, and delivered.

The latest stage in this evolution is the Fourth Industrial Revolution, commonly referred to as Industry 4.0. The term Industry 4.0 was first introduced at the Hannover Fair in 2011 and represents a new paradigm in manufacturing characterized by digitalization, connectivity, and intelligent decision-making (Saad et al., 2021).

As manufacturing paradigms have evolved, production planning and control (PPC) systems have become increasingly complex. The emergence of new manufacturing paradigms has created a growing need for seamless integration among processes, systems, and organizational functions. Consequently, PPC systems are continuously transforming to support higher levels of flexibility, responsiveness, and interoperability across manufacturing operations (Pissardini & Sacomano, 2020).

Torn and Vaneker (2019) summarized the major differences between the conventional production approach, often referred to as Industry 3.0, and the emerging Industry 4.0 manufacturing paradigm. These differences are presented in Table 2. The transition from Industry 3.0 to Industry 4.0 has also introduced a set of enabling technologies that support agile and intelligent manufacturing systems.

Paradigm	Product Architecture	Product Built	Customer's Role
Mass Production	Unified	Identical product	Choose a product
Mass Customization	Modular	Product built with one option	Choose among offered options
Mass Individualization	Open-Platform	Customer designed	Involved in final product design

Table 2: Comparison between characteristics of Industry 3.0 and Industry 4.0 (Torn & Vaneker, 2019)

Integrated and Intelligent Manufacturing Technologies

Sindhwani and Malhotra (2017) defined Agile Manufacturing System (AMS) as the capability of surviving and prospering in a competitive environment characterized by continuous and unpredictable change by reacting quickly and effectively to changing markets driven by customer-designed products and services. To achieve such agility, manufacturing systems require advanced planning, control, communication, and automation technologies.

Computer Integrated Manufacturing (CIM) is one of the early technologies developed to integrate various manufacturing activities, including product design, production planning, shop-floor control, and business functions, into a unified system. CIM enables information sharing among different functional units, thereby improving coordination, reducing lead time, and enhancing manufacturing flexibility. The concept of CIM has evolved further in the Industry 4.0 era, where seamless integration of digital and physical systems has become essential. Automation and robotics have also played a significant role in enabling agile manufacturing. Industrial robots provide high precision, repeatability, and flexibility, allowing manufacturers to rapidly adapt production lines to changing product requirements. Collaborative robots (cobots), autonomous mobile robots, and flexible robotic cells further enhance responsiveness by supporting frequent product changeovers and small batch production. Another important enabling technology is Advanced Process Control (APC). APC utilizes process models, real-time measurements, and optimization algorithms to monitor and control manufacturing processes. Particularly in semiconductor manufacturing, APC has been widely adopted to improve process stability, reduce variability, and maintain high product quality while responding to dynamic production requirements.

To further improve responsiveness and flexibility in distributed manufacturing environments, Wang and Lin (2009) developed an agent-based Agile Manufacturing Planning and Control System (AMPCS). By integrating Radio Frequency Identification (RFID) technology with Multi-Agent Systems (MAS), the proposed system possesses the characteristics of visibility, accountability, traceability, responsiveness, and flexibility in dynamic manufacturing environments.

Ultra-Flexible Factories

Schlegel et al. (2019) presented the concept of ultra-flexible factories to meet the requirements of mass customization. The key concept is the utilization of modular and mobile machines that can be continuously reconfigured and repositioned according to current production orders.

Matrix Fusion Factory (MFF) is an example of an ultra-flexible factory. It is a digital-physical factory created by fusing a standardized coordinate system with the real

factory (Siegert et al., 2017). Information from the real factory is registered according to time and location and transferred into the standardized coordinate system. The standardized coordinate system classifies data and information according to the required degree of accuracy and resolution. Furthermore, it maps the manufacturing system and fuses the physical production system with its digital representation (Zarco et al., 2019).

In MFF, a machine is considered a temporary combination of technical functional modules. These modules are continuously coupled, decoupled, and reassembled at different locations to process customer-specific orders. Consequently, the entire production system operates in a continuous flow and remains in a unique state at any given time.

Cyber-Physical Production Systems (CPPS)

Cyber-Physical Production Systems (CPPS) are Cyber-Physical Systems (CPS) applied in manufacturing environments to perform production-related tasks. According to Monostori et al. (2016), Industry 4.0 represents a new approach to organizing and controlling complete value-adding systems to fulfil individual customer requirements at the cost level of mass production. Achieving this objective requires the integration of physical manufacturing resources with digital technologies through CPPS. The three main characteristics of CPPS are:

- **Intelligence (Smartness):** The capability of system elements to acquire information from their surroundings and act autonomously.
- **Connectedness:** The ability to establish and utilize connections with other system elements, including human operators, for cooperation and collaboration, as well as access knowledge and services available on the Internet.
- **Responsiveness:** The capability to respond dynamically to both internal and external changes.

Communication Systems in CPPS

Architecture models and communication infrastructures are prerequisites for intelligent production systems. The enormous amount of data generated in such systems must be appropriately processed and presented to engineers and operators. To reduce costs and increase flexibility in manufacturing processes, open, decentralized, and flexible information architectures are required (Zarco et al., 2019).

CIMOSA (Computer Integrated Manufacturing Open System Architecture), TOGAF (The Open Group Architecture Framework), and PABADIS'PROMISE are examples of open architectures that support information integration in manufacturing systems.

Figure 1 illustrates the transition from the traditional automation pyramid towards the highly connected architecture of CPPS.

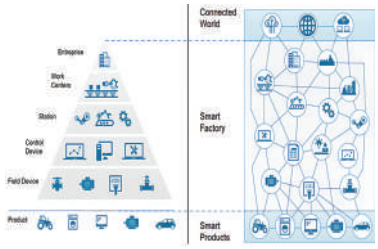


Figure 1: Automation pyramid vs connectivity in CPP

The Digital Production Twin

The Digital Production Twin represents a virtual image of production processes that supports data-driven decision-making through individualized digital applications (Schuh et al., 2020). A digital twin is a data model of a single asset, such as a product, machine, or service, that captures its properties, status, information, and operational data throughout the entire value creation process. Consequently, the digital twin provides a sufficiently accurate representation of real-world objects and processes. When such a digital representation is applied to manufacturing objects and processes, it is referred to as a Digital Production Twin.

Digital Twin Shop-Floor

The shop floor is the fundamental unit of manufacturing operations. To realize smart manufacturing, interaction and convergence between physical and virtual spaces are imperative. Based on digital twin technology, Tao and Zhang (2017) introduced the concept of the Digital Twin Shop-Floor (DTS), which provides an effective approach for achieving physical-virtual convergence.

DTS represents the shop-floor from two perspectives: the physical and the virtual. It consists of four main components: (1) physical shop-floor, (2) virtual shop-floor, (3) shop-floor service system, and (4) shop-floor digital twin data.

Figure 2 presents the conceptual model of DTS.

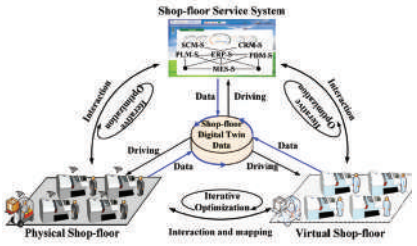


Figure 2: Conceptual model of DTS

Production factors such as human resources, equipment, materials, products, and environmental conditions continuously transmit data and information to the virtual space and receive control instructions in return. The physical shop floor is therefore capable of realizing interconnection and interaction among manufacturing entities.

Various wired and wireless sensors can be deployed on equipment to collect operational information such as machine speed, energy consumption, and tool wear. Modern manufacturing equipment with high levels of automation often incorporates embedded modules capable of providing real-time operational data. RFID technology can be utilized for lifecycle tracking of products and materials. OPC Unified Architecture (OPC UA) has emerged as a platform-independent communication protocol that enables standardized and interoperable data exchange across manufacturing systems.

Challenges and an Appropriate Approach Towards Digital Transformation

Despite the enormous potential of agile manufacturing and Industry 4.0 technologies, their implementation remains challenging for many manufacturing companies. The transformation from conventional production systems to intelligent and agile manufacturing environments requires significant investment in technology, infrastructure, and human resources. In addition, many companies operate legacy equipment that was not originally designed to

communicate with modern digital systems. Integrating these heterogeneous systems often requires substantial engineering effort and investment. The successful implementation of agile manufacturing not only depends on technological advancement but also on organizational readiness and workforce competence. Resistance to change within organizations may further slow down the digital transformation process.

Cybersecurity is also becoming increasingly important as manufacturing systems become highly interconnected. The integration of shop-floor equipment with enterprise systems and cloud services exposes production systems to potential cyber threats. Therefore, ensuring data security, system reliability, and information integrity is essential.
Manufacturing companies, particularly small and medium-sized enterprises (SMEs), should avoid attempting a complete transformation at once. Instead, digital transformation should be considered as a gradual and continuous improvement process.

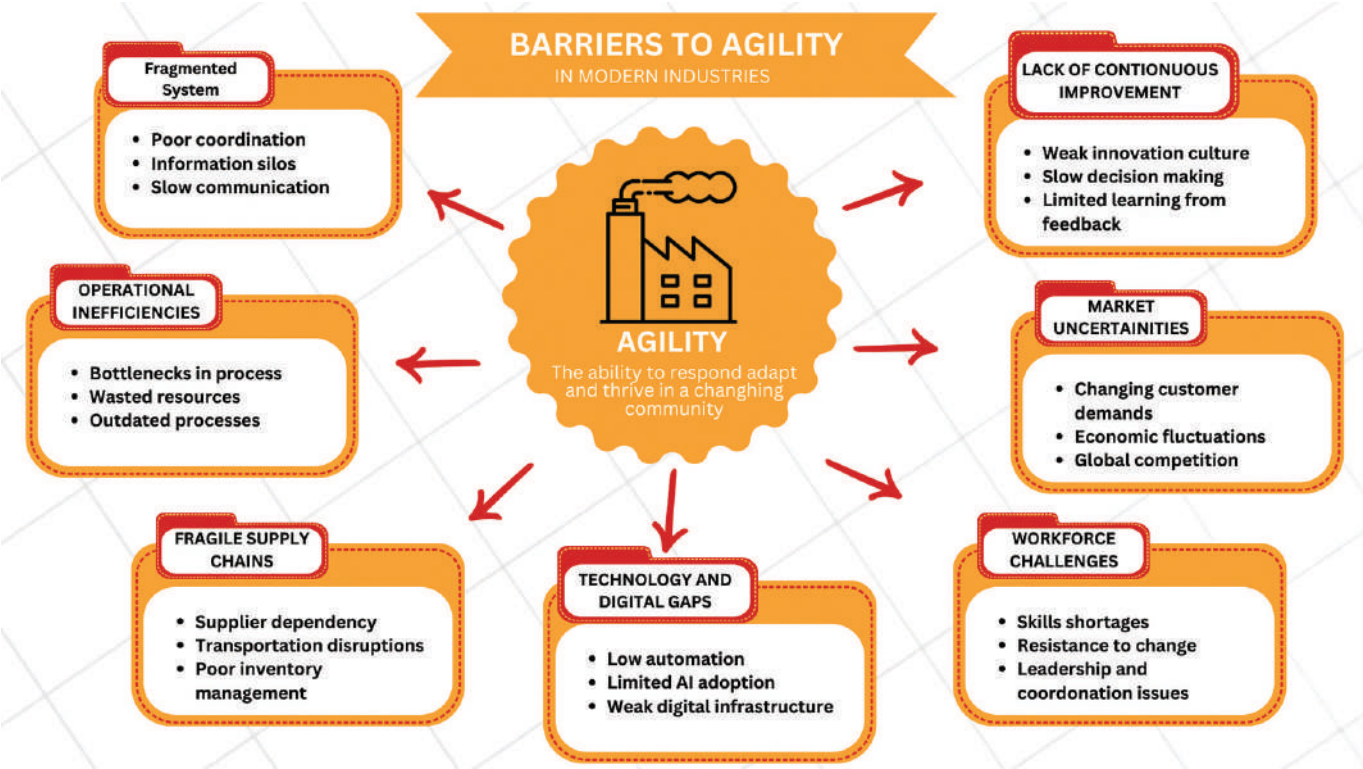
A practical approach for starting the transformation is to begin with small pilot projects that provide immediate business value. Examples include machine condition monitoring, production data collection, digital visualization dashboards, or implementation of RFID-based traceability systems. These projects require relatively low investment while allowing organizations to gain experience with digital technologies.

Once reliable data collection and communication infrastructures are established, companies can progressively introduce higher-level technologies such as Advanced Process Control (APC), Manufacturing Execution Systems (MES), Digital Twins, and Cyber-Physical Production Systems. Such a step-by-step implementation strategy reduces investment risks and facilitates organizational learning.

Ultimately, agile manufacturing should not be viewed merely as a technological upgrade, but rather as a strategic transformation that integrates people, processes, and technology to create a sustainable competitive advantage.

Conclusion

Manufacturing industries are undergoing a profound transformation driven by increasing customer expectations, rapid technological advancements, and intensified global competition. Agile Manufacturing Systems have emerged as a promising paradigm capable of addressing these challenges by combining flexible product architectures with advanced digital technologies. The integration of technologies such as automation, cyber-physical production systems, digital twins, and intelligent communication infrastructures enables manufacturers to respond rapidly to changing market demands while maintaining competitiveness. Nevertheless, successful implementation requires not only technological investment but also organizational readiness and a culture of continuous learning. As manufacturing continues to evolve towards Industry 4.0 and beyond, agility will remain a key capability for achieving sustainable competitive advantage.





FROM FIBER TO FUTURE

The Strength Working Against Us

When the textile industry looks for environmentally sustainable alternatives to cotton and synthetic fibre, hemp keeps coming up as a promising answer. But turning that rugged plant into soft yarn people actually want to wear has proven far harder than expected. Hemp is strong, but that strength is exactly why it's so hard to spin into soft and usable yarn. No matter what treatments are applied, hemp yarn struggles to achieve the smoothness of cotton or silk.

Cotton absorbs small tension changes during spinning, which is why it can stretch about 7% to 8% without snapping, while hemp usually elongates only around 1% to 3% (Delhom et al., 2024; Kirk et al., 2023). The bast fibre of the hemp plant contains significant amounts of lignin and natural waxes and has a somewhat harsh texture due to its rigid cell wall structure. Due to its rigid nature and limited elasticity of the cell, hemp fibre simply breaks when exposed to sharp tension variation in the process of making yarn.

Hemp stalks vary in diameter and moisture content also. A traditional decortication machine uses a fixed roller gap, so thin stalks get crushed, and thick stalks don't separate properly. This leads to uneven spots in the yarn, and those weak points are exactly where breakage happens during high-speed spinning, and there is no clean way to soften hemp without sacrificing something.

> ***"Hemp is strong, but the same strength is working against us.***

Removing the natural gums that bind hemp fibres requires either retting or chemical treatment. Dew retting is weather-dependent and slow; water retting pollutes; enzymatic retting is expensive and hard to control, while chemical treatment is faster but weakens the fibre. So, every innovation creates a new problem elsewhere.

Even after going through this process, it does not become soft enough. Nano-finishing and enzymatic treatments are done, but the fabric still can't fully match the premium feel of cotton or silk. That is why truly soft 100% hemp yarn at scale remains impracticable despite the constant innovation.

A Global Search for Softness

Despite this, engineers worldwide haven't stopped trying. Over the years, different countries have developed their own methods to make hemp yarn softer and more usable. China relies heavily on chemical degumming combined with mechanical softening. This gives fast results at a large scale, but the chemical treatment tends to weaken the fibre over repeated processes. Europeans favour dew retting and enzymatic retting because they are more environmentally friendly, but the process is slower and harder to control consistently across large batches.

Manufacturers are testing combinations of hemp with modest amounts of cotton, viscose, and fabrics like those. When the fabrics are blended, it makes the yarns much easier to spin and feel softer. But this isn't a real solution because the fabric is no longer 100% hemp.

While these innovations and practices improve hemp yarn quality to a greater extent, none of them eliminate the core problem, i.e., hemp's natural stiffness and inconsistency. The traditional methods rely on fixed friction discs or springs that can't adjust to yarn thickness or sudden tension changes instantly. They only reduce hemp's harshness without solving the real problem.

Closing the Loop

Hence, a more advanced engineering solution is necessary that can actually react to hemp's unpredictable behaviour in real time and fix exactly that particular bottleneck. This is where a closed-loop PLC and magneto-rheological (MR) fluid tensioning system are introduced. It fills the gap by reacting to hemp's unpredictability in real time. A closed-loop PLC (Programmable Logic Controller) controls the magnetic field of the MR fluid to adapt resistance and prevent sudden tension spikes. The sudden spikes are most likely caused by a thick spot, a thin spot, or unexpected fibre stress. PLC constantly monitors the yarn through sensors and checks for any sudden spike in tension. It instantly sends a signal to fix the tension before the yarn can snap. The actual fixing is done by a special liquid called MR (Magneto-Rheological) fluid, which can change from watery to thick and soft to sticky in milliseconds. The stronger the magnetic field, the thicker the fluid becomes, and the thickness controls how much resistance the yarn feels.



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The liquid and gel shift rapidly, which allows the tensioning system to respond so precisely and quickly that it gives just enough resistance to the yarn that it does not snap.

Together, this creates a closed loop: sensors detect stress, the PLC processes it, and the MR fluid adjusts tension automatically, over and over, without any manual interaction. This system actively responds in real time, which results in fewer yarn breakages, higher spinning speeds, and a more consistent and usable yarn.

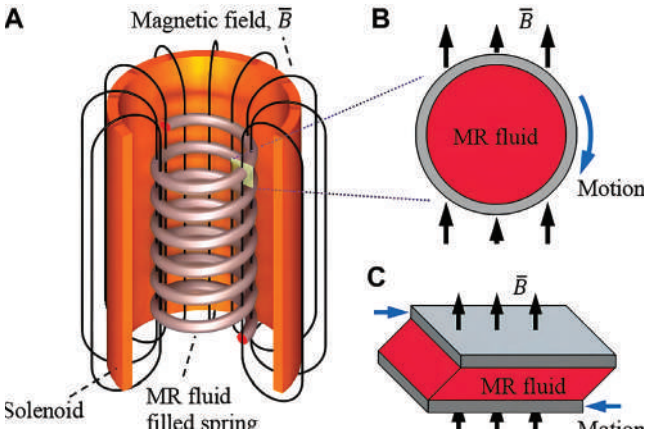


Figure: Diagram of the spring-solenoid system and MR fluid shear mode (Source: Sikulskyi et al., 2022)

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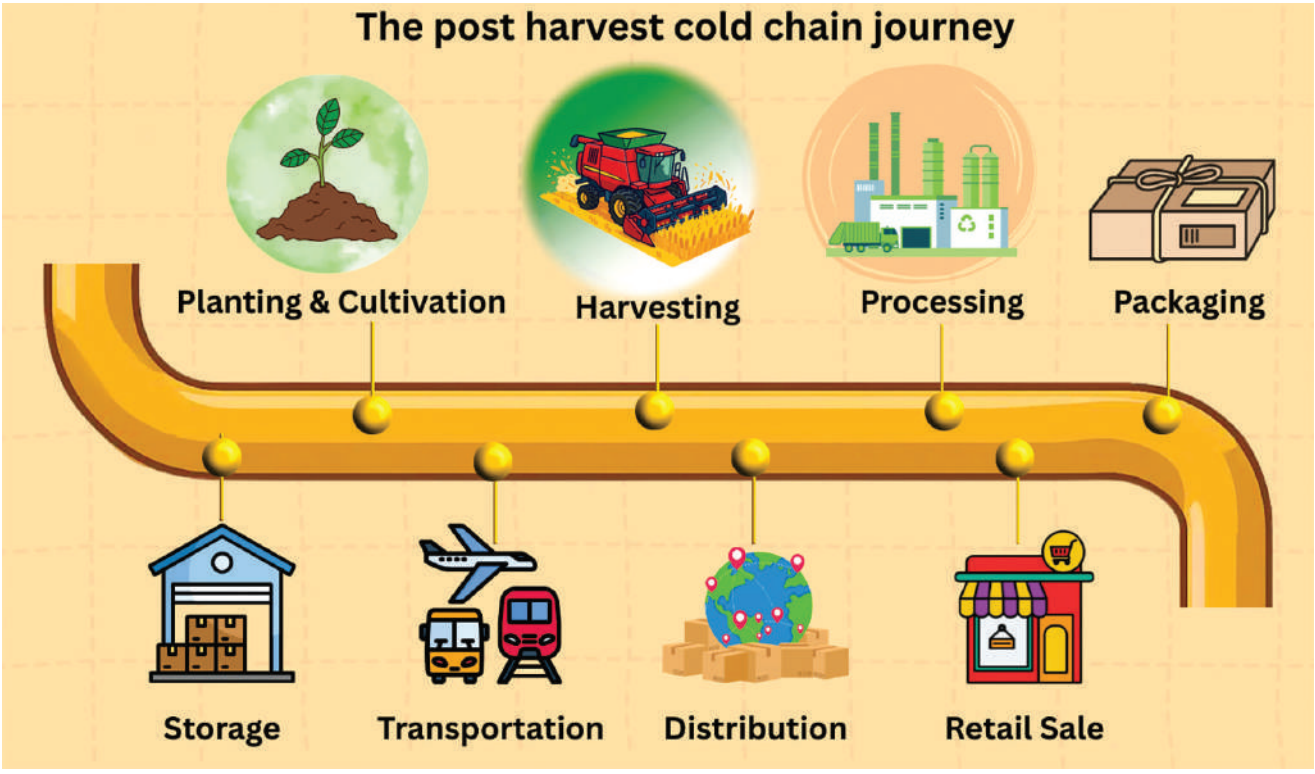
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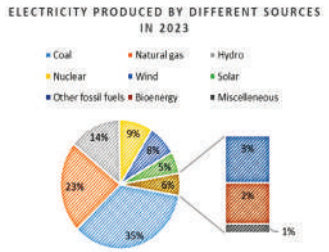


IS IT POSSIBLE TO FULLY GO GREEN?

According to the International Energy Agency (IEA), in 2023, almost 42% of the electricity produced globally was consumed by the industrial sector, so it's an important question to ask where all of that electricity comes from. The answer, for now, is still overwhelmingly fossil fuels. But the gap is closing faster than most people realise.

Where We Stood in 2023?

In 2023, fossil sources such as coal and gas produced 61% of global electricity. Coal was the single largest fuel, making up 35% of global generation, while natural gas produced 23% and other fossil generation made up around 2.7%. Together, renewables reached 30% of global electricity generation for the first time, a historic milestone. Within that, hydro remained the largest low-carbon source at 14%, nuclear contributed 9.1%, wind produced 7.8%, and solar accounted for 5.5%. Together, solar and wind generated 13.4% of global electricity, while bioenergy contributed around 2.4%.

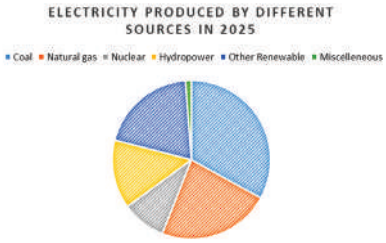


> ***"The question is no longer whether the world will move away from fossil fuels. The question is whether it will do so fast enough."***

Where We Are in 2025?

The picture has shifted considerably in just two years. In 2025, Coal's share fell to around 33%, while natural gas accounted for roughly 21–23% of global electricity generation. Nuclear power held steady at approximately 9% of global output, and hydropower has remained the largest single renewable source at around 14%. The combined renewable figure of ~33.8% already includes hydro, solar, wind, and bioenergy, together generating approximately 33.8% of global electricity, surpassing coal for the first time since 1919, a landmark moment in energy history.

Despite renewables overtaking coal, fossil fuels as a whole, coal plus gas and other fossil sources, still generated well over half of global electricity in 2025. The transition is real and accelerating, but it is far from complete.



What is the Carbon Cost of Our Choices?

The environmental case for switching is compelling

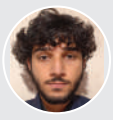
when you look at lifecycle CO2 emissions, meaning the total greenhouse gases emitted across the full life of a power source, from construction through decommissioning.

- **Coal:** approximately 820–1,000 g CO2 equivalent per kWh, depending on plant type and efficiency
- **Oil:** approximately 650–750 g CO2 equivalent per kWh
- **Natural gas:** approximately 450–500 g CO2 equivalent per kWh
- **Solar PV:** approximately 40–50 g CO2 equivalent per kWh
- **Hydropower:** approximately 24 g CO2 equivalent per kWh (though this varies widely)
- **Wind:** approximately 11 g CO2 equivalent per kWh

The contrast is stark. Over its lifetime, a wind turbine produces roughly 90 times fewer emissions per unit of electricity than a coal plant. These figures confirm that even when factoring in manufacturing and construction, renewables are dramatically cleaner than any fossil fuel source. Not only that, but the financial world has also taken notice of its potential.

The Investment Surge

According to BloombergNEF's annual Energy Transition Investment Trends report, global investment in the energy transition hit a record $2.3 trillion in 2025, up 8% from 2024. The largest drivers were electrified transport at $893 billion (up 21% year-on-year), renewable energy at $690 billion, and grid infrastructure at $483 billion.



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For the second consecutive year, investment in clean energy supply exceeded investment in fossil fuel supply, with the gap widening to $102 billion in 2025. This is a meaningful shift, but it is worth being precise that clean energy investment is not yet "nearly double" fossil fuel investment overall. Though the gap is growing, the comparison depends heavily on whether you include electrified transport and grid spending alongside direct energy supply.

China, the EU, and the United States continue to lead global spending, though the growth rate of investment has slowed from around 27% annually in 2021 to 8% in 2025 as markets matured and geopolitical pressures mounted. BloombergNEF's best-case scenario projects average annual energy transition investment reaching approximately $2.9 trillion over the next five years.

If current momentum continues, credible projections suggest the world could reach 70–80% renewable electricity by 2050. But fully replacing fossil fuels, particularly in heavy industry and developing economies, will take considerably longer. A lot is already changing in different sectors.

Industries are Already Making the Switch.

The transition isn't just happening in electricity grids. Several industries are pioneering the use of clean energy in their own processes, proving that even the hardest sectors to decarbonise can change.

Green Steel — HYBRIT, Sweden: Steel production accounts for roughly 7–8% of global CO2 emissions, making it one of the most carbon-intensive industries on earth. The HYBRIT project, a joint venture between Swedish steelmaker SSAB, energy company Vattenfall, and mining firm LKAB, has been working to change that. Using green hydrogen produced from renewable electricity to replace coal in the iron-making process, HYBRIT delivered the world's first fossil-free steel to truck manufacturer Volvo in 2021. Once fully operational, the project could reduce Sweden's total CO2 emissions by approximately 10% and cut 35–50 million tonnes of steel-related emissions globally per year. A related Swedish startup, Stegra (formerly H2 Green Steel), is building the world's first commercial-scale green steel plant in Boden, Sweden, with ambitions to produce 5 million tonnes of green steel annually by 2030.

Cement — Carbon Capture at Scale: Cement is responsible for roughly 8% of global CO2 emissions, and its chemistry makes it particularly stubborn to decarbonise. About 60% of its emissions come from a chemical process called calcination, not from burning fuel. However, progress is being made. Heidelberg Materials' cement plant in Brevik, Norway, became the first in the world to operate with industrial-scale carbon capture and storage (CCS) technology, designed to trap up to 50% of the plant's emissions. The company plans to scale this to capture close to 100% of emissions at further plants by 2030. Meanwhile, major cement producers including UltraTech, Shree, and Dalmia Cement have pledged to achieve 100% renewable electricity by 2050 under the RE100 initiative.

Aluminium: Aluminium smelters around the world have signed long-term power purchase agreements (PPAs) for solar and wind energy in Australia, Brazil, and Spain, totalling around 4.1 GW of clean energy capacity as of 2024. Aluminium is highly energy-intensive but, unlike cement and steel, its smelting process is already fully electrified, meaning it can switch to renewables without fundamentally reinventing the production method.

Tech Giants Leading by Example: Companies like Google, Apple, and Microsoft have long committed to running their operations on 100% renewable electricity. Google, for instance, has been carbon-neutral since 2007 and reached 100% renewable energy matching for its global operations. These large-scale corporate power purchase agreements have played a meaningful role in driving down the cost of solar and wind by creating guaranteed demand for clean electricity.

What Is Holding the Transition Back?

If renewables are cheaper, cleaner, and increasingly more abundant, why haven't we already made the switch? Several real and stubborn barriers remain.

Grid infrastructure: Solar and wind are intermittent; they generate electricity only when the sun shines or the wind blows. Scaling them up requires massive investment in grid upgrades, long-distance transmission lines, and energy storage (particularly batteries) to manage supply and demand. In 2025, grid investment reached $483 billion globally, but experts warn that even this is not enough to keep pace with the growth of renewable generation.

Hard-to-abate industries: Sectors like steel, cement, shipping, and aviation are deeply reliant on fossil fuels not just for energy, but as chemical feedstocks. These industries collectively account for a significant portion of global emissions and cannot easily be electrified with today's technology. Green hydrogen and carbon capture are promising but still expensive and unproven at scale.

Developing economies: Countries in the Global South are still in the process of expanding their electricity access. Coal remains cheap and reliable in markets where grid infrastructure is limited. India, for example, still generates nearly 75% of its electricity from coal, and demand is growing faster than clean energy can be deployed.

Financing gaps: Wealthy nations can access cheap capital to fund the energy transition. Many developing countries cannot, meaning that the countries most vulnerable to climate change are the least able to afford the infrastructure to reduce their emissions.

Political and policy instability: Investment in clean energy is sensitive to policy signals. In 2025, regulatory changes in China and political headwinds in the United States contributed to a 9.5% year-on-year drop in renewable energy investment even as the overall transition investment figure hit a record high.

The Road Ahead

So, can we fully go green? The honest answer is: yes, eventually, but not as quickly as the climate requires without a serious acceleration of effort.

The good news is that the trajectory is real. Renewables have overtaken coal in the global electricity mix for the first time in a century. Investment records are being broken year after year. Green steel is no longer science fiction; it is being delivered to customers today. The technology exists. The economics are increasingly favourable. And the will, in many parts of the world, is growing.

The harder truth is that electricity is only part of the story. Decarbonising heat, transport, heavy industry, agriculture, and land use will each require its own set of solutions, many of which are still being developed or have yet to reach

commercial scale. The transition will not be a single switch that flips; it will be a long, uneven, and sometimes frustrating process of rebuilding the systems that modern civilisation runs on.

But the direction of travel is clear. The question is no longer whether the world will move away from fossil fuels. The question is whether it will do so fast enough.

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चिलिमे जलविद्युत कम्पनी लिमिटेडको अगुवाईमा स्थापना भएको यस चिलिमे - सेती हाइड्रोपावर कम्पनी लिमिटेडले प्रवर्धन गरिरहेको सुदूरपश्चिम प्रदेशको बझाङ्ग जिल्ला जयपृथ्वी नगरपालिकामा अवस्थित ८७ मेगावाट क्षमताको अर्धजलाशययुक्त जलविद्युत आयोजना सेती नदी - ३ जलविद्युत आयोजना, नेपाल सरकारको " जनताको जलविद्युत कार्यक्रम" अवधारणा अनुसार निर्माणाधीन आयोजना हो । नेपाल विद्युत प्राधिकरण, चिलिमे जलविद्युत कम्पनी लिमिटेड, प्रदेश सरकार, स्थानीय सरकार, स्थानीय जनता लगायत नेपाली जनताको संयुक्त लगानीमा यो आयोजना निर्माण हुने योजना रहेको छ।

INTERVIEW



Ishwor Bahadur GC

Mr. Ishwar G.C.
Chairman, GC Group Nepal
Executive Committee Member, FNCCI
Owner & Chairman, Lumbini Lions

> ***If you want to start something on your own, do something new. Don't copy others... The risk you're taking should be calculative for it to be successful.***

Ishwar GC is the Chairman of GC Group, a prominent business conglomerate in Nepal. Building upon the entrepreneurial foundation established by his father, Hari Bahadur GC—who began in the textile industry in 1985—Ishwar GC expanded and modernized the family venture into a multi-sector enterprise. Under his strategic leadership, the GC Group operates across diverse industries, including healthcare, medical device manufacturing, sports, hospitality, agriculture, FMCG, IT, finance, and hydropower. His vision prioritizes operational excellence, local manufacturing, and sustainable economic growth, with a major focus on pioneering domestic medical device production and expanding Nepal's tourism and hospitality infrastructure.

Every industrial trajectory begins with a foundational idea. Looking back at the inception of the GC Group, you set out with a clear vision: to keep local talent in Nepal, build domestic manufacturing, and create economic self-reliance. What was the initial spark or market gap in Nepal that triggered this mission for you?

Well, there is a huge gap to bridge between industrialists and skilled manpower. The scrutiny remains a problem between both parties: the industrialists believe they would be unable to find perfectly suited manpower, while the manpower believes there are no opportunities in Nepal. So, industrialisation is important for job creation, while proper education and skills are important for the manpower to be hired. This specific gap in the market triggered the mission for us.

Before Fortuna Healthcare, the majority of Nepal's medical supplies were imported. You built a WHO-GMP and ISO-certified facility in Lalitpur to manufacture syringes and medical devices locally. What did it take to establish this precision facility from scratch?

We have established a factory with international standards when we were not even compelled to do so. Anything you do, do it while thinking about 10 years down the lane. The harsh truth is people do not completely follow the rules, but we have been strict regarding our operational procedures, going beyond the rules, as health is a very sensitive sector. The operation needs high precision; that's why we had to hire operational leaders from India, but all their assistants are Nepali so that we can promote them in operational management positions in the future.

Producing high-precision devices like 31G insulin needles—thinner than human hair—leaves zero margin for error. How does your team ensure quality control?

There are already guidelines available in international standards that can be followed. So, there are not many add-ons that we need to do from our side. The affiliated technological machinery is imported, and the operational leaders are from India, as I mentioned earlier, ensuring the best possible outcome for quality control.

Through your executive role at FNCCI, you represent corporate entities and engage directly with state policymakers. What specific regulatory or economic policies are you advocating to protect domestic industrial investments?

There is no specific policy that I would like to change. I strongly believe that the government should forget the past and introduce entirely new policies, thinking 20 years ahead. If we become specific to policy changes, then it would not be able to accelerate the kind of growth our country needs. If it were possible, we should have been thinking 50 years ahead in the future but due to a lack of R&D, it is hard to achieve. Anybody willing to start something on their own or at least want to reach a certain level in the country should be able to do it, and for that, a simple policy reform won't be enough.

Your acquisition of the Lumbini Lions franchise under Fortuna Healthcare caught nationwide attention. What made you want to invest in a cricket franchise, and how does sports asset building fit alongside your broader industrial ventures at GC Group and FNCCI?

Cricket has been my passion since I was young. We had even initiated a cricket club named "7 Star Cricket Club" for youngsters when we were young, which unfortunately could not be formalised due to some circumstances. I feel cricket is a source of motivation and discipline. Just as others have pictured cricket that could be a probable booming sector in Nepal, I too have seen its potential to introduce Nepal amongst international people in a newer segment.

With eight teams participating in the NPL organised by the Cricket Association of Nepal (CAN), what do you believe this professionalised franchise structure will do for the broader economic landscape, sports infrastructure, and career sustainability for Nepali athletes?

As we all know, the IPL is highly celebrated amongst people in different nations, with a huge Nepali fan following as well. Why would we Nepalese just keep cheering for sports teams of other countries while there could be a possibility to cheer for our own people and for our own national teams? That feeling of patriotism and my immense love for cricket lured me to invest in a cricket franchise, and I also believe cricket could be a sector that could bloom other sectors while giving employment opportunities and creating a ray of hope among the athletes all over Nepal.

Lumbini Lions had started a Lumbini Lions talent hunt, which invited local talented players to the team. How did that move strengthen the community, and how do you maintain the "Pride of Nepal" brand as a whole?

Lumbini Lions has also appointed Mr. Robin Singh,who serves as the coach of Mumbai Indian Emirates, bringing his experience and expertise to the team. We believe Cricket could be a platform to promote Nepal in the international market. Why should we limit ourselves to introducing ourselves with the things that we've been gifted from nature? Why don't we create an opportunity to create pride for Nepal from the things that we Nepalese have created? NPL has been able to create a spark among people that there is an opportunity for the growth of sports in Nepal and develop a deeper feeling of patriotism when they are cheering for their hometown in the NPL. It has brought people closer to Nepali cricket and to each other, and that's how it has been creating a positive impact to strengthen the community.



The resilience of Lumbini Lions is truly commendable, looking at the growth it has been able to achieve. How can one bring such resilience and agility in any sector they're in?

Dedication. No matter what kind of condition you're in, whether you're in your highs, lows, or any situation, you must be committed to delivering the best output. And also, identifying your weaknesses is crucial. If you can figure out your flaws on your own, it's fine, but when you receive criticism, you need to work on it and deliver your best. That's how we could show significant growth in Lumbini Lions, and that mantra works for any other sector as well.

The Ministry of Youth, Labour and Employment focuses on reducing youth unemployment through vocational training. How can private sector groups partner with these national efforts to create genuine, high-value domestic career pathways for young Nepalis?

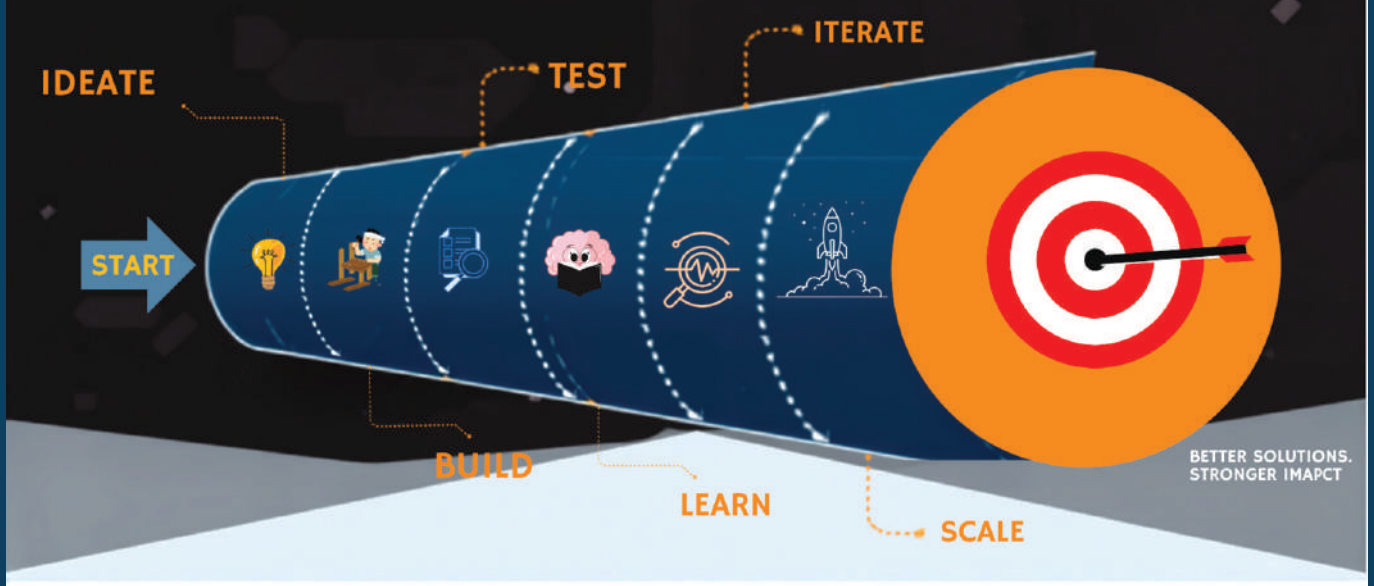
In order to reduce youth unemployment, firstly the government has to know what the youth have studied and what job they're seeking. It all revolves back to having a data centre. The main reason for brain drain and unemployment is that the government is unaware of youths' expectations and what skills they have, so that they can integrate the information to create a happy, employed life for the youths. What the private sector can do is create a software or IT platform to store information about the expectations and qualifications of youths to create a data-driven solution. Private sectors could use that information to generate more jobs according to the qualifications of youths to solve this major issue.

What would you like to advise the young industrial engineers reading Industrial Vision Vol. 11?

If you want to start something on your own, do something new. Don't copy others. Usually there is a tendency to start a business looking at other people and how they're doing. These types of businesses usually collapse. Some students generate business ideas with their friends and start without evaluating the market and the consequences. Don't do that either. The risk you're taking should be calculative for it to be successful.

Fail Fast
Prototyping Tunnel

Experiment, Learn, Iterate, Improve



ITERATE

Iterate, testing stage fiction, sequentially and toward data base is out.

LEARN

Iterate, testing stage fiction, sequential targetally base is out.

SCALE

Iterate, testing state location, sequentially targets barely base is core.

"The goal isn't to avoid failure."

It's to learn faster.

ANFA'S GOVERNANCE CRISIS

A Lession in designing resillent organizational system



Image Source: Nur Photo

In June 2026, FIFA suspended the All Nepal Football Association (ANFA), the governing body for football in Nepal, for disagreements over its electoral process and allegations of third-party interference. It has disrupted international competitions, derailed development programmes and resulted in serious financial and operational uncertainty for the football ecosystem in Nepal, impacting clubs, players and youth development programmes. More importantly, it revealed basic defects in the way the organisation was run.

It wasn't a dramatic event at first. It all began months ago with something mundane: a row over when to hold an internal election. But by the time the suspension was imposed, what should have been a routine governance cycle had collapsed into a total system failure. Most of the coverage described it as a political battle between a sports federation and its government regulator. That framing isn't wrong, but it misses a more useful lesson. Instead of asking who was to blame, the more meaningful question is where the process went wrong and why the system was not able to make room for change. ANFA is not just a sports governing body, but a complex system of organisations in which regulatory requirements, institutional responsibilities and stakeholders' expectations have to be aligned. The crisis was in football administration, but the problems are common to any organisation that operates in a complex regulatory environment.

> ***"Organizations rarely fail because of a single decision; they fail when their systems lose the ability to adapt.***

What Happened

Between late 2025 and mid-2026, ANFA faced a governance dispute involving Nepal's National Sports Council (NSC), FIFA, and the Asian Football Confederation (AFC). Differences in regulatory expectations, disagreements over the electoral process, and limited coordination between key stakeholders gradually escalated into a broader institutional crisis. The suspension that followed was not merely the result of one controversial decision but the outcome of a governance process that struggled to accommodate multiple authorities operating under different rules and priorities.

The Process Map

The crisis illuminated a common organisational problem: procedures that work well in a stable environment often collapse when multiple stakeholders have independent authority and changing expectations. In these cases, sequential decision-making, delayed communication, and isolated approvals increase the chances of misunderstanding and costly rework. Organisations need to think of governance



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as an integrated process with ongoing coordination and common visibility, rather than a series of stand-alone approvals.

In industrial engineering, this is a waterfall process. You plan everything upfront, execute it in one long line, and check the result at the end. Waterfall works well when requirements are stable but fails when multiple independent actors can introduce new requirements along the way. ANFA's environment was exactly that kind of volatile. Four independent entities (ANFA, the NSC, FIFA and the AFC, and the judiciary) could each impose new conditions. Every new requirement forced previously completed work to be reopened, creating costly rework. The process also generated waiting waste, as the NSC was engaged only after FIFA and AFC approval, leaving regulatory requirements invisible for months. Bilateral communication without multilateral checkpoints further created redundant information flows that never converged.

In the Theory of Constraints, throughput is the slowest interface. Here the NSC became the bottleneck. The process was waterfall, so the bottleneck was hidden until the last stages. By then the work-in-process inventory had grown to where the cost of rework was too high.

Root Cause Analysis

Understanding organizational failures requires looking beyond immediate events to identify the underlying conditions that enabled them. Rather than assigning blame, a structured root-cause analysis examines how process design, stakeholder interaction, and decision-making structures contributed to the outcome.

Why did FIFA suspend ANFA? Because the fears of third-party interference in its electoral process were never fully resolved.

Why were they never fully dealt with? When the NSC eased its suspension in May, FIFA and the AFC still considered some of the underlying requirements raised by the NSC in March open.

Why did that gap exist? Because there was no single shared record that all parties used to confirm exactly what had been resolved and what remained open.

What caused that gap? As there was no common record used by all parties to confirm what exactly had been resolved and what was still open, the NSC was made and tracked together.

Why did they design the process that way? The governance cycle was treated as one single, monolithic project, with no possibility for incremental validation, visual status tracking, and multilateral feedback loops. That fifth answer is the underlying cause. There was no bad faith on the part of either party. FIFA and AFC were arguing regularly because of their statutes. The NSC was acting within the four corners of its legal mandate under the Sports Development Act. Both sides were right in their own frames. There was no quick, shared way for the system to compare those frames to each other before the conflict became irreconcilable.

The Organizational Impact

Organizational failures are never confined to administrative processes alone. When governance systems break down, their effects extend to employees, stakeholders, service users, and the broader public. In the ANFA case, the suspension disrupted competitions, delayed development programmes, and created uncertainty across the football ecosystem, illustrating how weaknesses in organizational processes ultimately affect people. This is why process design is not an abstract concern. It is a stewardship responsibility. A poorly architected governance cycle does not just waste meetings and paperwork. It wastes careers, seasons, and public trust.

What a Redesigned Process Would Look Like

A better-designed process would not remove the underlying tension between a federation and its regulator. That tension is normal, even healthy. But it would surface disagreements early, while they are still small, rather than letting them grow for months inside separate information silos. The first change is visibility. All milestones, compliance requirements, and open items should live in a single shared digital dashboard, updated in real time for ANFA, the NSC, and FIFA/AFC. Like a Toyota Andon cord, the dashboard makes system state visible to everyone. If the NSC logs a concern and FIFA logs a counter-requirement, both appear on the same board. No party can believe an item is closed while another still has it open. Disagreements that lingered for months would be caught in days. The second change is smaller batches. ANFA bundled statute amendments, district elections, and executive elections into one block. A problem with any one froze everything. The redesign treats each as its own track with its own gate. Statute amendments could be ratified in February with NSC observers present, creating a checkpoint before the election timeline begins. A disagreement over one track would no longer derail the others.

The third change is shorter cycles. Instead of a six-month marathon, the process should move in two- to three-week sprints, each ending in a joint checkpoint. All parties review the dashboard, confirm alignment, and authorise the next sprint. If a stakeholder raises a new requirement, the sprint pauses while the joint team determines if it can be absorbed. Late-stage surprises become structurally impossible. The fourth change is error-proofing. There should be a standard protocol with five mandatory gates: joint scoping, statute validation with NSC sign-off, district certification, multilateral approval on the shared dashboard, and a pre-election joint audit. Certain actions should be procedurally impossible until prior gates show green. The system does not allow an election date to be announced until prerequisites are verified. Errors are caught at the source.

The fifth change is interface management. ANFA, the NSC, and FIFA/AFC should establish a standing coordination group that meets at fixed intervals. This group serves as the synchronisation layer where all three parties validate shared understanding. It transforms the process from one-way handoffs into a network of coordinated interfaces. None of these changes require ANFA to surrender its independence or the NSC to abandon its oversight role. They simply require all parties to check their requirements against each other on a regular, agreed schedule, instead of only after something has already gone wrong. Together, these improvements create a governance system that is transparent, adaptive, and collaborative. Rather than relying on isolated approvals and delayed interventions, the redesigned approach encourages continuous alignment among stakeholders, allowing emerging issues to be identified and resolved before they evolve into institutional crises.

The Deeper Lesson

The significance of the ANFA case is beyond football. It shows how organisational systems can be vulnerable when governance structures are inflexible, communications are fragmented, and stakeholder expectations are moving faster than existing processes. The suspension is a reminder

that resilient organisations are not built by avoiding disagreement but by designing processes that can handle it well. This was a failure of the process. It was a one-way, rigid system in an environment that required constant, shared feedback. The waterfall architecture, lack of shared visibility, large batch size, and absence of multilateral feedback loops created conditions where any significant requirement change would cascade into total system collapse. It wasn't a question of whether the system would fail, but when. Industrial engineering provides a rigorous framework to avoid such failures. Tools to design systems that absorb variance without breaking are shared visibility, smaller batch size, shorter feedback cycles, standard work, error-proofing, and interface control.

The aim is not to take away disagreement. Disagreement between federation and its regulator is a normal feature of governance. The goal is to develop processes that surface and resolve disagreement early, when it is small and before it can propagate through the system to a point of no return. Complex environments mean that those who work in them are bound to encounter conflicting expectations, regulatory change and competing stakeholder interests. The ability to sustain over the long term depends on the development of governance systems that foster transparency, ongoing dialogue, shared responsibility, and timely adaptation. The ANFA case shows that sustainable organisational excellence is not obtained from reacting to crises, but by developing systems capable of preventing them.

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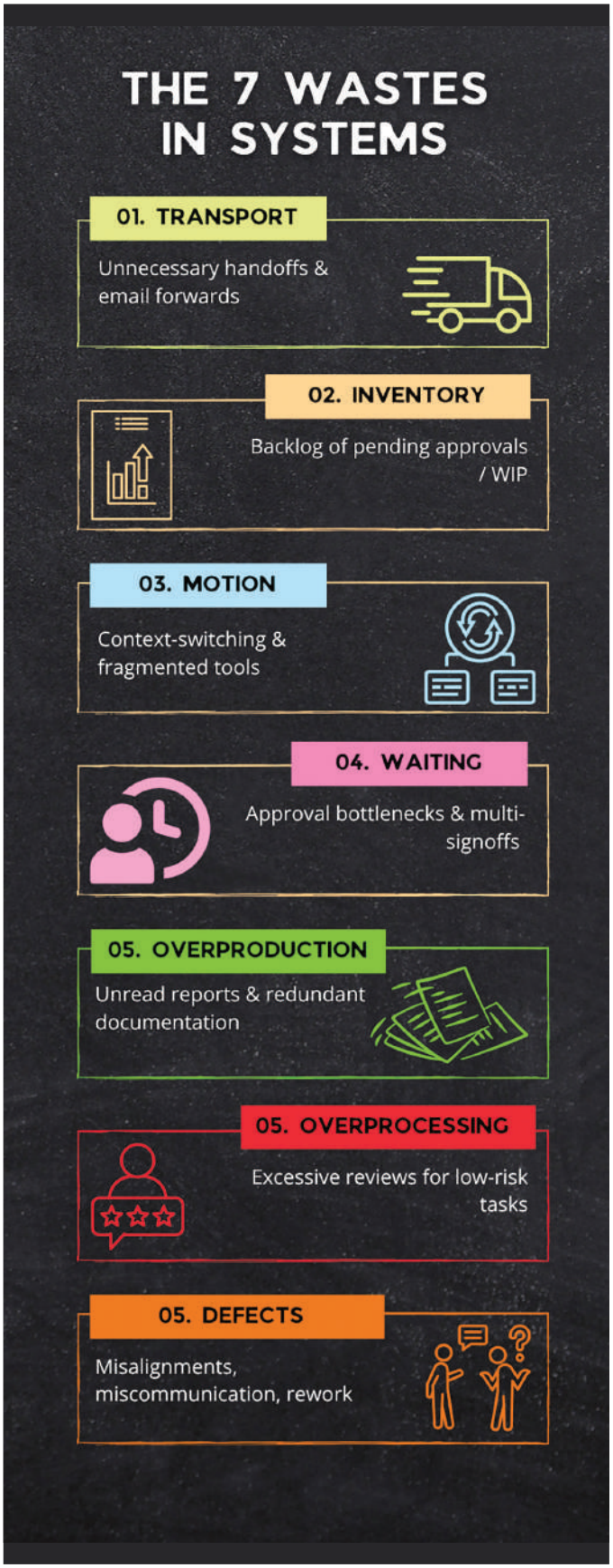
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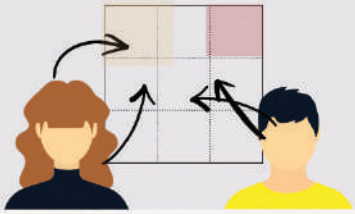


Game Theory

The Science of Strategic Decision-Making

What is Game Theory?

Study of strategic decision-making where outcomes depend on the actions of multiple players.



Key Concepts

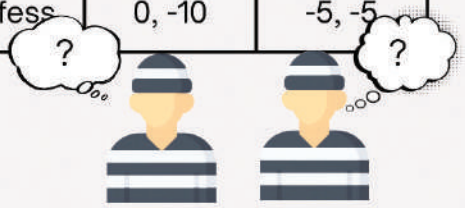
- Players
- Strategies
- Playoff
- Equilibrium

Types of Games

Zero Sum	Non--Zero Sum	Simultaneous	Sequential	Cooperative	Non Cooperative
Winner Vs. Loser	Mutual Gain	Same Time	Turn by Turn	Alliances	Act Independently

Prisoner's Dilemma

A \ B	Silent	Confess
Silent	-1, -1	-10, 0
Confess	0, -10	-5, -5



Applications

- Economics & Business
- Politics
- Military Stratigy
- Biology

Advantages

- Predicts Behavious
- Strategic Planning
- Rational Decision

Limitations

- Assumes Rationality
- Requires Full info
- Complex with Many Players

DESIGNING BEFORE MANUFACTURING

How DFM, DFA, and LCA Can Help Nepal's Industries Compete?



Introduction

Revitalizing industries is almost always addressed in terms of factories, policies, and investments. Rarely considered, however, is the decision that precedes all of these in its importance – the design of a particular product. Engineering literature has repeatedly demonstrated that design-related decisions have a major bearing on both the cost and carbon emissions associated with the production of any product – nearly 80% of the total carbon associated with the manufacture of any product is determined by the design phase, even before the first unit is manufactured [1]. For Nepal's manufacturing sector, which consists of SMEs that compete at thin profit margins with imported products, it is no mere theoretical issue.

What DFM and DFA Actually Do?

Design for Manufacturing (DFM) and Design for Assembly (DFA) are complementary methodologies that ask a simple question at the design stage: can this part be made more simply, and can it be put together with fewer steps, without sacrificing function? Rather than designing a product first and troubleshooting production problems afterward, DFM/DFA integrates manufacturing and assembly considerations into the design process itself [2].

These findings, where used, are practical rather than theoretical. For example, in a study that examined the assembly efficiency of a water leak alarm, researchers discovered that the original design was only 14% efficient in terms of assembly. By simplifying the design to use one screw instead of three and substituting the wired component with a wireless component, the assembly efficiency improved to 34% without affecting the functionality [3]. Studies conducted on industrial scale projects, for instance, the redesign of diesel engine parts using DFMA techniques, have shown a measurable reduction in production costs through reduction in part geometries and elimination of unnecessary features, all while not affecting performance. In both cases, the common theme has been that approximately two-thirds of the total part count of a product can usually be reduced or removed through minimum part count design without any changes to materials or vendors.

What Life Cycle Assessment Adds

Life Cycle Assessment takes this concept further by analyzing the effects on the environment. Life Cycle Assessment examines a product throughout its entire life cycle from raw material extraction, production, transportation, usage, and disposal to find where the environmental impact really lies instead of automatically attributing the environmental impact solely to the production phase [4]. In most product categories, the production phase itself accounts for the biggest portion of the environmental impact of the product. As such, most of the environmental impact is determined before the product is even manufactured.

It is important to note that LCA and DFA are not two competing methods; rather, each addresses a different aspect of the design problem. In the case study on the water leakage alarm, it was noted that using the combination of DFA and LCA evaluation provides a more comprehensive understanding than using either of them individually, since the changes in design that were made to make the assembling process easier did not automatically improve all categories of environmental impacts.

Why This Matters for Nepal Specifically

In Nepal, small and medium enterprises form more than 90 percent of all registered enterprises and account for about 22 percent of GDP, and are found mainly in metal and plastic home appliances, furniture, food processing industries, and handcrafting. The very products that these enterprises produce belong to the category to which the application of DFM and DFA is most relevant.

Competitive pressure is at stake here. Currently, only around 12% of Nepalese SMEs can export their products effectively, which is much lower than 45% in other similar countries, where rural companies also have to spend 25%-40% more money on delivery than urban businesses [5]. As delivery and material costs are not affected by anything but location, then there is one other aspect which can be managed by competing businesses and reduced – cost of production which is included in the final cost of the product itself and which DFAMM and DFAA aim to reduce. If a Nepalese manufacturer of metal furniture and plastics reduces parts and assembly steps, he automatically becomes closer to prices of imports without additional investments.

In addition to the first one, LCA also brings a second, more business-oriented aspect into play. The export markets, especially the European Union, are beginning to consider compulsory sustainability reporting for the imported products [6]. Nepalese



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producers that can prove they have a smaller life cycle environmental impact will be able to access those markets much more easily as these regulations become more common than not.

A Practical Starting Point

Nothing of this sort necessitates the construction of costly infrastructure in order to get started. DFM, DFA, and LCA are all systematic approaches to the design review process, which is what industrial engineers are taught to do from the very beginning. A good place to start for Nepalese manufacturers would be by performing a minimum-part-count review of one of their current product lines, in the same way that was done in the water leakage alarm example, in order to find out how screws or separate parts might be combined or eliminated.

Conclusion

The reconstruction of the industry in Nepal would involve investments and policies and other infrastructure, but the first steps that could be taken are actually more initial and less costly than is generally considered when discussing industrial revival: these include the designing phase prior to the manufacturing of the products. Through DFM, DFA, and LCA, the manufacturers of Nepal can achieve this relatively cheaply through means that industrial engineers are already familiar with.

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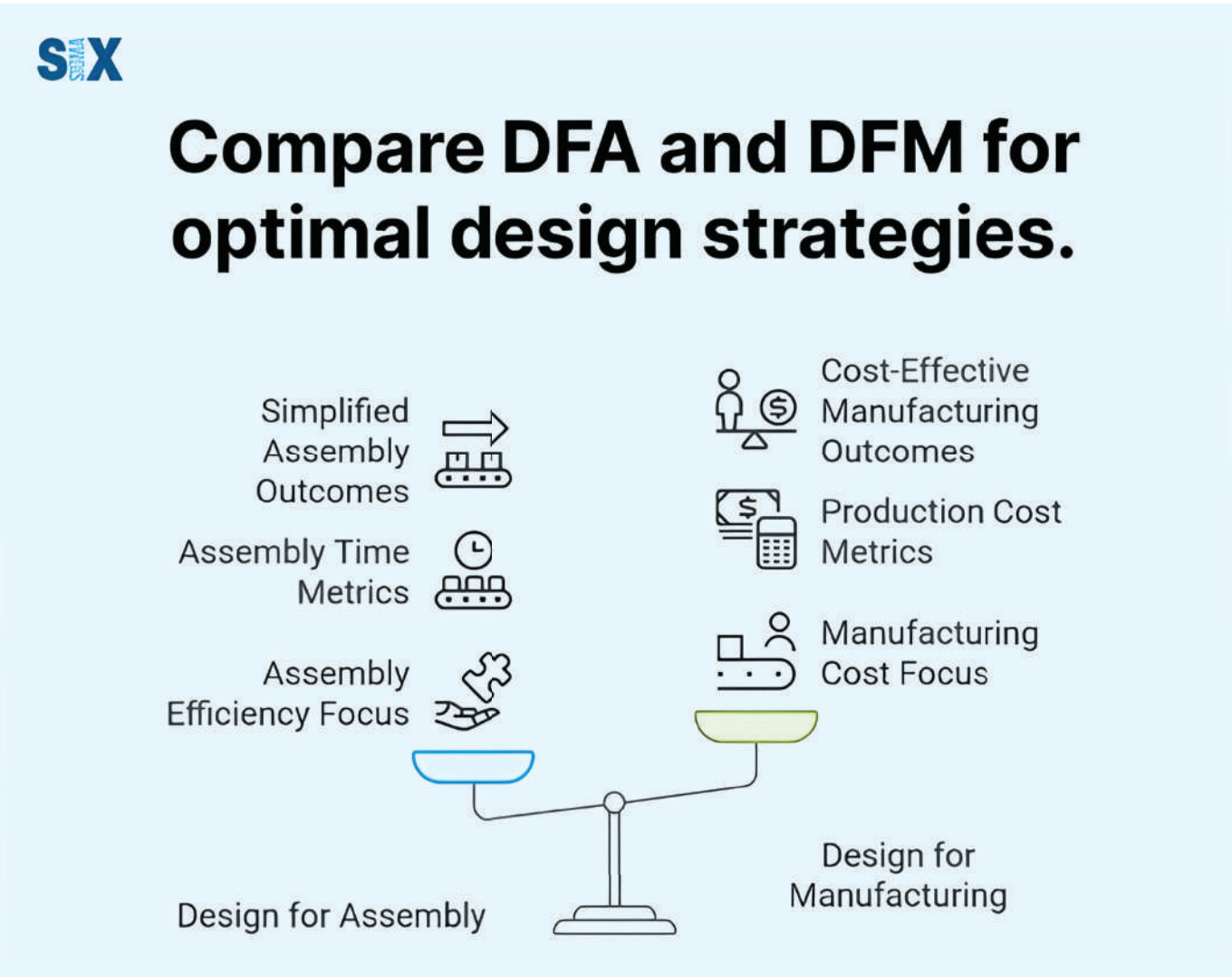
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PILGRIMAGE TOURISM & SUSTAINABLE VALUE

Rethinking Nepal's Tourism Success



Every year, Nepal gets the same headline: more tourists than last year. In 2025, the country welcomed 1,158,459 international visitors, closing in at 96.8 percent of its pre-pandemic 2019 peak.[1] Buses to Lumbini are full. Boudhanath is packed with prayer flags and camera phones. Trekking permits keep setting records. On paper, tourism is booming. But during Kartik of fiscal year 2082/83, tourism foreign exchange earnings actually dropped 12.94 percent year-on-year, even as arrivals kept rising.[3] More people are walking in. The country isn't earning proportionally more from them.

Talk to the people on the ground and you get the same story. A hotel owner in Lumbini. A homestay operator in Bandipur. A handicraft seller in Bhaktapur. More tourists are showing up, but the money isn't following at the same rate. So which is it: is Nepal actually getting richer off tourism, or just busier?

It's one of the first things we learn in Industrial Engineering: throughput and value are not the same thing. A factory that pushes more units through the line without making more money isn't improving, it's just working harder for the same paycheck. Nepal's tourism sector is starting to look exactly like that. Arrivals keep climbing; the value per visitor isn't climbing with it. Nowhere is that gap more visible than at Nepal's biggest pilgrimage site: Lumbini.

> ***"Nepal's tourism sector doesn't have an arrival problem. It has a value-capture problem.***

Pilgrimage Tourism in Nepal: The Lumbini Story

Lumbini, birthplace of Gautam Buddha and a UNESCO World Heritage Site, is Nepal's flagship pilgrimage destination. In 2025 it recorded 140,969 foreign visitors, a 26 percent jump from 111,403 the year before. Pilgrims came from 106 countries, drawn in by the Maya Devi Temple, the Ashoka Pillar, and a monastic zone where nations from Thailand to Germany have each built their own temple.

But growth in arrivals hasn't translated into growth in local income, at least not according to the people who actually run the businesses there. Lilamani Sharma, Chairman of the Lumbini Hotel Association, points out that most visitors spend only a few hours on site before leaving, which leaves local businesses little room to capture any of that spending. As he put it, "Lumbini has immense potential, but we are merely watching it like an ornament locked in a cupboard."[5]

It's a familiar pattern in pilgrimage economies everywhere. Tour operators run day-trip circuits, buses park just long enough for a temple visit and a quick meal, and the group is gone by evening. Almost nobody stays the night. Almost nobody wanders out to Tilaurakot, Devdaha, or Ramagrama, or tries the birdwatching and village walks nearby, even though local officials keep pointing to these as ways to stretch a visitor's footprint (and spending) further into the local economy.

What you end up with is a pilgrimage economy running high traffic and low



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yield: plenty of visitors, short stays, and a hospitality sector watching more buses pass than rooms fill.

Why More Tourists Do Not Automatically Mean More Income

It's tempting to treat arrivals as a stand-in for income. They're related, sure, but they're not the same thing. Total tourism income comes down to three things: how many people show up, how long they stay, and how much they spend per day. A mid-range traveler here spends roughly USD 40 a day; a budget traveler, closer to USD 15-25. A day-tripper who spends three hours in Lumbini and leaves might spend a fraction of even that modest figure, a bus ticket, a meal, maybe a bottle of water. A pilgrim who stays two nights eats at local restaurants, hires a guide, and buys handicrafts before heading home. Same visitor count. Completely different economic outcome.

Economists call this the *tourism multiplier effect*, essentially how many times a rupee of tourist spending circulates through the local economy before it leaves for good. A pilgrim pays for a homestay; the homestay owner buys vegetables from a nearby farmer; the farmer pays a labourer; the labourer spends the wage at the village shop. That rupee changes hands again and again, generating income at each step. A day-tripper who arrives by chartered bus with an imported thermos of tea and leaves by afternoon barely touches this cycle at all. The visitor count is identical. The value is not.

Understanding Economic Leakage and Local Value Creation

The flip side of the multiplier effect is leakage: money that exits a destination's economy almost as fast as it comes in, through imported goods, foreign-owned hotel chains, outside tour operators, and wages sent abroad. Estimates put leakage as high as 70 percent in parts of Southeast Asia, with some worst-case destinations globally retaining as little as 5 percent of tourist spending locally.

Nepal has some natural protection here. Its hospitality sector is still mostly small, locally owned hotels and guesthouses rather than international chains, and its trekking and pilgrimage economies lean heavily on local guides, porters, and teahouse operators. But that advantage only kicks in if visitors actually spend time with those local businesses, and time is exactly what's missing. Nobody rents a local room if they never stay the night. Nobody orders from a Lumbini restaurant if the tour bus packed lunch from Kathmandu. A short visit is its own kind of leakage, even with zero imported goods involved, simply because the visitor is gone before the local economy has a chance to engage.

Sustainable Tourism as an Economic Strategy

"Sustainable tourism" usually gets framed as an environmental issue: protect the forests, manage the waste, cut emissions from long-haul flights. Fair enough, those matter. But for a place like Lumbini, sustainability is just as much an economic question as an environmental one.

A sustainable pilgrimage economy is one where a homestay owner can build a business around predictable overnight demand, where a handicraft producer gets steady sales instead of sporadic foot traffic, and where a young person in Rupandehi district can see hospitality or guiding as an actual career instead of a reason to leave for work elsewhere. Community empowerment isn't a nice-to-have bolted onto tourism policy. It's what makes tourism revenue durable instead of fragile.

An Industrial Engineering Lens on Tourism

If you look at pilgrimage tourism the way an industrial engineer looks at anything, you stop seeing individual transactions and start seeing a system: inputs, processes, bottlenecks, leak points. Not unlike a production line.

Run it through a value chain lens and the pilgrimage visit is getting cut off right before its highest-value stages, accommodation, dining, guiding, local retail almost never get activated before the visitor leaves. Systems thinking would design the whole Greater Lumbini experience as one connected journey, linking the Sacred Garden, the International Monastic Zone, Tilaurakot, Devdaha, village homestays, and eco-tourism trails, instead of treating Lumbini as a single stop.

Process improvement points to some practical fixes: stagger bus schedules so midday doesn't get overcrowded, build local guide services into standard packages instead of leaving them as an optional extra, and set up simple marketplaces, digital or physical, where handicraft producers can reach visitors directly instead of relying on roadside stalls. None of this works without the right people in the room, the Lumbini Development Trust, local governments, private hoteliers, tour operators, and community groups moving together, not separately.

Policy and Industry Recommendations

A few concrete steps follow from all this. Nepal's tourism authorities should start tracking and publishing average visitor spending and length of stay as headline numbers, right alongside arrivals, so success gets measured in value, not just volume. Packaged pilgrimage tours should build in at least one overnight stay and one local meal by default, not as an optional upgrade. Local governments around Lumbini should help handicraft and food producers meet the consistency and presentation standards tour operators actually require. And secondary sites like Tilaurakot, Devdaha, Ramagrama, along with community-based eco-tourism circuits, deserve real, coordinated marketing as part of one Greater Lumbini itinerary, not a footnote to the main temple visit.

Conclusion: Measuring Value, not just volume

Nepal's tourism sector doesn't have an arrival problem. It has a value-capture problem. The buses keep filling, the permits keep stamping, arrivals keep inching back toward pre-pandemic levels. But a bigger tourist count means very little if it doesn't show up as a bigger income for the shopkeepers, homestay owners, guides, and farmers who actually make up a pilgrimage town's economy.

Lumbini's story is Nepal's story, just smaller. A destination with extraordinary global pull, drawing more visitors than ever, still figuring out how to turn that pull into lasting local prosperity. The fix isn't fewer visitors, and it's not necessarily more either. It's redesigning the system, the way any industrial engineer would, so every visitor who arrives leaves a little more value behind than the last one. Success shouldn't get counted at the immigration counter. It should get counted in a local economy that's richer for the visitor having been there.

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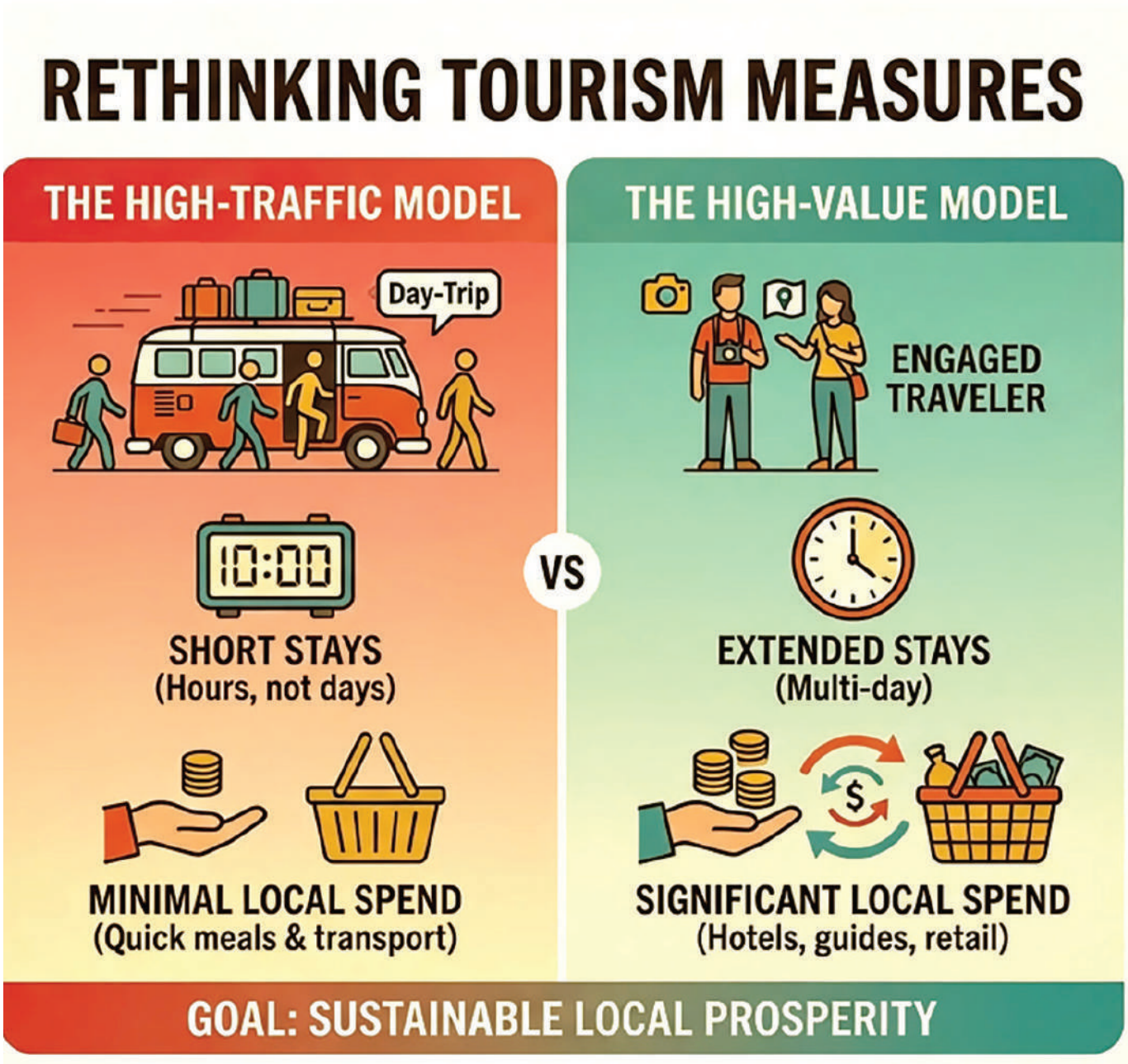
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ERGONOMICS
IN A FACTORY FLOOR

Design the workplace around people for safer, healthier and more productive operations.

WHAT IS ERGONOMICS?

Ergonomics is the scientific appoach to designing the workplace, tools and tasks to fiit the capabilities and limitations of the worker.



BENEFITS OF ERGONOMICS

IMPROVES SAFETY
Reduces risk of injuries and musculoskeletal disorders.

INCREASES PRODUCTIVITY
Improves efficiency, quality and performance.

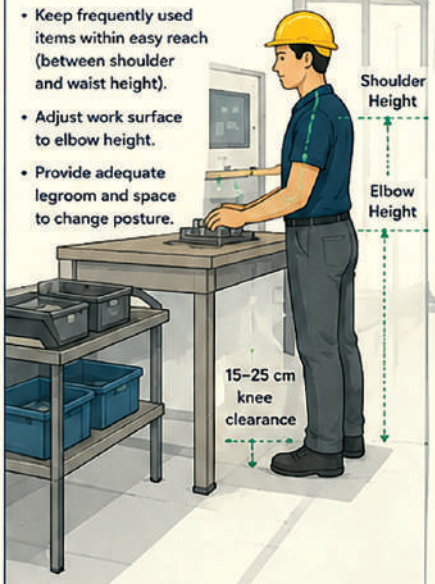
ENHANCES WELL-BEING
Reduces fatigue, stress and discomfort.

LOWERS COSTS
Reduces absenteeism, turnover and compensation costs.

KEY ERGONOMIC PRINCIPLES IN ACTION

1 WORKSTATION DESIGN

- Keep frequently used items within easy reach (between shoulder and waist height).
- Adjust work surface to elbow height.
- Provide adequate legroom and space to change posture.



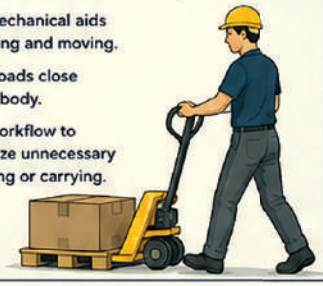
2 GOOD POSTURE

- Keep back neutral.
- Avoid bending or twisting.
- Keep head upright and in line with the task.



3 MATERIAL HANDLING

- Use mechanical aids for lifting and moving.
- Keep loads close to the body.
- Plan workflow to minimize unnecessary reaching or carrying.



4 TOOLS & EQUIPMENT

- Use tools that fit the hand.
- Ensure low vibration, low noise and comfortable grip.
- Keep controls easy to reach and operate.



5 ENVIRONMENT

- Ensure good lighting to reduce eye strain.
- Maintain comfortable temperature and ventilation.
- Control noise and minimize glare.



BEST PRACTICES CHECKLIST

- Encourage stretch breaks and micro-pauses
- Train workers on safe posture and best practices
- Involve workers in identifying ergonomic issues
- Regularly assess workstations and tasks
- Maintain tools and equipment properly
- Promote a culture of safety and well-being

REMEMBER
Good ergonomics is not an extra cost, it's an investment in people and performance.

COMFORT TODAY, PERFORMANCE TOMORROW.
BUILD ERGONOMIC, BUILD EXCELLENCE.





IS NEPAL READY FOR THE NEXT EVOLUTION OF 5S?

Nepal's industries are entering a period of transformation. New manufacturing facilities are emerging, digital technologies are gradually finding their place on factory floors, and industries are being challenged to become more productive while remaining competitive in an increasingly global market. Yet many organizations continue to focus on improving machines while overlooking one of their greatest assets, the people who operate them. As the nation strives to build more competitive industries, the next frontier of productivity lies not only on the factory floor but also in the spaces where ideas are exchanged.

For decades, the Japanese philosophy of 5S has helped industries reduce waste, improve safety, and create organized workplaces. However, as industries move toward agility and continuous innovation, workplace organization must evolve beyond neatly arranged tools and spotless factory floors. The next challenge is designing workspaces that enable employees to communicate efficiently, share ideas naturally, and adapt quickly to changing situations.

> ***"The smartest layout is not the one that saves the most space, it is the one that lets communication flow as seamlessly as the work itself***

In the context of Nepal's growing industrial sector, this evolution of 5S could become a practical step toward building agile industries. Traditionally, the five principles of 5S (Sort, Set in Order, Shine, Standardize, and Sustain) have focused on organizing physical workplaces (5S TODAY, n.d.). Today, these same principles can be extended to organize communication pathways, collaborative spaces, and the interactions that drive innovation and problem-solving.

An organized workstation means little if employees struggle to communicate, repeatedly walk across departments for simple discussions, or remain isolated inside closed office cabins. Productivity today depends not only on efficient processes but also on efficient collaboration.

This is where open workspace design complements the philosophy of 5S. Rather than viewing office space merely as rows of desks separated by partitions, agile organizations treat the workplace as a living system that encourages collaboration while preserving spaces for focused work. One concept that reflects this philosophy is **Obeya**, a Japanese term meaning "big room." Developed within the Toyota Production System during complex product development projects, Obeya brings together cross-functional teams in a shared workspace where visual management boards, project information, and key performance indicators are displayed openly (Venkatrao). Instead of relying on lengthy meetings or fragmented communication between departments, engineers, managers, and decision-makers work together in one environment, allowing problems to be identified quickly and decisions to be made collaboratively. While originally introduced in manufacturing, the Obeya concept has since been adopted across various industries as an effective way to improve coordination, transparency, and continuous improvement.

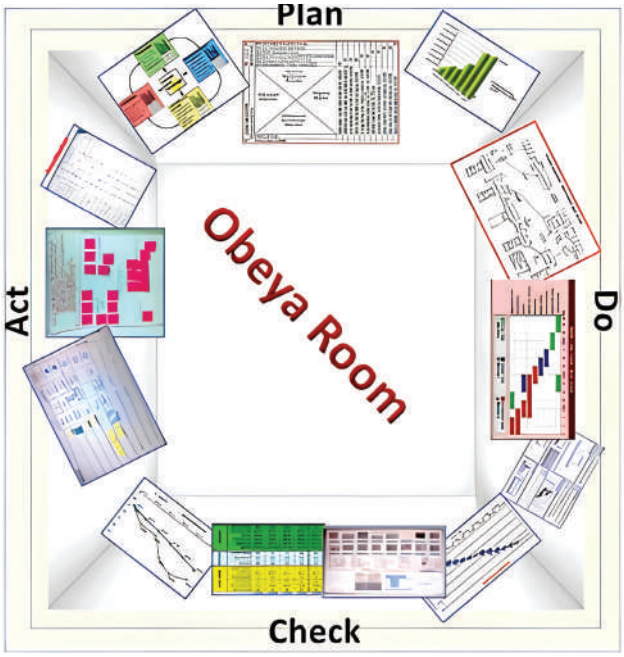
Companies such as Google and Facebook have demonstrated how thoughtfully designed collaborative environments can strengthen communication and encourage creativity. However, research suggests that openness alone does not guarantee better performance. Excessive noise, reduced privacy, and frequent interruptions can negatively affect employee concentration and well-being if workspaces are poorly planned (M, 2024). Therefore, the goal should not be to eliminate walls entirely, but to create a balanced workspace that combines collaborative zones with quiet areas for focused work. When supported by the discipline of 5S, such environments can foster both teamwork and individual productivity.

Machines build products, but connected people build agile industries!

Nature has always inspired engineering innovation. One remarkable example is the migration of birds flying in a V-shaped formation. Instead of each bird flying independently, they organize themselves into a coordinated system where aerodynamic resistance is reduced, communication is



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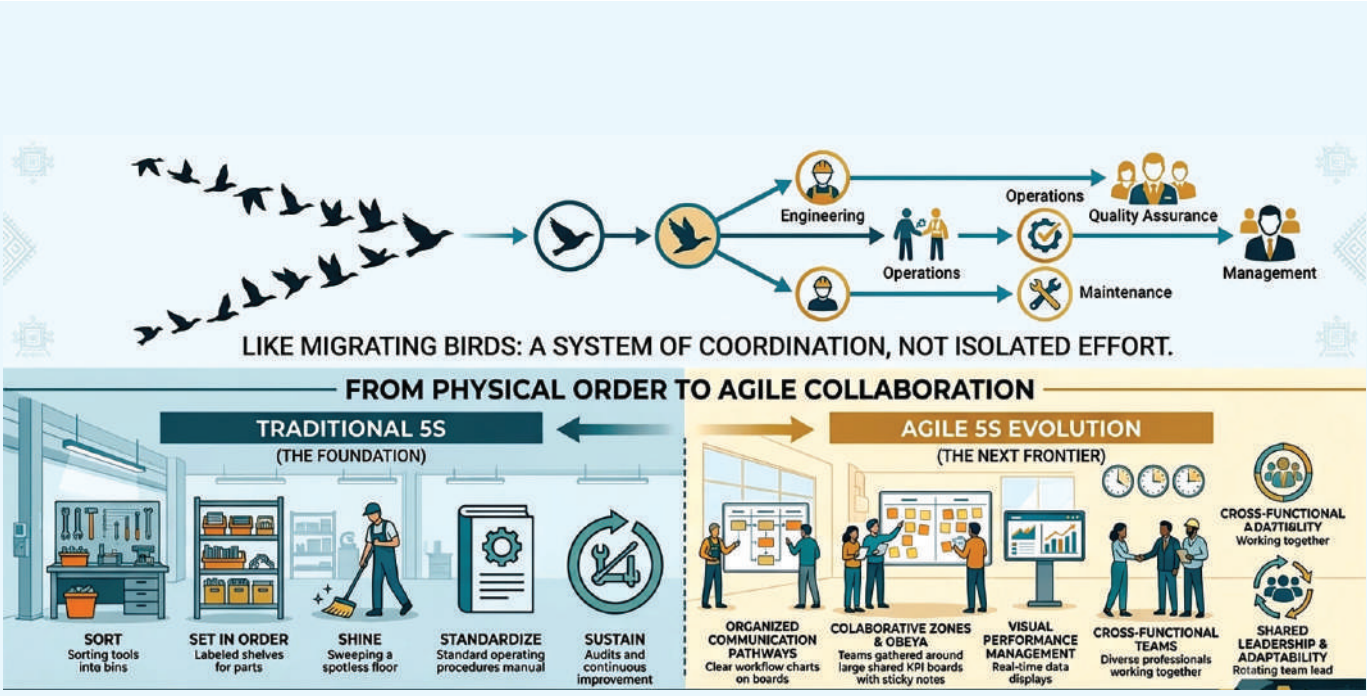
maintained, and leadership is shared. When the leading bird becomes tired, another naturally takes its place, allowing the flock to continue its journey efficiently.

The strength of the flock lies not in the speed of a single bird but in the coordination, adaptability, and shared effort of the entire formation.

This principle closely resembles the philosophy behind agile organizations. Industries operating in today's competitive environment must continuously adapt to changing market conditions, technological advancements, and customer expectations. Like migrating birds, organizations should build workplaces that promote teamwork, flexibility, knowledge sharing, and collective problem-solving rather than isolated individual performance.

Nepalese industries are currently navigating rapid technological change, global competition, evolving customer expectations, and policy shifts. Like migratory birds, industries cannot depend solely on individual effort or isolated departments. Success depends on coordinated systems, effective communication, and the ability to adapt collectively. An agile workplace built upon 5S principles can become the organizational equivalent of this natural formation, enabling employees to collaborate efficiently while maintaining order, discipline, and continuous improvement. This perspective is particularly relevant for Nepalese industries, where communication between production, quality assurance, maintenance, and management often follows traditional hierarchical structures. By introducing collaborative workspaces inspired by Obeya and supported by 5S principles, organizations can reduce communication delays, encourage cross-functional problem-solving, and improve responsiveness without requiring major investments in new technology.

The future of Nepalese industries will not be defined solely by advanced machinery or larger production facilities, but by how effectively people collaborate within those systems. The true evolution of 5S extends beyond clean floors and organized tools to designing workplaces where communication flows naturally, ideas are shared openly, and continuous improvement becomes part of everyday work. Just as migrating birds achieve remarkable journeys through coordination, adaptability, and shared leadership, Nepalese industries can achieve systemic excellence by building agile workplaces that balance organization with collaboration. In doing so, 5S evolves from a workplace management technique into a philosophy for designing the resilient and competitive industries of tomorrow.



भ्याट नं. ६१००४२०१२ दर्ता नं. २६६५२३/०७८/०७५

जियो सिभिल ल्याब एण्ड कन्सल्ट प्रा. लि.

GCLC Geo Civil Lab and Consult Pvt. Ltd.

(ISO: 9001:2015 Certified)

मुख्य कार्यालय: बुटवल-८, दशरथपथ, सुख्खानगर

फोन : ०७१-५३२७३७, ९८५७०८५७३७, ९८५१२४७७१५

शाखा कार्यालयहरु

सन्धिखर्क-१, हललाईन, अर्घाखाँची,
फोन नं. ९७४८७४९२९१, ९८४१६१०२१९, ९८५१०५२०२३

कावासोती-८, हलचोक ,नवलपरासी, (ब.सु.पू)
फोन नं. ०७८-५९०२००, ९७६२५६२४०२, ९८५५०६४५७४






उपलब्ध सेवाहरू:

निर्माण सामाग्रीहरू (छड, सिमेन्ट, गिट्टी, बालुवा, विटुमिन आदी) को गुणस्तर परिक्षण, गुणस्तरिय प्राविधिक परामर्श, सिपमूलक तालिमहरू

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Confederation of Nepalese Industries

INTERVIEW



Er. Birendra Raj Pandey

President, Confideraion of Nepalese Industries

> ***Nepal's future will not be built by competing on mass manufacturing, but by defining our niche. To break the cycle of import dependency, we must shift from a consumption-driven economy to a production powerhouse—and that begins when our youth choose to be job creators rather than job seekers.***

Birendra Raj Pandey is the President of the Confederation of Nepalese Industries (CNI) and the Vice Chairman of CE Construction, one of Nepal's premier engineering and development conglomerates. A seasoned civil engineer and corporate leader with over three decades of industry experience, Pandey has been instrumental in expanding CE Construction's footprint across infrastructure, real estate, energy, and technical education. At the helm of CNI, his strategic vision centers on accelerating Nepal's industrialization, fostering robust public-private partnerships, and building sustainable infrastructure to drive national economic growth and domestic manufacturing.

As someone deeply involved in both industry and construction, how would you describe the current state of Nepal's industrial sector?

Currently, Nepal is unfortunately going through what economists call premature deindustrialization. Manufacturing that once contributed around 12–13% of our GDP is today down to about 5%. That means we've struggled to build a strong manufacturing base and have increased our dependence on services and remittances. Also, we may brag about having a young workforce, but we do not have enough industries to create jobs, making many youth move abroad for better opportunities while increasing our dependence on remittances. Overall, I think Nepal's industrial sector has been on a downward trajectory and urgently needs renewed focus.

Where do you see the greatest opportunities and the most pressing concerns?

I believe if we focus on areas where we have a natural advantage, such as clean energy, agro-processing, and specialized construction materials, instead of competing with large manufacturing economies on volume, these sectors can give us a strong competitive edge. On the other hand, our biggest challenge is the gap in infrastructure and industrial capacity. To become a much stronger economy, we need sustained growth above 6 to 7% each year, along with better logistics, faster infrastructure development, and policies that encourage investment.

The recent national budget introduced several measures aimed at attracting investment and promoting entrepreneurship. Which policy reforms do you believe could have the greatest long-term impact on Nepal's industrial transformation?

Good policies only matter if they're implemented well. Policies need to pivot from their historical political dialogues, and political parties should be evaluated on tangible metrics such as jobs created, progress on import substitution, and closeness to achieving a $100 billion economy. Nepal needs consistent execution rather than just good announcements. In the long run, I believe we should invest more in human capital, healthcare, and stronger capital markets. We also need a simpler and fairer tax system, faster tax refunds, and clear

regulations so businesses aren't left dealing with uncertainty. Finally, Nepal should identify a few industries where we can genuinely compete instead of trying to do everything, as setting clear priorities creates long-term industrial growth. Policies need to pivot from their historical political dialogues, and political parties should be evaluated on tangible metrics such as jobs created, progress on import substitution, and closeness to achieving a $100 billion economy.

Environmental conservation and industrial development are often portrayed as conflicting priorities. How can Nepal strike a balance between sustainable resource management and economic growth?

Striking a balance between environmental conservation and industrial development requires a shift toward an economy-centric model where sustainability and growth go hand in hand. By shifting toward clean energy and sustainable practices championed by organizations like the Confederation of Nepalese Industries (CNI), Nepal can enhance the value of its production ecosystem while remaining sensitive to its immense climate vulnerability.

Are there any policies, practices, or industrial models from other countries that Nepal could realistically adopt to accelerate its development?

Rather than allowing natural assets to go underutilized, Nepal should look to successful examples like Bangladesh and learn to commercialize its rich internal strengths responsibly. Formulating proactive policies that sustainably manage and extract high-value resources such as forestry products, construction materials, medicinal herbs, and minerals will allow the nation to scale its industrial sector, dramatically improve its minimal GDP contribution, and achieve rapid economic growth without compromising its long-term environmental commitments. Severe deindustrialization causes people to be hesitant to be entrepreneurs.

What do you see as a major structural barrier preventing industrial growth today?

We need to critically examine where our national economic policies traditionally direct us. Naturally, capital and talent flow toward areas where growth and opportunities are easiest to capture. Currently, if an entrepreneur can easily import a product and sell it for a quick profit, they will vastly prefer trading over manufacturing. Our policy frameworks heavily favor customs duty collections from imports over long-term industrialization. Even when local manufacturing industries manage to open, they struggle to survive. Entrepreneurs find themselves entirely stuck after setting up operations, having to navigate endless bureaucracy and systemic hurdles rather than focusing on production, causing a major structural barrier preventing industrial growth today.

CNI had started the Make in Nepal swadeshi campaign along with the government with the goal of generating employment for a huge mass of people. How is it going, and what are the prospects for the campaign?

The "Make in Nepal - Swadeshi" campaign is a visionary initiative designed to transform the country's economic landscape. At its core, the campaign is built upon three strategic pillars aimed at revitalizing domestic manufacturing: cultivating a consumer culture where the general public proudly buys Nepalese goods, scaling up international trade to hit an ambitious $4.6 billion export goal via 22.5% annual growth, and leveraging institutional purchasing power by positioning the government as a primary buyer. The campaign's trajectory is guided by aggressive, clear quantitative benchmarks designed to measure its long-term impact on mass employment. The ultimate roadmap sets a target of registering 1,000 new industries and creating 150,000 industrial jobs every single year. The initiative has already demonstrated powerful momentum toward these goals, successfully enrolling over 150 enterprise members, establishing more than 700 new industries, and generating 35,000 new jobs in the past year alone. Looking ahead, the future prospects of the campaign hinge on narrowing the gap between these initial achievements and its yearly targets.

Industrial Vision XI is themed "Systemic Excellence: Designing Agile Industries." In your view, can the agile model be adopted in the construction industry as well?

The construction industry is traditionally viewed as a rigid, slow-to-evolve sector. However, implementing agile models here is entirely feasible and highly necessary. While it may seem difficult to pivot instantly in physical development, building agility into the construction framework means moving away from stagnant, outdated protocols and significantly accelerating the adaptation rate across our national projects. Ultimately, human-centric agility in construction comes down to lowering environmental friction. By optimizing our supply chains to reduce structural pollution and actively lowering our nationwide carbon footprint, we can design a modern construction industry. This progressive, nature-based approach builds an agile ecosystem that values systemic sustainability alongside fast-paced industrial development.

How can Nepali industry adopt agile principles while prioritizing workforce development and human-centric designs?

In the context of Nepal, adopting agile principles must focus on ecological and systemic flexibility rather than just speed. True agility in this sector requires a radical shift toward a circular economy model. This means designing project lifecycles that actively prioritize the enhancement and usage of sustainable, local materials, ensuring that economic growth supports our regional communities rather than relying entirely on heavy import reliance.

CNIYEF(Young Entrepreneurs Forum) and other platforms engage the next gen. What advice would you give to aspiring entrepreneurs on contributing to Nepal's industrial future?

To the next generation of aspiring entrepreneurs, my fundamental piece of advice is simple yet profound: Be a job creator, not a job seeker. The ultimate way to contribute to the economic future of Nepal is to build enterprises that create employment opportunities for others. It is important to acknowledge that entrepreneurship is not for everyone; it requires a unique capability. Entrepreneurs are a special breed of people; they are resilient risk-takers and dedicated problem solvers. If you choose this path, you must embrace the mindset of a lifelong learner, constantly adapting and gathering knowledge as you build your venture.

Finally, remember that you do not have to walk this challenging path alone. Aspiring entrepreneurs should actively leverage institutional ecosystems. Platforms and organizations like CNI can play a pivotal role in your journey, offering critical networks, mentorship, and structural support to help turn your business vision into a reality that elevates Nepal's industrial landscape.

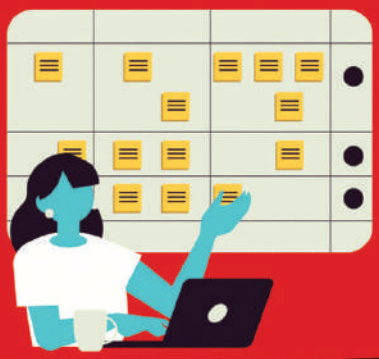
BOOST YOUR PRODUCTIVITY

Strategies for Getting More Done

1 UNDERSTANDING PRODUCTIVITY

Productivity is the measure of efficiency in completing tasks, balancing the quantity and quality of work.





2 BENEFITS OF PRODUCTIVITY

Increased productivity leads to improved work performance with higher output and better quality, often resulting in recognition and advancement.

3 TIPS TO BOOST PRODUCTIVITY

Setting clear goals is crucial; they should be specific, measurable, achievable, relevant, and time-bound (SMART).





4 TIME MANAGEMENT TECHNIQUES

The Pomodoro Technique involves working for 25 minutes, followed by a 5-minute break, repeating the cycle four times before taking a longer break.

THE RHINO THAT STAYED

Five Years of Make in Nepal, Swadeshi



Make in Nepal, Swadeshi is a national movement led by the Confederation of Nepalese Industries (CNI) in partnership with the Ministry of Industry, Commerce and Supplies.

When the silhouette of a One-Horned Rhinoceros first appeared on product labels across Nepal in March 2021, the sceptics were quick to dismiss it. "Another fleeting campaign," they said. "Another logo that will fade with the headlines." Five years later, that same rhino is stamped on the packaging of 145 registered companies, backed by government procurement guidelines, protected by a collective trademark across ten industrial categories, and woven into a national ambition that stretches far beyond factory floors.

This is not the story of a sticker. This is the story of Make in Nepal, Swadeshi, and how an upfront investment of conviction is slowly rewriting what it means to produce, procure, and pride oneself in Nepali goods.

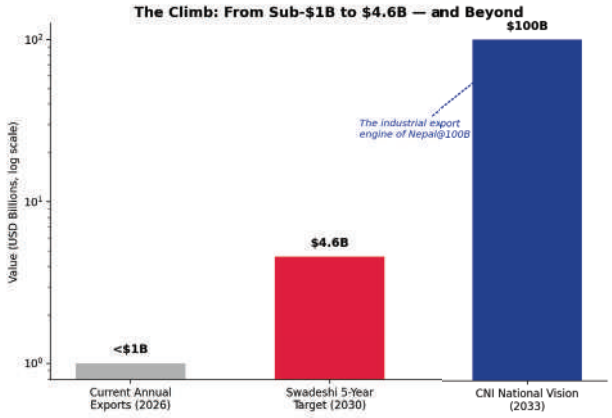
The $4.6 Billion Runway to a $100 Billion Dream

In the corridors of CNI, the conversation has shifted. The Swadeshi campaign was born with a precise, muscular target: raise Nepal's annual exports from less than $1 billion to $4.6 billion within five years. Push industrial sector contribution to GDP from a paltry sub-14% to 26% by 2030. Establish over 1,000 new industries. Generate employment at scale.

But zoom out, and that target is no longer standing alone. CNI is currently championing a validated national vision, Nepal@100 billion Economy, aiming to make Nepal a $100 billion economy within the next decade. The Swadeshi campaign is not merely a side project in that journey. It is the industrial engine room.

"Only when Nepali goods are competitive within the Nepali market, will they have a better chance of competing abroad."

That sentence, etched into the campaign's founding philosophy, captures the logic perfectly. Before Nepal can sell to the world at the scale a $100 billion economy demands, it must first learn to make for itself, brand for itself, and trust itself. Swadeshi is that classroom.





Three Pillars, One Pride

The campaign rests on seven strategic pillars, from import substitution to infrastructure spending, but it channels its energy through three that touch everyday life:

1. Nepali Citizens Consume Swadeshi

The rhino emblem was never meant to be decorative. It is a consumer compass. Through Meta-backed digital marketing workshops, AI automation training, and packaging improvement sessions with IIDS, the campaign has taught 145 member companies how to look competitive not just against smuggled goods, but against the best on the shelf. When a mother in Pokhara picks up a bottle of shampoo with the rhino mark, she is no longer guessing. She is choosing Hamro Samaan, Hamrai Swabhiman, Our Goods, Our Pride.

2. Government of Nepal Procures Swadeshi

This is where the campaign stopped being an NGO-style awareness drive and became a policy force. A formal MoU between CNI and the Ministry of Industry, Commerce and Supplies laid the groundwork. The result? The government's "Guidelines for Using Domestic Products in Public Entities, 2081 BS" now mandates public institutions to prioritise local goods. A transparent digital portal, Nepali Utpadan, has been built to make that mandate operational. The government is no longer just cheering from the sidelines. It is buying in.

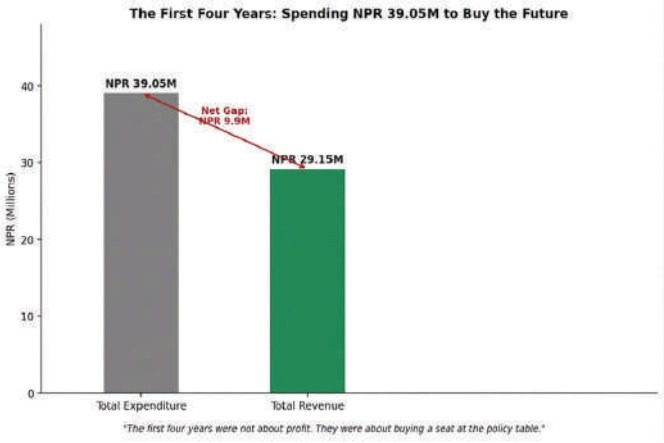
3. Swadeshi Goods in Foreign Markets

CNI's membership spans footwear to electrical transformers. That diversity is now being leveraged through bilateral relationships and a dedicated B2B digital portal to connect Nepali producers with foreign buyers. And here is the hidden weapon: the Swadeshi Collective Trademark, approved across ten industrial categories, grants exporters an additional 1% cash incentive. That is not branding. That is balance-sheet impact.

The 145: Who They Are, What They Get

Membership is not handed out. A company must be registered in Nepal, originate in Nepal, add at least 30% value domestically, and meet industry standards (NS, FDA, DDA, ISO, or expert committee recommendation where standards do not exist). Environmental compliance is non-negotiable. Even MNCs can join, but only for goods manufactured in Nepal.

In return, those 145 members receive a toolkit that most Nepali MSMEs have never had access to: capacity building, digital marketing training, export compliance education, ISO Quality Management Systems workshops, LEAN process improvement, and a B2B portal that actually brings buyers to their doorstep



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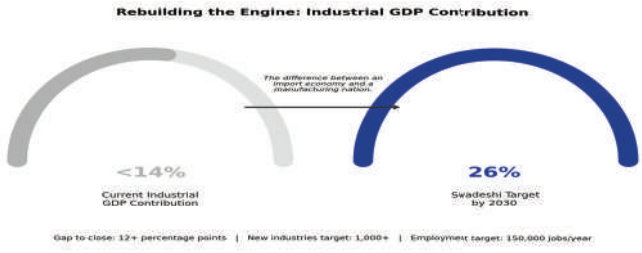
From Campaign to Movement

If the first five years were about proving the model, the next phase is about institutionalizing it. The campaign's Way Forward outlines four operational bodies that will transform Swadeshi from a project into a self-sustaining ecosystem:

- Administration: scaling membership and internal governance
- Compliance: enforcing the 30% value-addition rule and quality standards
- Marketing: expanding the rhino emblem's consumer recognition nationally

- Research & Policy: continuing the lobbying that has already changed procurement law

Revenue models will diversify. Member fees, already scaled by sector and turnover, will be supplemented by certification services, B2B portal commissions, and training programmes. The goal is simple: financial sustainability by design, not by donation.



The Marketing Muscle

The campaign's reach is not theoretical. Over five years, it has built a presence that rivals many commercial brands:

- Traditional: National print coverage, brochures, out-of-home billboards
- Digital: Dedicated website, mobile app, Viber community, active Facebook, Instagram, TikTok, and LinkedIn channels
- Experiential: Annual Swadeshi Summit (policymakers, economists, industrialists), Swadeshi Bazar (physical marketplace for MSMEs), trade expos, influencer gift campaigns
- Partnerships: USAID (Tayar Nepal), UKaid (SEP), Daraz, QFX Cinemas, each lending market access and public awareness

The rhino is no longer a logo. It is becoming a shorthand for quality, much like the "Made in India" lion or the "Swiss Made" cross.

Looking Forward

The sceptics of 2021 asked a fair question: Can Nepal really make its own? Five years later, the answer is being written in procurement ledgers, export invoices, and the growing roster of companies that no longer see the rhino emblem as a favor from CNI, but as a competitive advantage.

Nepal's $100 billion economy will not be built on slogans. It will be built on factories, standards, B2B portals, and the quiet, stubborn work of making things well. The Swadeshi campaign has spent half a decade laying that foundation. The rhino did not fade. It multiplied.

And it is only getting started.



Women Leadership Summit 2026



Women Leadership Summit 2025


Women Leadership Summit 2024



Women Leadership Summit 2023

THE BULLWHIP EFFECT

Small Demand Changes → Big Supply Chain Problems

WHAT IS THE BULLWHIP EFFECT?

The Bullwhip Effect occurs when small changes in customer demand cause increasingly larger fluctuations in orders as they move upstream in the supply chain.



WHY IT HAPPENS?

- Poor demand forecasting
- Order Batching
- Price fluctuations & Promotions
- Lack of information sharing
- Long lead times



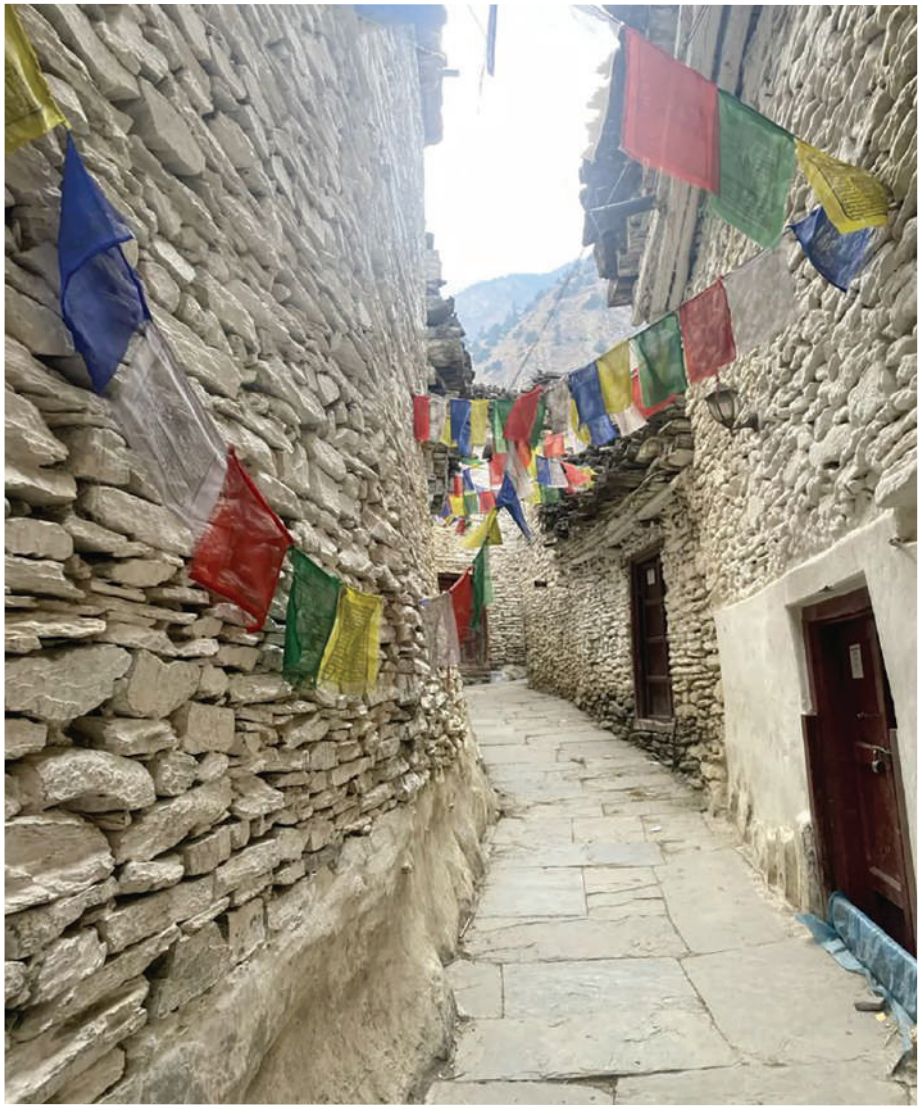
HOW TO REDUCE THE BULLWHIP EFFECT

- Share real-time demand data
- Improve forecasting methods
- Reduce lead time
- Smaller and frequent orders
- Stable pricing



Information Accuracy → Supply Chain Stability

WHEN FILMS BUILD INDUSTRIES



One scene in the Nepali film *Jerry* opens with a group of friends arriving in a quiet Himalayan village. Nobody involved could have predicted that this single scene would put the village on the map. Marpha, its whitewashed homes, apple orchards, and sunlit stone lanes drew audiences in more than the plot did. After *Jerry* was released in 2014, Mustang saw a sharp rise in visitors, many asking specifically for "***Jerry Galli***", the streets the film had turned into a landmark. Within months, Marpha went from a quiet stop on the Annapurna circuit to one of Nepal's most-searched destinations.

That's usually where the story ends: a film put a village on the map. But that's only the visible half of it. Before *Jerry* ever found an audience, Marpha was already running as a working production site. Hotels filled with cast and crew. Local drivers moved equipment trucks over roads that were never built for that weight. Restaurants scaled up to feed extra mouths for weeks at a stretch. Carpenters built sets. Costumes, cables, and generators had to be carried in. Villagers became guides, porters, and labourers almost overnight. For a few weeks, a mountain town was operating like a production line: sourcing, scheduling, and delivering.

> ***"Every successful industry is built on a system. A film is no different***

None of it was planned. The coordination happened because the film needed it and no system existed to make it repeatable. Once filming wrapped and the crew left, most of those working relationships dissolved with them. Marpha kept getting visitors, but the network of suppliers, skilled labour, and local businesses that had briefly come together quietly disappeared. What could have become a foundation for the next production never got the chance. That's the part of the story worth telling: how it could turn this from "one successful film" into a question about the future of an entire industry.

What if Nepal's film sector were built so that every production left something behind for the next one? A stronger supply chain, a more experienced local workforce, and working relationships that outlast the wrap party instead of just a finished film?

Seeing Film as an Industrial System

Looked at through an economic lens, Nepal's film industry functions as a production system as much as a cultural one. Every film pulls together transport operators, builders, hospitality providers, caterers, costume makers, equipment rental firms, financiers, and marketers, all working against fixed constraints of time, cost, and quality. That coordination has spillover effects: local value chains get activated, temporary employment is created, and economic activity spreads well past the film itself. From an industrial engineering standpoint, the parallel to manufacturing holds up reasonably well: the script functions as the blueprint, the shooting schedule as the production plan, cameras and costumes as the production system, and editing, VFX, marketing, and distribution as the steps that get the product to its customer, **the audience.**

Nepali feature film production runs through four fairly standard stages: development, pre-production, production, and post-production. Budgeting, scheduling, and coordination matter as much as they would on any industrial floor. What



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makes filmmaking harder to plan around is the amount of uncertainty baked into it. A snowstorm can close the only road into a location. A lead actor's schedule can shift overnight. A scene might need a rewrite because the light isn't right. Weather, permits, transport, financing, and creative decisions are all moving at once, and that's exactly where deliberate system design earns its keep. Not by boxing in creativity, but by absorbing enough of the logistical load that filmmakers spend less time firefighting and more time actually making the film.

Building the System Behind the Screen

Every film tells two stories. One is seen on the screen, where audiences are drawn into characters, emotions, and unforgettable moments. The other unfolds behind the camera, where careful planning, coordination, and hundreds of interconnected decisions quietly bring that experience to life. The first earns the applause. The second is what makes the first possible.

Behind every memorable scene lies an intricate production system. Locations must be secured, transport arranged, permits approved, equipment delivered, and cast and crew brought together at exactly the right place and time. Each task depends on another, and when one part of the system falls behind, delays ripple through the entire production. Time is lost, costs rise, and creative energy is redirected from storytelling to solving logistical problems.

The fix isn't to change how filmmakers tell their stories but to strengthen the system underneath them. A production performs best when it's treated as one connected system rather than a series of isolated tasks. Decisions made during script development influence everything that follows, from budgeting and procurement to scheduling, logistics, and post-production. Recognising these connections early lets production teams anticipate challenges instead of reacting to costly setbacks. That's what systems thinking offers here: processes that reduce friction, improve coordination, and give creativity room to breathe, without making filmmaking feel mechanical.

Great films are remembered for the stories they tell, not for the logistical problems solved along the way. Yet every successful production depends on a system that quietly keeps everything moving. Smarter procurement, better scheduling, efficient transport, and stronger coordination do more than save time and money; they protect the creative process itself. The best production systems are almost invisible. Audiences never remember the schedules, permits, or procurement plans; they remember the story, and a well-designed system quietly removes obstacles so creativity can take centre stage.

Managing Uncertainty Behind the Camera

Unlike a factory, no two film productions are exactly alike. A location that looked perfect during scouting may become inaccessible overnight. A permit can be delayed. Weather can force an entire day's schedule to change, while creative decisions continue evolving until the final shot. In filmmaking, uncertainty isn't the exception but part of the process.

That's why the productions that hold up best are the ones built to adapt when the plan breaks, not the ones with the tightest plans. When change is inevitable, the ability to respond quickly matters more than following a schedule perfectly. Agile planning lets production teams reorganise resources, adjust timelines, and solve unexpected problems without bringing the entire shoot to a halt.

Technology can make that adaptability much easier. A shared production-management platform that integrates budgeting, scheduling, procurement, equipment tracking, and daily progress reporting gives everyone access to the same information at the same time. Instead of reacting to problems after they occur, production teams can identify issues earlier, coordinate faster, and make informed decisions before small disruptions become costly delays.

Resilience also extends beyond a single production. Every film depends on a network of hotels, transport providers, caterers, technicians, costume makers, carpenters, and equipment suppliers. Instead of rebuilding that network from scratch for every project, a shared pool of trusted suppliers and experienced professionals would reduce procurement challenges, improve reliability, and let each production start from a stronger foundation than the last.

What Happens After the Credits?

The credits may mark the end of a film, but they shouldn't mark the end of its impact. Every production has the potential to leave something behind, whether it is a local business with new opportunities, a technician with new skills, stronger partnerships, or experience that makes the next film easier to produce. That's how individual projects grow into a stronger industry.

New Zealand and Japan show how far the value of filmmaking can extend beyond the screen. In New Zealand, the global success of *The Lord of the Rings* and *The Hobbit* transformed not only the country's film industry but also its international identity. Tourism New Zealand has reported that around 12% of international visitors were influenced by the films when deciding to visit, with film tourism generating hundreds of millions of New Zealand dollars in visitor spending over the years. The films opened the door, but it was a well-coordinated ecosystem of tourism agencies, hospitality providers, transport operators, local businesses, and government institutions that turned that exposure into long-term economic opportunity.

Japan reached a similar destination through a different path. Rather than relying on a few blockbuster productions, it has systematically integrated films and animation into regional development through what researchers describe as *content tourism*, using popular screen content to promote destinations and revitalise local economies. Places featured in productions such as *Your Name, Spirited Away*, and numerous anime series continue attracting visitors years after their release, encouraging investment in local businesses, cultural heritage, transport, and community-led tourism. Different countries, different approaches, but the same lesson: when the network around a production is built with purpose, a film leaves behind far more than entertainment. It creates lasting value for industries, communities, and the economy long after the cameras stop rolling.

Nepal does not need New Zealand's scale or Japan's mature creative economy to learn from these examples. It already possesses extraordinary landscapes, rich cultural heritage, and a growing community of creative talent. The greater challenge is connecting these strengths through a system that lets every production create lasting value across tourism, hospitality, manufacturing, transport, and local services instead of disappearing once filming wraps.

Building that system doesn't require an industry-wide overhaul. It begins with practical steps that strengthen coordination and encourage long-term collaboration. A national supplier directory could connect production houses

with trusted transport operators, accommodation providers, equipment suppliers, and skilled technicians across the country, reducing procurement challenges while creating more consistent opportunities for local businesses. At the same time, regional film clusters could build on the unique strengths of different parts of Nepal: Mustang for high-altitude productions and film tourism; Pokhara for outdoor and adventure filmmaking; and other regions around their own landscapes, heritage, and creative communities. Such specialisation would spread the economic benefits of filmmaking far beyond Kathmandu while encouraging local industries to grow alongside it.

Ultimately, every production should leave behind more than a finished film. It should strengthen local suppliers, develop skilled professionals, create lasting business relationships, and make the next production easier than the last. Marpha demonstrated what is possible, even if it was by accident. For a few weeks, transport providers, hotels, restaurants, craftspeople, and local workers came together to support a single production. Imagine what could happen if those connections were built intentionally instead of left to disappear when filming ended.

The real legacy of a film is not measured only by ticket sales or awards. It is measured by what remains after the cameras stop rolling. If every production leaves the industry stronger than it found it, cinema can become far more than a cultural achievement; it can become a catalyst for sustainable industrial development, regional growth, and long-term economic resilience.

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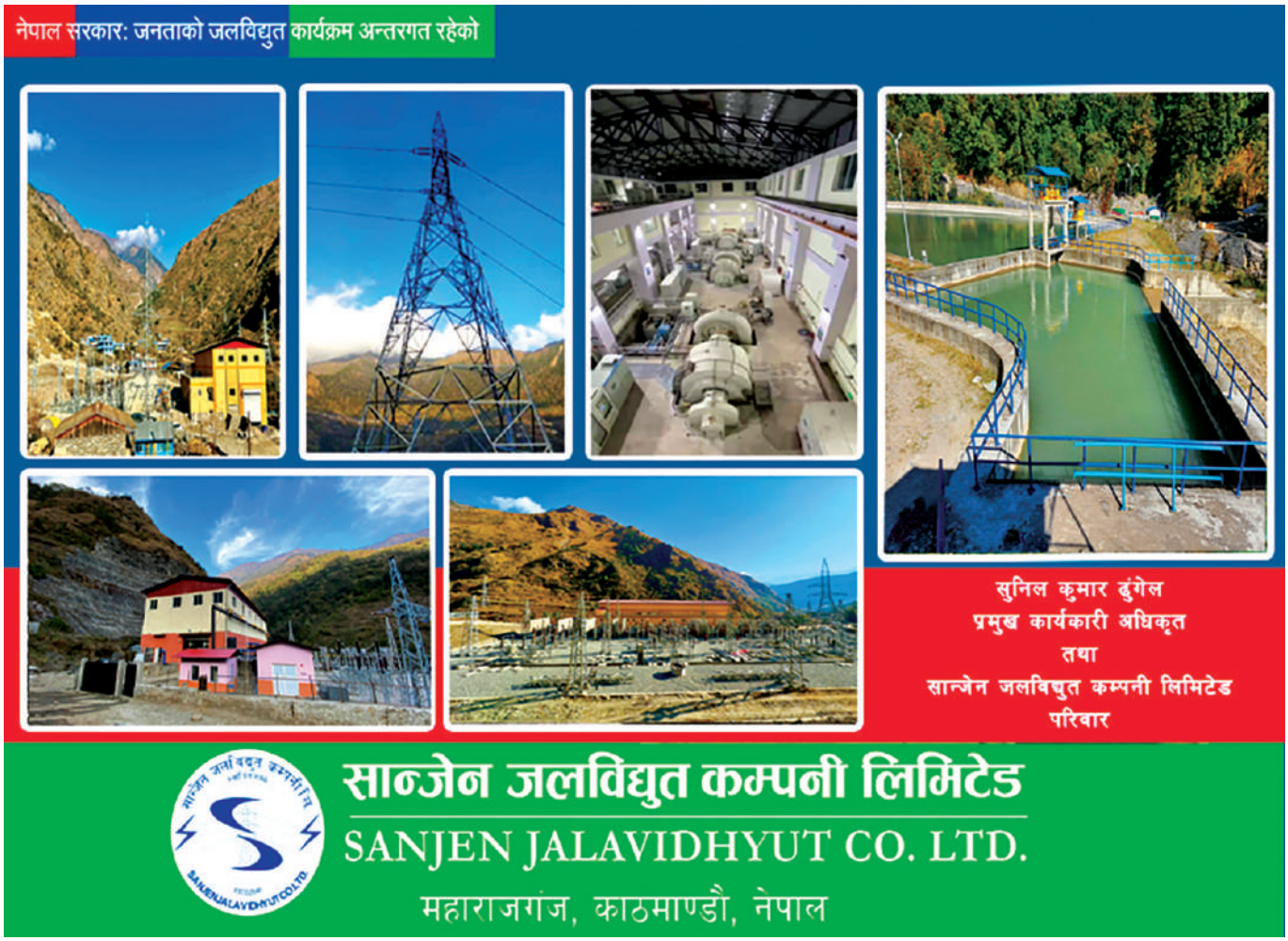
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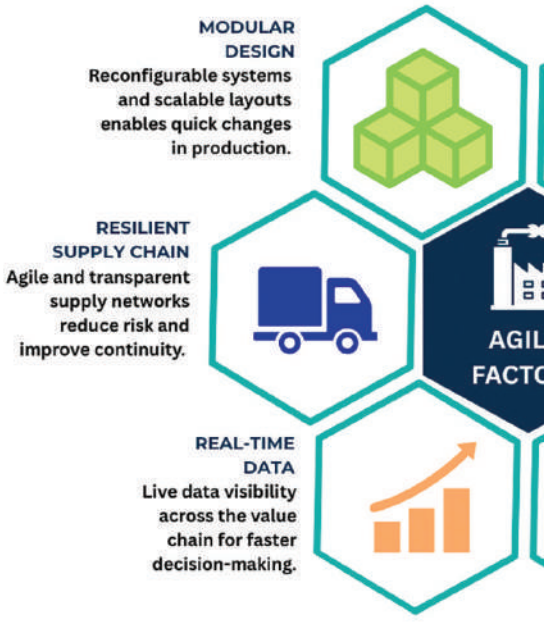
SMART
Uses data and AI for real-time insights and decisions.

CONNECTED
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RESPONSIVE
Quick to respond to disruptions and opportunities.

SUSTAINABLE
Optimizes resources and reduces environmental impact

THE BLURPRINT: KEY COMPONENTS



MODULAR DESIGN
Reconfigurable systems and scalable layouts enables quick changes in production.

DIGITAL TECHNOLOGIES
AI, IoT, Digital Twins, and advanced analytics drive intelligent operations.

RESILIENT SUPPLY CHAIN
Agile and transparent supply networks reduce risk and improve continuity.

CONNECTED WORKFORCE
AI, IoT, Digital Twins, and advanced analytics drive intelligent operations.

REAL-TIME DATA
Live data visibility across the value chain for faster decision-making.

FLEXIBLE AUTOMATION
Cobots, AMRs, and adaptive automation ensure high mix, low volume efficiency.

THE JOURNEY TO AN AGILE FACTORY

01 ASSESS
Evaluate current processes, systems, and capabilities.

02 PLAN
define vision, priorities, and roadmap

03 IMPLEMENT
Adopt technologies, build capabilities, and integrate.

04 OPTIMIZE
Continuously monitor, analyze, and improve performance.

05 SUSTAIN
Embed agility in culture and business strategy.

A NEW WAVE OF RESURGENCE

Dreams, Means, And Challenges



Nepal's economy stands at a critical juncture today. The rising trade deficit, excessive dependence on imports, contraction of the manufacturing sector, and the migration of millions of youth towards foreign employment are raising questions about the current model of development. Under such circumstances, industrial resurgence is not merely the agenda of a single sector; it is a national imperative for building a self-reliant economy.

The formal inception of modern industrialization in Nepal is considered to have begun in 1936 AD (1993 BS) with the establishment of Biratnagar Jute Mill. In the subsequent decades, institutions such as Janakpur Cigarette Factory, Hetauda Textile Industry, Udayapur Cement Industry, Nepal Orind Magnesite, Nepal Iron and Steel Company, Balaju Industrial District, Raghupati Jute Mill, Nepal Plywood, and Gorakhkali Rubber Industry laid the foundation for Nepal's industrial development. These industries provided employment to thousands of Nepalis, promoted domestic production, saved foreign currency through import substitution, and built the foundation of industrial self-reliance. Those industries were not merely production centers; they were also symbols of the nation's economic self confidence.

> ***"The weakest link in Nepal's cement supply chain is not production—it is decision-making based on guesswork.***

World history has already established industrialization as the most effective medium of prosperity. South Korea, Japan, China, and recently Vietnam prioritized manufacturing economies, taking employment, technology, research, and exports forward simultaneously. Industry does not merely produce goods; it also builds skills, innovation, entrepreneurship, and long-term economic stability. For this reason, industrial development is considered the economic backbone of any nation.

However, Nepal could not preserve this foundation. Political interference dominated over professional management in public enterprises. Investment could not be made in timely technological modernization. Armed conflict, over politicization of trade unions, pressure from cheap imported goods following economic liberalization, weak financial discipline, corruption, and a lack of capital reinvestment gradually turned industries sick. The land and assets of several industries became trapped in encroachment and legal disputes, making revival even more complex. As a result, many industries in which the state had invested for decades shut down, yet new productive industries could not be built in their place.

Nevertheless, the possibility of resurgence has not ended. What is required for it is clear policy, professional leadership, and long term commitment. Rising above the traditional mindset of the government operating industries itself, Public Private Partnerships (PPP) must be implemented in a transparent and result oriented manner. If the managerial efficiency of the private sector, policy support of the state, and investment from the financial sector can be focused on a single objective, a foundation for revival can be established.

Along with this, the time has come to trust domestic technical capability. The tendency to rely solely on foreign consultants for industrial setup, expansion, and modernization does not yield long-term solutions. If skilled engineers, researchers, and technical personnel produced from domestic educational institutions including Tribhuvan University's



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Institute of Engineering(IOE) can be given responsibility from planning to execution, costs will be reduced and sustainable solutions tailored to local needs can be developed. The leadership of the industrial renaissance must be undertaken by Nepalese knowledge and capability itself.

The Hetauda Cement Industry serves as a representative example of this. Consumer trust in its quality still persists in the market. Despite sufficient demand, the industry has been unable to maintain regular production. This demonstrates that Nepal's problem is not a lack of market, it is a lack of continuity in production, managerial efficiency, and policy stability. Opening an industry may be an achievement, but operating it sustainably is the true success.

Industrial resurgence also opens doors of new opportunities for young Nepalese engineers, managers, and entrepreneurs. The development of industrial consulting firms, utilization of skilled workforce returning from abroad, modernization of old industrial infrastructure, and expansion of research-based production systems can guide Nepal towards a new industrial era. For this, universities also need to enhance collaboration with industry and integrate industrial management, innovation, and resurgence engineering into their curricula.

Now Nepal must make a clear decision whether to remain limited to a consumption oriented, import dependent economy or to build a production oriented, competitive, and self-reliant economy. This decision is not the responsibility of the government alone; it is the shared obligation of the private sector, educational institutions, financial sector, and civil society.

The ruins of old industries tell stories of past failures. However, if the foundations of new industries, new technologies, new employment, and new hope can be established upon those very ruins, those same places can become symbols of Nepal's economic renaissance. Industrialization is not merely a program to open factories; it is a long-term project of nation-building. Now is not the time to dwell only on the past; it is time to usher in a new era of production, innovation, and self-reliance. Resurgence is no longer an option; it is an indispensable national requirement to secure Nepal's economic future.



WHEN THE LIGHT DECIDE WHO SURVIVES

Energy Rigidity As Nepal's Hidden Agility Problem



Every conversation about industrial agility in Nepal eventually circles back to the same comfortable villains: outdated machinery, poor logistics, a workforce that keeps leaving for the Gulf. What almost nobody talks about is the thing sitting underneath all of it, the one input every factory depends on and controls least i.e. electricity. And if you actually look at how power reaches Nepali industry, you start to wonder how any of them manage to plan a quarter, let alone build the kind of responsive, adaptive systems everyone keeps asking us to imagine.

Take the recent dispute over industrial electricity billing in Nepal. The issue came to light when the Nepal Electricity Authority (NEA) disconnected the electricity supply of around twenty-five major industries over unpaid bills related to dedicated feeder and trunk line services. The affected industries argued that they were charged premium tariffs for reliable, uninterrupted electricity but did not consistently receive the promised level of service during the load-shedding period. NEA, however, maintained that the bills were valid and proceeded with the disconnections. As a result, industrial operations were disrupted, thousands of workers faced uncertainty, and the dispute over outstanding dues estimated at around NPR 22 billion escalated into a major legal and policy issue that eventually reached the Supreme Court for resolution [1].

> ***"The weakest link in Nepal's cement supply chain is not production—it is decision-making based on guesswork.***

This incident highlighted a much deeper and more persistent challenge within Nepal's electricity pricing system. While residential consumers benefit from relatively lower electricity tariffs, industrial and commercial users generally pay higher rates, effectively subsidizing the lower residential tariffs through a cross-subsidy mechanism. Although this approach helps keep electricity affordable for households, it also increases operating costs for industries. Furthermore, Nepal's tariff structure provides limited incentives for industries to shift energy intensive operations to off-peak hours, as time-of-day pricing remains limited in its application. In many countries, dynamic electricity pricing encourages factories to schedule production when electricity is cheaper, reducing costs and improving grid efficiency. In contrast, Nepal's relatively inflexible tariff system offers few such opportunities, making it more difficult for industries to optimize production schedules, reduce energy costs, and improve competitiveness [2].

And then there's the hydropower calendar itself, which every industrial planner in Nepal already knows in their bones even if nobody writes it down. During the monsoon, rivers run high, generation booms, and Nepal ends up with enough surplus to sell power across the border. Come the dry months, that surplus evaporates, and the same industries that were running comfortably a few months earlier are suddenly bracing for shortages. This isn't a policy failure so much as a geography problem, but the fact that it's natural doesn't make it less disruptive. An industry trying to run lean, just-in-time operations has to build in enormous slack simply to survive a season the calendar could have told them was coming.

Put these three things together; an unpredictable regulator, a tariff that carries no useful signal, and a grid whose capacity swings with the rain and you get an environment where industrial agility is nearly a contradiction in terms. Agility is about being able to sense change and respond to it quickly: shifting output, reallocating resources, adjusting plans as conditions move. But that kind of responsiveness



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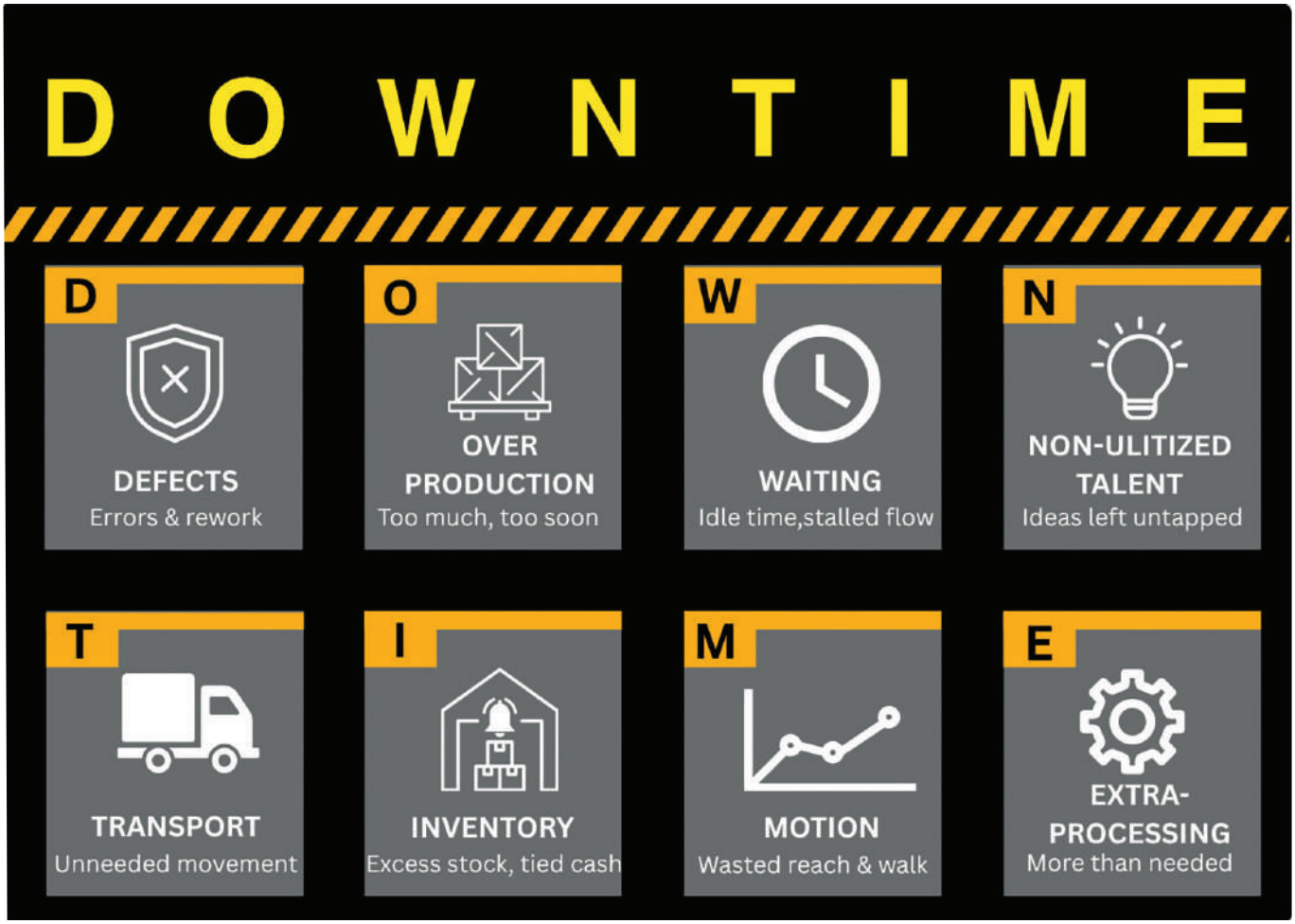
assumes the ground beneath you is at least somewhat stable, or at minimum predictable enough to plan against. When your energy cost can change because of a billing dispute nobody saw coming, or your available capacity can shrink because it's January instead of August, agility stops being a design choice available to management and becomes a luxury imposed on them by circumstance.

This matters more than it might seem, because most conversations about building agile industries in Nepal focus entirely on what happens inside the factory gate: lean tools, better scheduling, digital dashboards, workforce training. All of that is real and useful. But it quietly assumes a stable foundation that, in Nepal's case, simply doesn't exist. No amount of internal process redesign can compensate for an energy backbone that behaves unpredictably for reasons entirely outside a firm's control.

What would it take to address these challenges instead of simply managing their consequences?

A more effective electricity tariff structure should better reflect the actual cost of electricity supply while expanding the use of time-of-day pricing. Such a system would encourage industries to schedule energy-intensive operations during off-peak hours, reducing costs and improving overall grid efficiency. Several studies on Nepal's electricity sector have identified time-based pricing as a promising direction for tariff reform. In addition, dedicated feeder and trunk line services should be supported by clear, transparent, and contractually defined service agreements that specify the quality of supply, pricing, and responsibilities of both the utility and consumers. This would help minimize future disputes and provide industries with greater confidence for long-term planning and investment. At the same time, many industries are exploring hybrid energy solutions, such as combining grid electricity with captive solar generation, to improve energy reliability and reduce dependence on seasonal hydropower shortages. These initiatives demonstrate that while the private sector is adapting to existing challenges, supportive policies and regulatory reforms are essential to fully strengthen Nepal's industrial energy system.

None of this is a call for more subsidies or sympathy. It's a call to recognize that industrial agility has a precondition that rarely gets discussed in these pages: an energy system that is itself agile, transparent, and predictable enough to plan around. Until that foundation exists, every lean transformation and every agile supply chain built on top of it in Nepal is standing on ground that can shift without notice.



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INTERVIEW



Rajendra Bikram Baniya
President
Federation of Transport Entrepreneurs (FTTEN)

> ***Our goal is to build a transport system that is efficient, transparent, and capable of supporting Nepal's economic development in the years ahead.***

Mr. Rajendra Bikram Baniya is the President of the Federation of Transport Entrepreneurs Nepal (FTTEN). With decades of experience in Nepal's transport sector, he has been actively involved in advocating for transport entrepreneurs, improving logistics and mobility, and addressing national transportation policy issues. Mr. Baniya is widely recognized for his leadership in representing the concerns of the transport industry and promoting collaboration between the government, private sector, and transport stakeholders to strengthen Nepal's transportation system.

As the president of FTTEN, you've seen firsthand how heavily Nepal depends on Indian and Chinese transit routes. How has that dependency affected our trade competitiveness, and what realistic alternatives do you see opening up in the next 5–10 years?

As we all know, Nepal has a disadvantage in the supply chain, as it is a landlocked country, which is the primary cause of its dependency on India and China. We don't have proper railway facilities or any other facilities that would make the routes more feasible. There are not many other alternative routes, but the methods used to trade could be modified to create ease in the supply chain for Nepal.

Monsoons, landslides, border blockades, festival rushes – these are regular realities for transporters here. How do these seasonal disruptions actually affect import and export scheduling, and what contingency systems does the industry rely on?

Seasonal factors do not disrupt import/export scheduling at all; rather, the overall truck transport business increases during such harsh times. The truck drivers are obliged to work more during seasonal disruptions or pandemics because that is when aid is needed the most. The transport industry is obligated to run despite the physical challenges that may occur. When talking about contingency, transport prices do fluctuate according to the supply and demand of trucks, and prices are raised when the external environment is risky.

One issue that keeps coming up among truck owners is finding the right balance: carrying enough cargo to stay profitable without crossing the weight limits. How do you guide FTTEN member truck owners on this?

To be honest, the truck owners do not follow the weight laws as strictly as they should. They obviously do not carry loads that the vehicle cannot endure, but the regulation of that law is not as strict as it should be. The only solution for the truck drivers to find the right balance is by following the rules, utilizing spaces, and being available to the customers during demand.

How exactly do you calculate a fair shipping price for different routes when fuel prices keep going up and down?

The prices are standardised by a group of professionals, keeping the margin sustainable for changing fuel price conditions. Even when fuel prices go up and down, the idea

is to protect the transporters' margin so the business can still run. So, even though the price fluctuates according to the geopolitical scenario, the shipping price does not change with the same level of frequency. The rates are kept more stable compared to how often fuel prices change.

GPS tracking has become a major topic in the transport sector lately. How is GPS technology being used in the trucks affiliated with FTTEN?

The government has now given us an order to introduce GPS tracking in truck transport, but we had already integrated GPS systems to track our drivers to ensure the safety of the cargo as well as the safety of the drivers. But the GPS systems are now integrated to maintain transparency so that no illegal substances are introduced in the country, but those systems were pre-initiated by us in the trucks affiliated to us.

While tracking technology (GPS, RFID) is being introduced, what challenges are still holding back its wider adoption among Nepali transporters?

As I had said earlier, we have been implementing these technologies in the transporters as much as possible. But not all truck owners are familiar with these technologies, and that has been holding back the wider implementation among the Nepali transporters; hopefully, gradually they might implement these technologies as the government is pushing for it too.

How does the Nepali road infrastructure impact the truck transport in Nepal, and what obstacle does the shipment transport industry face as a whole in Nepal?

Well, the Nepalese road infrastructure is planned too narrowly, especially for import/export transporters. There are no resting lanes for drivers of any category. Truck drivers have to travel extremely long routes without proper parking spaces or holding centres, which increases health risks among drivers and raises the probability of accidents. There is no fixed working time for them in a day, and the infrastructure is not strategically planned enough to provide ease for them, which also causes serious shipment issues.

If Nepal succeeds in fully digitising customs and the single-window trade system within the next three years, what concrete time or cost savings do you expect transporters and entrepreneurs to experience?

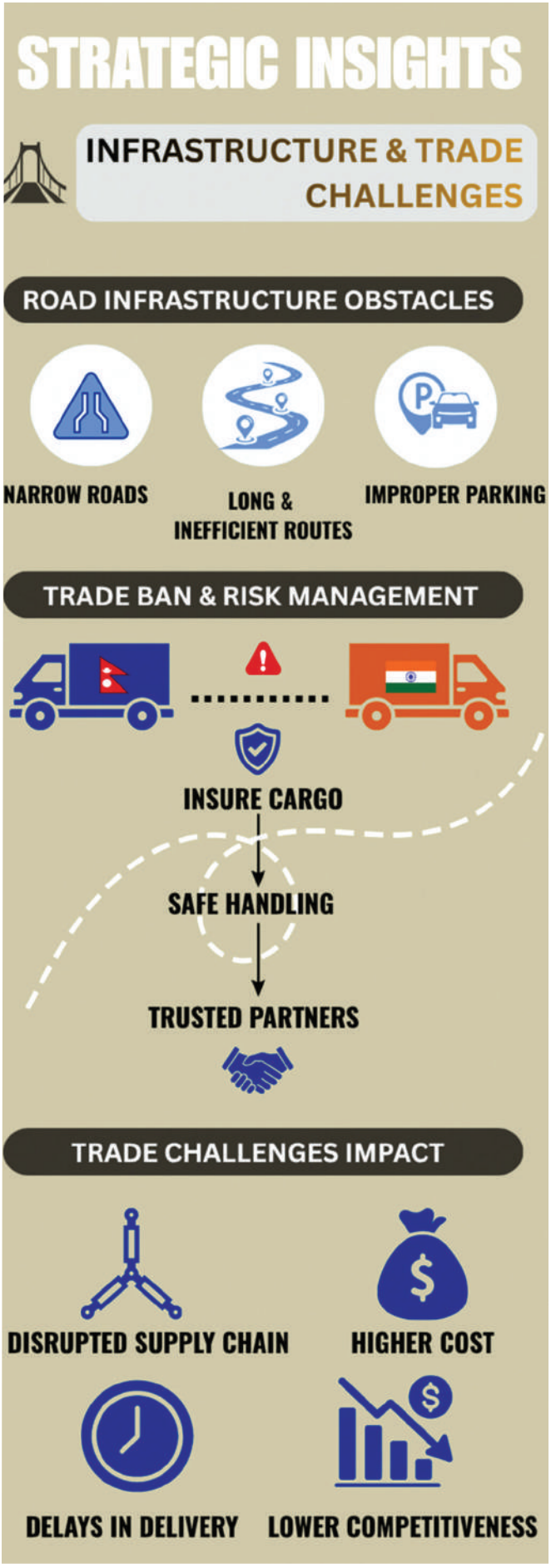
Digitalisation plays a significant role in reducing time and costs across this economy. If document standardisation becomes robust, then cross-border shipment does get easier and less costly with less transaction time as a whole.

FTTEN has publicly demanded a ban on Indian cargo vehicles entering Nepal; what's the actual efficiency argument here?

The Indians purchase their cargo vehicles at a much lower price than Nepalese. If these vehicles enter Nepal and also carry these shipments within Nepali territory, then it would be too unfair to the Nepali truck owners. They would get a much higher profit margin for supply than the Nepalese people for the same amount of work. Usually, Nepalese have to purchase the very same vehicles for three times higher prices than Indians, and we are obligated to buy these vehicles from Indian companies, as the tax and overall cost to purchase them from other countries would be even higher.

Are there financing or insurance mechanisms available to small exporters to protect against shipment loss or delay?

Exporters can take cargo insurance to protect their shipment. So even if any harm occurs, the loss will be covered by the insurance company. They can also choose a trusted transport company to export their goods, which gives further assurance that the items are in safer hands.



JUST IN TIME VS JUST IN CASE SPECTRUM

Two Approaches. Different Mindsets. Different Outcomes

JUST IN TIME

Right Item. Right Quantity. Right Time
Minimize waste, Maximize flow

JUST IN CASE

Have it when needed, just in case
Minimize risk, Maximize readiness

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Low inventory Keep only what is needed.	**INVENTORY**	**High inventory** Keep extra to cover uncertainities.
Low holding cost Less inventory , less cost.	**COST**	**Higher holding coost** More inventory, more cost.
Shorter lead time Faster flow, quicker response.	**LEAD TIME**	**Longer lead time** Stock in advance.
Works best with stable demand Requires accurate planning.	**DEMAND VARIABILITY**	**Better for uncertain demand** Buffer aginst fluctuation.
High risk of stockout If something goes wrong.	**RISK**	**Low risk of stockout** Prepared for disruptions.
Less flexible Changes are harder to adopt.	**FLEXIBILITY**	**More flexible** Can handble chages and shocks.

FIND THE RIGHT BALANCE

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Nepal's Industrial Future in an Age of Global Realignment



Image Source : Onlinekhabar

A

Introduction

The restructuring of global supply chains presents Nepal with both challenges and opportunities, making strategic adaptation essential for sustainable industrial development. Today, rising geopolitical tensions, trade restrictions, and global supply shocks have redefined logistics, transforming supply chains into strategic assets that prioritise resilience alongside operational efficiency. For a landlocked and import-dependent country like Nepal, these global realignments have significant implications for the availability and cost of fuel, food, raw materials, and other essential industrial inputs. Heavy dependence on a limited number of trade routes increases the vulnerability of domestic industries to external shocks, highlighting the need for more resilient supply chains and diversified logistics networks. The future of Nepal's industrial sector will be shaped by its capacity to improve logistics, enhance domestic value chains, and respond effectively to evolving global uncertainties, along with maintaining stable political functioning. This article explores how geopolitical changes are reshaping global supply chains and what they mean for Nepal's industrial future.

> ***"For a landlocked nation, supply chain resilience isn't a luxury- it's national economic design***

History of Policy Without Follow-Through

Nepal's industrial development has long been defined by a disconnect between ambitious policy frameworks and actual execution. While early efforts like the 1936 establishment of Biratnagar Jute Mills and the post-1956 industrial estates signalled a state-led development agenda, the post-1990 shift toward liberalization, foreign investment, and private sector participation aimed to modernize the ecosystem.

Recent legislative efforts, such as the Industrial Enterprises Act (2020), the Foreign Investment and Technology Transfer Act (2019), and the Nepal Trade Integration Strategy (2023), have further strengthened the legal framework for industrial growth. However, this progress is consistently undermined by structural barriers: limited financial resources, weak institutional coordination, and persistent political instability. Rather than an absence of sound policy, it is this implementation gap that remains the most significant barrier to Nepal's industrial future, rendering industrial progress stagnant despite these progressive initiatives.

How the World's Supply Chains Are Being Redrawn?

Since the COVID-19 pandemic, global supply chains have undergone significant transformation due to a series of geopolitical and economic disruptions. The pandemic exposed the risks of dependence on a limited number of production hubs, prompting many countries and firms to diversify supply networks. At the same time, strategic competition between the United States and China has accelerated supply chain realignment, encouraging the relocation of manufacturing and investment to alternative destinations. China's Belt and Road Initiative (BRI) and the U.S.-supported Millennium Challenge Corporation (MCC) Compact have also highlighted the growing strategic importance of infrastructure and connectivity in countries such as Nepal. Meanwhile, India's initiatives to strengthen domestic manufacturing and regional connectivity continue to reshape trade and production patterns across South Asia.

The Russia-Ukraine war, conflicts in the Middle East, tensions surrounding the Strait of Hormuz, and periodic U.S.-Iran confrontations have disrupted global energy markets, shipping routes, and commodity supplies, leading to higher transportation and import costs. Although Nepal is not directly involved in these geopolitical conflicts, its landlocked and import-dependent economy is highly vulnerable to their indirect effects. Rising fuel prices, supply chain disruptions, and increased logistics costs highlight the importance of building resilient supply chains, diversifying trade routes, and strengthening domestic industrial capacity.

Where Engineering Comes In?



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The challenges of escalating energy costs, fractured transit corridors, and unpredictable industrial inputs are fundamentally issues of structural architecture rather than mere diplomatic hurdles. Nepal's systemic fragility stems from the configuration of its logistics networks, which are characterised by a lack of redundancy and an overreliance on critical single points of failure. From an industrial engineering perspective, these vulnerabilities can be addressed through disciplined system design. By leveraging core disciplines such as lean manufacturing, supply chain management, and continuous process improvement, the nation can transform these liabilities into a resilient industrial framework, navigating geopolitical complexities through technical expertise rather than political leverage alone.

In the context of Nepal's landlocked status and reliance on external industrial inputs, the principles of supply chain management have become increasingly vital. Contemporary global realignments demonstrate that operational efficiency must now be balanced with risk mitigation and flexibility. By optimising inventory management, procurement strategies, and distribution networks, Nepal can enhance its domestic value chains and secure more reliable cross-border trade. Rather than pursuing capital-intensive technological shifts, the country can achieve significant productivity gains by systematically applying these engineering frameworks. Such an approach fosters long-term economic resilience, allowing the industrial sector to adapt to a volatile global trade environment through data-driven decision-making and a commitment to minimising resource inefficiencies.

Lessons Nepal Has Already Paid For

Nepal has repeatedly experienced the consequences of supply chain disruptions, highlighting the vulnerabilities of a landlocked and import-dependent economy. The 2015 earthquake severely disrupted transportation networks and delayed the delivery of relief materials and reconstruction supplies, particularly to remote mountain districts. Later that year, the economic blockade along the Nepal–India border exposed Nepal's heavy dependence on a single transit route for fuel, medicines, and other essential commodities, leading to widespread shortages across the country. The COVID-19 pandemic further demonstrated the risks of global supply chain disruptions, as border restrictions and trade interruptions affected the availability of medical supplies, industrial inputs, and consumer goods. More recently, seasonal floods and landslides have repeatedly blocked major highways, including key trade corridors connecting Nepal with India, disrupting the movement of goods and increasing transportation costs. Together, these events validate a core principle of industrial engineering and supply chain management, i.e., excessive dependence on limited transportation routes and supply sources undermines resilience, making it essential for Nepal to diversify logistics networks, enhance domestic production capacity, and establish healthy supply chains capable of enduring geopolitical and natural disruptions.

Where the Real Opportunities Are?

Rather than competing in large-scale manufacturing, Nepal should focus on sectors where it possesses natural resources, comparative advantages, and growing global demand. The service sector, particularly tourism, information technology, and business services, offers significant potential for export-led growth. Nepal's abundant hydropower resources can support domestic industrialisation while expanding electricity exports to neighbouring countries. In manufacturing, the textile and garment industry can strengthen its position by targeting specialised markets and value-added markets. Similarly, Nepal can capitalise on the global demand for large cardamom, orthodox tea, ginger, high-altitude Himalayan coffee, medicinal and aromatic plants, and other high-value agricultural products. The country also has opportunities to expand exports of cement and cement materials supported by its limestone reserves and increasing regional demand. By focusing on these competitive sectors and improving supply chain efficiency, Nepal can strengthen its integration into regional and global value chains while promoting sustainable industrial development.

What Nepal Should Actually Do

To build a resilient and competitive industrial sector, Nepal must prioritise sound economic planning, policy consistency, and evidence-based decision-making. The government should adopt mature political and economic strategies that provide long-term policy stability and strengthen investor confidence. Considering Nepal's strategic location between India and China, maintaining balanced and constructive trade and economic relations with both countries is essential to ensure secure market access, diversified supply chains, and sustainable industrial growth.

Industrial modernisation should be guided by proven engineering principles rather than short-term or politically motivated decisions. While embracing new technologies and digital transformation is important, Nepal should also preserve and improve effective traditional manufacturing and management practices. A balanced approach that combines innovation with established best practices will provide a stronger foundation for sustainable industrial development and long-term economic resilience.

Conclusion

Nepal's industrial evolution requires moving beyond reactive, short-term measures toward a disciplined, engineering-focused framework that prioritises systemic resilience. By leveraging its unique comparative advantages and integrating proven industrial principles with strategic global alignment, the nation can transform its structural vulnerabilities into competitive strengths.

Ultimately, Nepal's future depends on the capacity to synthesise long-term vision with consistent, technical execution, securing its role within increasingly volatile regional and global value chains.

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THE STIGMERGY PRINCIPLE

Ants Can Teach Us About The Future Of Design



Imagine you are a tiny foraging ant. You have just stepped out of your nest into a chaotic jungle of grass blades, discarded soda cans, and unpredictable pavement cracks. Your mission is to find sugar.

You have no map or GPS. Your queen is miles away, deep underground, and she isn't providing tactical updates. Yet, within a few hours, you and thousands of your colony will have built a perfectly optimized highway directly to a dropped slice of sugar, bypassing every obstacle in your path.

How can a brain smaller than a grain of sand pull off such a logistical miracle?

The secret is a fascinating biological phenomenon called Stigmergy. When an ant wanders, she leaves behind a faint chemical trail known as a pheromone. If she finds food, she heads back to the nest, laying down a stronger scent. Other ants discover this new path and follow it, adding their own scent markers along the way. As the ants take the shortest route and complete their round trip quickly, their trail accumulates pheromones rapidly. The longer, less efficient paths simply disappear as the chemicals evaporate.

> ***"A problem caught at the design stage costs 1 unit to fix, at production 10 units, and after reaching the customer, 100."***

The ants never actually talk to each other. They don't hold meetings or coordinate schedules. Instead, one ant's actions leave a mark in the environment, and that mark prompts the next ant to act. In short, **the work coordinates itself.**

What can we learn?

In the human world, we often do the opposite. Whether we are building software, managing a corporate team, or designing a manufacturing line, we focus on top-down, command-and-control structures. We believe that without a master plan and a person to enforce it, chaos will ensue.

But strict plans are fragile. If a supplier is late, a server crashes, or a market changes, the entire chain can break. The system pauses while waiting for new instructions, wasting time and resources.

Stigmergy offers a bold alternative. What if we stopped trying to manage people and started managing the environment?

For that, we shall follow three laws of the stigmergy principle.

The 3 Laws of Stigmergic Design

To build a self-organizing system—whether digital or physical—we need to mimic how ants create their trails. This requires establishing three simple environmental rules:

- **Build a Pliable Medium**

The environment must be able to record and hold "traces" of actions. In a warehouse or factory, this is a Unified Namespace (UNS)—a live, shared digital space where every machine and worker continuously provides real-time updates, leaving a digital trail of their work.

Industry	The Legacy Approach (Rigid)	The Stigmergic Approach
Software Architecture	Tightly coupled monolithic codebases	Decoupled microservices communicating via event brokers
Workplace Productivity	Endless status meetings and micromanagement	Digital Kanban boards where a card's visual position dictates the next action
Logistics	A central server calculating static truck routes	Autonomous vehicles adapting in real-time to traffic "traces"



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- **Let Old Data Evaporate**

If chemical trails on the sidewalk lasted forever, ants would constantly get lost on outdated paths. Similarly, digital traces must "decay." Alerts, tasks, and data routing paths should automatically expire if they aren't reinforced by real-time actions.

- **Create Local Triggers**

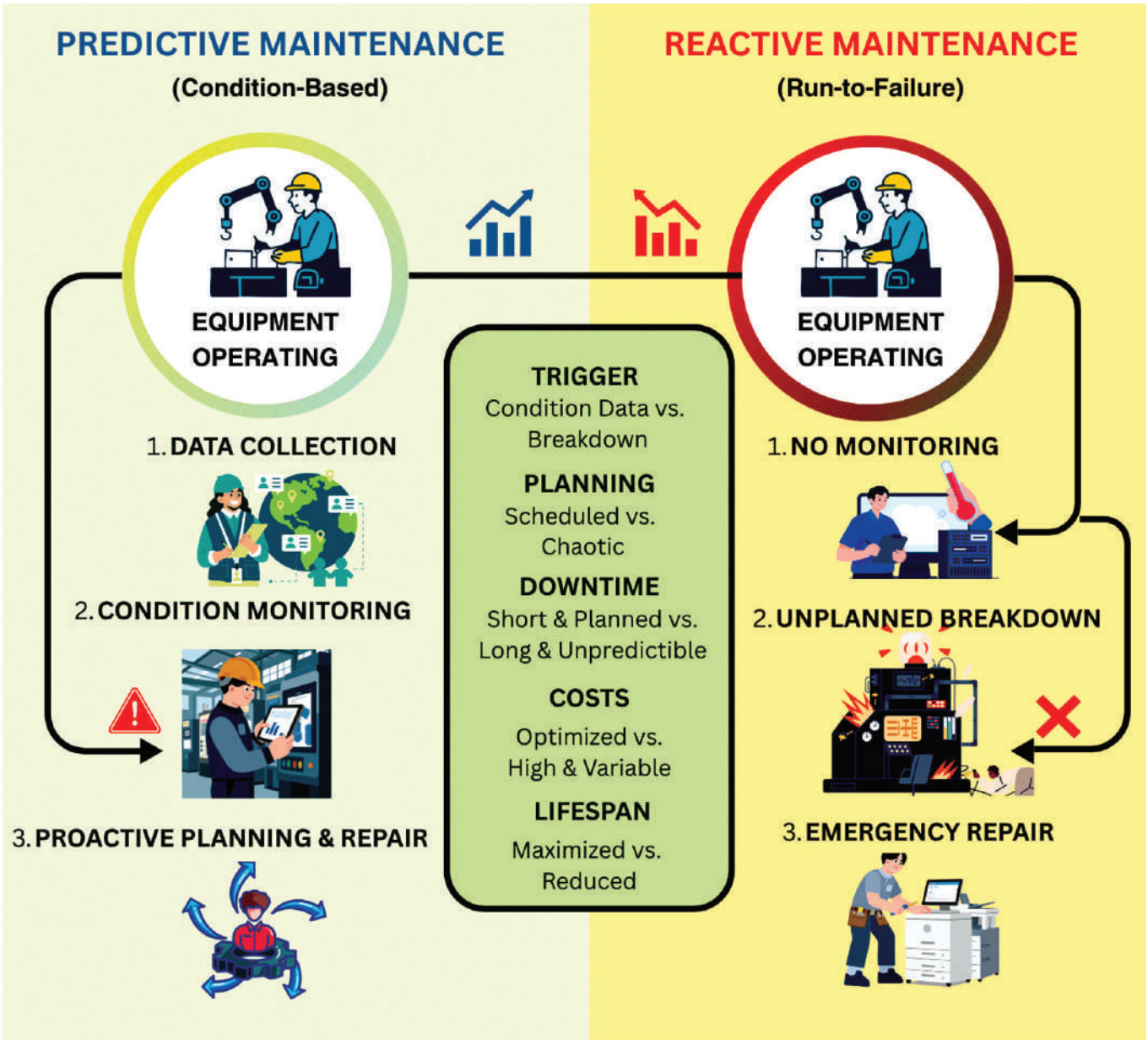
Instead of complex, master schedules, give your agents simple guidelines. For example, if a digital queue fills up, a microservice automatically creates a new instance to manage the load. No manager needs to step in; the work itself triggers the response.

Following the stigmergic approach, we are redefining success from control to flow. Comparing it with the legacy approach, we can see its benefits.

Thus, the ultimate promise of the Stigmergy Principle offers a humbling lesson for designers, leaders, engineers, and writers alike: We do not need to know everything to create something beautiful.

The most resilient, agile systems on Earth do not come from top-down designs. They emerge from the bottom up, built from simple interactions with a responsive environment.

As we design the organizations and technologies of the future, our goal should not be to create heavier rulebooks or more complex maps. When we step back and let the environment guide the work, the results are impressive. So, we aim to prepare the ground, take a step back, and let the paths form naturally.



Why Nepal's Industries Need Systems, Not Just Growth?



I've spent a long time thinking about why some industries hold together under pressure, and others don't. Nepal keeps giving me the same answer. In late 2015, landlocked Nepal was recovering from one of the worst earthquakes in its modern history. Then a second crisis arrived at the border. A trade disruption with India cut off fuel, medicine, and raw materials for months. Factories in Birgunj and Hetauda sat idle not because of damaged machinery, but because the inputs needed to run them simply could not get through. Industries that had survived the earthquake could not survive a blocked road.

That episode revealed something important. Nepal's industrial problem was never only about capacity. It was about design.

A Narrow Foundation

Nepal's manufacturing sector rests on a structurally fragile base. According to a World Bank report, more than 90 percent of Nepalese exporters import some of the components of their finished goods from other countries. Intermediate goods alone accounted for nearly 35 percent of Nepal's total imports in 2022, with India supplying 58 percent of everything the country brought in. This means most Nepali factories are not self-contained production systems. They are assembly points at the end of long, foreign-controlled supply chains. When those chains hold, the factories run. When they don't, everything stops.

What Agile Systems Actually Look Like

Industrial resilience is not a vague aspiration. It has practical, measurable components, and other countries have built them deliberately.

Supply chain diversification is the most immediate lever for this. Bangladesh's garment industry, often cited for its vulnerabilities, has over the past decade developed multiple supplier relationships across fabric sourcing, spreading purchases across markets like China, India, and domestic mills rather than depending on a single country of origin. That shift didn't eliminate risk, but it meant a disruption in one supplying country no longer meant a factory floor going idle. Nepal's industries, by contrast, often have a single supplier for critical inputs, with no backup and no buffer stock.

Local sourcing is a second and underused lever. Nepal has raw material potential that its industries have not fully connected to. Agricultural byproducts from the Terai, timber from managed forests, and mineral resources in hill districts remain largely unprocessed or exported raw. An agro-processing industry that sources inputs domestically does not just reduce import dependency. It creates a second layer of economic activity and makes the supply chain shorter and more controllable.

> ***"There is the difference between a factory and a system. A factory Produces. A system responds."***

Process flexibility is a third component that rarely gets discussed in Nepal's industrial planning. A flexible production system can shift between product lines, adjust output volumes, or substitute materials when one input becomes unavailable. This is a design choice, not an expensive upgrade. It means training workers across multiple roles, investing in modular equipment, and building inventory systems that give managers real visibility into where pressure is building before it becomes a shutdown.

The Hetauda Industrial District has the physical infrastructure to support this kind of redesign. In my own observation of the district, what it has often lacked is coordination between individual factories, less a resource problem than a systems-thinking one. This is an area that deserves closer study than any single article can offer.

None of this is free. Buffer stock ties up working capital. Dual sourcing often means paying more per unit than a single high-volume supplier would charge. Process flexibility requires training investment that doesn't show up on a balance sheet as quickly as new machinery does. If these levers were costless, Nepali manufacturers would likely have pulled them already. The honest case for systemic design isn't that it's free; it's that the cost of doing nothing, paid in idle production lines and unfulfilled orders, has already proven larger.

Nepal's Past Disruptions as a Design Brief

The 2015 blockade is the most dramatic example, but it is not the only one. The COVID-19 pandemic exposed the same structural weakness when global shipping costs rose sharply, and container availability collapsed. Nepali importers faced delayed shipments and price spikes they had no contractual protection against. The wheat flour crisis of 2022, driven partly by the Russia-Ukraine conflict disrupting



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global grain markets, showed that Nepal's food processing sector had no meaningful buffer against international commodity shocks.

Each of these disruptions followed the same pattern. An external event reduced input availability. Factories with no local alternatives, no buffer stock, and no flexible processes shut down or cut output sharply. Recovery depended on the external situation improving, not on anything Nepal had built internally.

A systems-oriented approach treats each disruption not as bad luck but as a signal. It asks: what would have softened this? A domestic supplier? A stockpile? A contract clause? A flexible production line? These are engineering questions, not policy abstractions, and industrial engineers are precisely the people trained to answer them.

The Role of Industrial Engineering

Industrial engineering as a discipline sits at the intersection of people, processes, and systems. That intersection is exactly where Nepal's industrial problem lives.

Optimizing a single factory's output is useful. But the more valuable work is mapping the dependencies between factories, suppliers, logistics networks, and workforce capabilities, and then identifying where the system as a whole is most exposed. This kind of analysis, what industrial engineers call systems modeling or supply chain risk mapping, is standard practice in industries across Southeast Asia and South Asia. It is not widely practiced in Nepal's industrial planning. It's worth being precise about scope here. Some of the fix sits with individual factories, buffer stock, process flexibility, and workforce training. Some of it sits with government, trade agreements, customs infrastructure, cross-border logistics. Industrial engineers can't fix a closed border. What they can do is make sure a closed border doesn't have to mean a closed factory.

Thapathali Campus and institutions like it are training people with exactly these tools. Value stream mapping can reveal where idle time and waste accumulate in a production process. Inventory optimization models can calculate the right buffer stock levels without tying up excessive capital. Workforce cross-training programs, designed with ergonomics and operational continuity in mind, can build the human flexibility that complements process flexibility.

The gap in Nepal is not a lack of technical knowledge. The gap is in application. The methods exist. What Nepal's industries need is a generation of practitioners who apply them to Nepali realities rather than waiting for conditions to resemble those somewhere else.

Building Before the Next Disruption

Nepal's industries will face another external shock. The timing is uncertain. The form it takes is uncertain. What is not uncertain is that industries built on single-source supply chains, with no buffer inventory and no process flexibility, will respond the same way they always have.

The work of industrial engineering is to make sure they don't have to.

Resilience is a design decision made before a crisis, not a recovery strategy deployed during one. Nepal has enough documented disruptions to know exactly what kind of system it needs to build. It has the human capital in its engineering schools and its factory floors to build it. What it needs now is the institutional will to treat systemic design as an industrial priority rather than an afterthought to growth.

If you know why you are doing what you do, the path forward becomes clearer than any disruption can make it.



THE FINANCE-ECONOMIC CYCLE DILEMMA IN NEPAL



The funny part of learning economics is once it starts to make sense, you keep looking at yourself as poor. Nepal introduced its First Five-Year Plan in 1956 (2013 B.S.), marking the beginning of planned economic development. The then finance minister, Subarna Shamsher Rana, in the Constitution of Nepal 2015 BS, had introduced "*General Provisions: (1) No tax shall be levied except by or under the authority of law*" as one of the policy-level financial landmarks. This envisioned today's handful of socio-financial statements of "*to enhance the national economy through partnership and independent development of the public, private, and cooperative sectors*"; indeed, Nepal has come a long way. The public-centric economy has come a long way toward shifting focus from public policy to industrial development. In the uphill evolution of economic policy, Dr. Ram Sharan Mahat played a leading role in advancing Nepal's market-oriented reforms, and the Privatization Act, 1994 provided the legal framework for privatizing state-owned enterprises.

> ***"Nepal's economic path isn't a choice between market liberalization and state control, but a challenge of harmony—where well-governed, community-led cooperatives bridge the gap between capital growth and social equity***

With the rise in private equity owners of large-scale industries, taxation policies also can't be unlinked. This was a steppingstone in shaping a modern-day Nepalese economy along with its transformative policy approach. The privatization wave of the mid-1990s did not just transfer ownership of state-owned enterprises to private hands; it fundamentally altered the relationship between the state, capital, and citizens. For the first time, policy discourse began to seriously weigh fiscal efficiency against social equity. Yet, as private equity grew dominantly in sectors like manufacturing, hydropower, and finance, a new paradox emerged: the same private sector that drove growth also exposed regulatory gaps. Taxation, while legally anchored in the constitution, often lagged behind the complex financial instruments and cross-border capital flows that accompanied liberalization.

In the years following, successive governments oscillated between attracting foreign direct investment and protecting domestic industries. The cooperative sector, envisioned in the constitutional statement as a third pillar of the economy, flourished numerically but remained fragmented, often operating with little oversight. Meanwhile, public sector infrastructure projects struggled with bureaucratic inertia. The result is a tripartite economy where the public, private, and cooperative sectors coexist more by accident than by design, each pursuing its own logic rather than a shared national vision.

Today, Nepal stands at a critical juncture. The "public-centric" aspiration has not fully translated into industrial competitiveness. But the real question is whether public-private partnership is acceptable for the upcoming generation, or if economic liberalization will persist on such a wide scale that a fully private-driven open market is inevitable.

Hereby, looking through a farsighted lens, evolving community-led cooperatives and their beneficiary circle leads to structural economic brilliance. The fragmented society cannot be knotted into one garland of uniform economic policy. Each social basket fed by cooperation leads to unique financial systems that accompany the development of each society at its own pace. The big question marks are on us: what is our financial market like so that we can keep up with farsighted competition, or can the government intervene and create alternative routes? The fact is Nepal lacks effective financial monitoring institutions. This creates a gap in the commercial lending-borrowing system. Transparent governance,



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efficient tax administration, predictable regulations, and judicial confidence are equally important in attracting investment and sustaining long-term economic growth. The effectiveness of policy ultimately depends on implementation rather than legislative intent alone.

Nepal is a country that heavily depends on small-scale businesses and medium-economy enterprises that uphold the most part of our inclusive economy. Small farmers, micro-entrepreneurs, and rural producers often lack bargaining power, access to affordable finance, modern technology, and organized markets. Well-governed cooperatives can aggregate production, negotiate fair prices, facilitate access to credit, provide technical assistance, and establish common processing and distribution networks. This collective approach transforms economically vulnerable individuals into active participants within larger value chains while improving productivity and market competitiveness. However, the success of this model depends fundamentally on institutional integrity. Nepal's cooperative sector has experienced remarkable numerical expansion, yet its credibility has been challenged by weak governance, political interference, inadequate financial oversight, and instances of mismanagement. Therefore, a future cooperative-based economic policy must emphasise transparency, professional management, financial accountability, independent regulation, and regular auditing. Strengthening governance is essential if cooperatives are to regain public trust and evolve into reliable pillars of the national economy rather than remaining fragmented local institutions.

Ultimately, the question is not whether Nepal should choose between state-led development, market liberalisation, or cooperative ownership. The more significant challenge is determining how these three pillars can reinforce one another while reflecting Nepal's unique socioeconomic realities. A mature cooperative movement built on transparency, professionalism, and community participation could become the foundation of an inclusive development strategy that balances economic competitiveness with social justice, ensuring that national prosperity is not measured solely by aggregate growth but also by the breadth of opportunity shared among its citizens. The combined efforts led by the government in uplifting the community-based financial institutions with the cooperation of individuals will sustain a chain reaction of structurally based development across the nation.

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THE GUESSING CHAIN

How Nepal's cement industry is loosing two-third of its capacity to information gaps



Nepal's cement sector has significant production capacity—over 25 million tonnes. In the year 2023/24, it only used less than 8 million tonnes of that capacity. The country is still rebuilding after the earthquake in 2015. There are many infrastructure problems across every province. The demand for cement is there, and so are the factories. However, more than two-thirds of the sector's capacity is not being used every year.

This is not a problem with money or infrastructure. It is a problem with information. Factories are deciding how much to produce without knowing how much the market will actually buy. Distributors are placing orders based on what they sold the previous season. Contractors are guessing how much material they will need weeks in advance without getting any real-time information from the supply side. Every person in the chain is making decisions without talking to the others. The result is a sector that is only operating at 52.03% capacity despite having real demand.

> ***"Nepals industries are not underperforming, they are operating blind***

The Theory of Constraints says that the whole system is limited by its link. In Nepal's cement supply chain, the weakest link is not the factory or the quarry. It is the decision-making process. The point where someone is guessing instead of knowing. That is the bottleneck this article is talking about, and data science is the tool that can fix it.

How the Information Gap Compounds?

The cement chain in Nepal has four people: manufacturers, distributors, retailers, and contractors. Each one makes decisions that depend on the others. A contractor guesses how much material they will need for a project. A retailer orders from a distributor based on that guess. A distributor orders from a manufacturer based on what the retailers are ordering. A manufacturer decides how much to produce based on what the distributors are ordering. At every step, the information gets distorted. Guesses become estimates; estimates become guesses, and by the time a production decision is made, it is based on a distorted version of what the actual demand is.

The distortion compounds with each step down the chain. A manufacturer who overestimates demand builds up much inventory. A distributor who underestimates demand runs out of stock in the middle of a project. A contractor who cannot get material on time delays construction and pushes the order cycle into a different season. Each person responds to the distortion by adding a buffer. Inventory, longer lead times, and higher safety stock. And those buffers represent the gap between 25 million tonnes of capacity and 8 million tonnes of production.

This problem has a name in supply



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chain theory: the bullwhip effect. Small changes in demand get amplified into swings in orders. Nepal's cement sector is an example which is made worse by the fact that there is no shared information across the chain.

What Data Science Changes?

Demand forecasting addresses this directly. Two to three years of distributor order data, combined with construction permit volumes, seasonal project cycles, and regional infrastructure spending, can be used to make accurate production projections. Research has shown that using analytics can reduce stockouts by 22% and improve forecast accuracy by 17%. For a cement manufacturer that is only running at one third of capacity, accurate demand forecasting can change how capital is allocated, when raw materials are bought, and how production shifts are scheduled.

Inventory optimisation tackles the buffer problem specifically. Each person in Nepal's cement chain holds inventory because they do not trust the information from the person below them. Using a concept like Economic Order Quantity can help distributors and manufacturers make better decisions about how much inventory to hold. This reduces the over-ordering that drives the bullwhip effect.

Logistics analytics closes the remaining gap. Cement is a volume, low-margin product. Transport cost is a part of the final price. While there are problems with freight routes in Nepal that no model can solve overnight, using data on route performance can help procurement managers make decisions about which carriers to use and which routes to avoid.

Why It Has Not Happened?

The barriers are not technological; they are operational.

- Most distributors are overnight and do not have data on transactions. Orders are placed by phone, and inventory is reconciled at the end of the month in ledgers. A forecasting model needs two to three years of timestamped data. Most distributors do not have that.
- There is a trust problem. A distributor who has managed cement inventory for fifteen years based on intuition does not immediately trust a model's output. That trust is built by running forecasts in parallel with existing decisions and tracking accuracy over time.
- Nepal's AI policy is framed as a national technology agenda. But the cement sector needs something: distributors need to use systems that record transactions and analysts who can build demand models on that data. The policy gap and the operational gap are different.

Where Industrial Engineers Fit?

The cement supply chain problem is not a data science problem. It is an industrial systems problem where data science is one of the tools. Understanding why a distributor holds extra inventory requires knowing how credit terms work between distributors and retailers in Nepal's construction market. Understanding why a manufacturer's production schedule lags behind orders requires knowing how batch processing works in a factory.

Industrial engineers are trained to understand systems in detail. The gap is that most industrial engineering graduates in Nepal are not connecting that understanding to applied analytics. Building that connection is the work that needs to be done: running demand forecasts on real data, calibrating safety stock models, and analysing real freight performance data.

Seeing Clearly

Nepal's cement sector has the capacity to produce three times what it currently produces. The demand is there. The constraint is that no one in the chain knows what anyone else is doing with precision to make aligned decisions. Data science can solve that problem. Through demand forecasting, inventory optimisation, and logistics analytics.

The process starts with recording what is already happening. Digitising transaction records, building models on data, and verifying forecast accuracy before acting on it. It is an operational process. It is also the way to improve the supply chain that addresses the actual bottleneck rather than building more capacity on top of a broken information layer.

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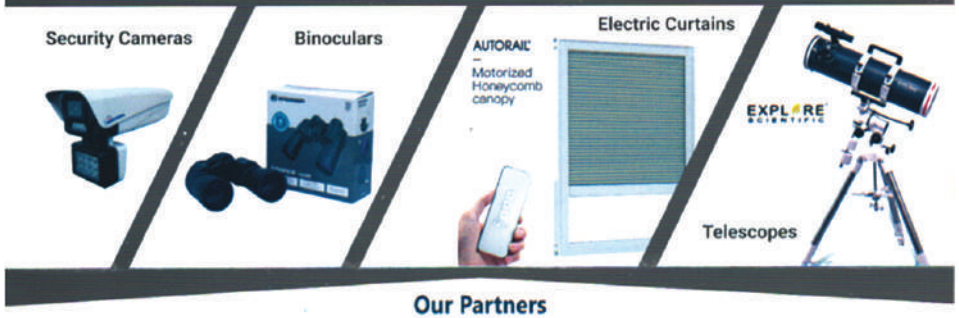
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INTERVIEW



"Entrepreneurship is a journey of taking risks, learning from failure, and turning market gaps into opportunities.

Bharat Raj Acharya is a prominent Nepali industrialist and business leader, and the former Treasurer of the Federation of Nepalese Chambers of Commerce and Industry (FNCCI). He is the Chairman and CEO of TSN Corporation, a diversified business group with interests across manufacturing, packaging, trading, education, healthcare and other sectors. He has also served as Chairperson of FNCCI's Industry Committee and currently leads the Nepal Packaging Industry Association. With experience spanning industrial operations and private-sector policy advocacy, Acharya brings a practical perspective on Nepal's manufacturing competitiveness, logistics, workforce development and industrial transformation. In this interview, he discusses Industry 4.0, automation, industry–academia collaboration, production costs and the opportunities ahead for Nepal's industrial sector.

As the Treasurer of FNCCI, you see the pain points of the business community nationwide. What role should FNCCI play in helping traditional Nepali industries transition toward more flexible, modern production systems?

Nepal's industrial history is neither too long nor too short , as the Nepal's first modern industry started in Biratnagar. At the same time, industrial revolution was also happening in Europe but after some time it shifted to Japan. For 20 years, Japan had tremendous growth in the industrial sectors and later in the 1970s it shifted towards East Asian countries and later towards China in 2000s. And as of 2015, it is slowly shifting to South Asia, we see pattern where every 20 years the major center of the global supply chain is changing. So, as South Asia is becoming a pin point of the global supply chain and there is a need to establish correct industrial policies. One of the major pain point would be cost of production, so reducing cost of production in total production areas, logistics, resource cost would help the businesses.

If you could sit down with the policymakers today, what is the single, absolute reform the government could make tomorrow that would genuinely unlock industrial growth?

As we are dreaming of Industry 4.0 where AI is taking place, we are still stuck on the learning about the machines so there is mismatch in the skills being learned and the skills which are actually needed in the industry for which the skills are being outsourced from other countries. To mitigate this problem, there should be real-time skill development according to the skill required in the industry and implement protected industrial regime to allow our industries to compete with its neighbor countries.

Many manufacturers point out a severe lack of skilled industrial labor in Nepal. Are you currently integrating smart automation or IoT (Internet of Things) inside your own facilities to combat this shortage, or are you focusing heavily on upskilling your current workforce?

Several studies and research have stated that in our near future not only in industries but also in our daily life AI will take over 70% of the human work. As AI is relatively new in the context of Nepal as there is lack of technology and the skilled manpower required to operate those technologies. We are also trying to bring new technology with the consideration of increasing the automation and reduce the human effort.

Since your packaging plants rely heavily on imported plastic resins, how do you manage your supply chain logistics to prevent international shipping delays or currency fluctuations from completely halting your factory floors?

As we all know Nepal is a landlocked country, being a landlocked country comes with its own problems like not having access to seaways. Our nearest access to seaway is about a 100 kilometers away though may not be too far but according to some research 29 to 30 percent of the cost is spent on logistics which in comparison to other South Asian countries who only spend about 18 to 19 percent. So the cost of logistics is too high which puts us at a competitive disadvantage. Likewise, there are no effective ways to transport goods other than highways inside the country of which the its condition is also not the best. So, to tackle these problems and to manage the supply chain logistics we hand the responsibility to the logistic company.

We've encountered that TSN group also designs industrial layout for industries and IE students are well capable for that. Do you have any IE graduates in that field and about how many layouts have you planned so far?

We have diversified business intervention and we build a complete packaging ecosystem for companies. Yes, you are right industrial Engineers are fit for that job and we specifically require their expertise in that particular sector. But we have not hired industrial engineers for job but we have had some industrial engineering interns in our company. We still have industrial requirements yet to be fulfilled but are not able to find right human resources.

Your investments cover highly diverse areas like textiles, schools, hospitals, and plastics. How does owning so many different types of businesses help protect your group during a tough economy? How can one manage so many verticals?

Just like medicine and engineering, management also has tools and techniques that helps to plan, track and work together. For example, if you look at a machine it has different components inside it like electrical component, mechanical component, control component etc which work together to improve the efficiency of a machine likewise in a corporate there are different departments each with their own set of responsibilities working together which reflects on the management. So as a chairman I am not alone, I have a team behind me who help me in managing these verticals.

Have you ever affiliated your company with universities with MOUs to support industry-academia approach?

No, we have not signed MOUs with any universities yet. We had advocated for industry-academia approach in FNCCI too so that the real-time human resources that are being shaped in universities would match our real-time industrial skill requirements. I think we had done some MOUs with some colleges but the output was not fruitful enough. Talking about the private sectors that I'm affiliated in, we have not signed MOUs with any colleges yet but we wish to do. If we get to know how the students are being prepared for practical industrial environment and what the curriculums are like, we would be delighted to sign MOU with colleges.

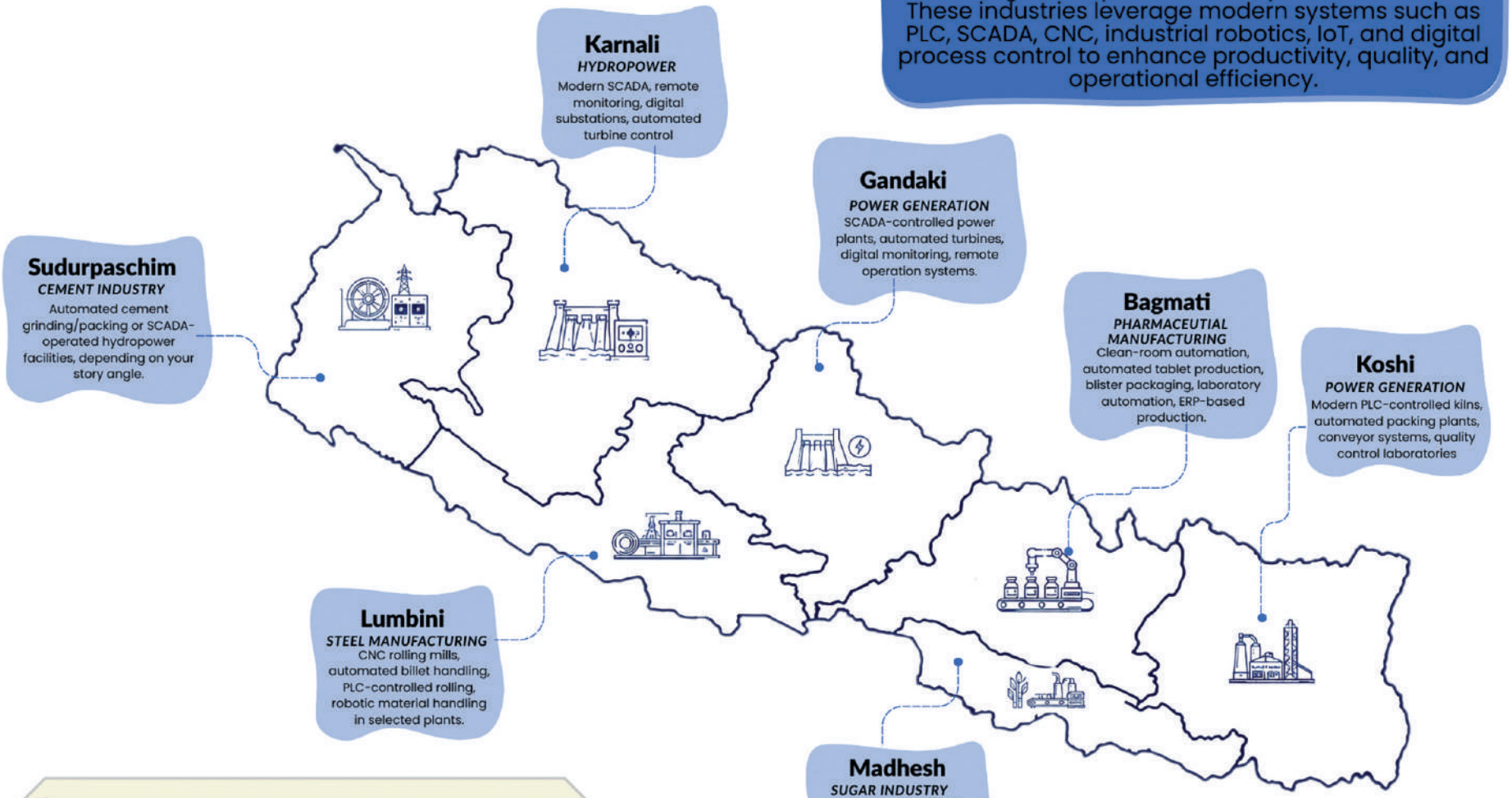
Looking back at your own journey across manufacturing, imports, and diverse investments, what is your number one piece of advice for the next generation of industrial investors in Nepal who want to build something that lasts?

Entrepreneurship is all about taking risks. If you think about it life itself is a business from when you are born till you reach your adulthood, you take risk at every chapter of your life. Entrepreneurship is like a journey of your life, for example the subject you are studying is also a form of taking risk because you could have chosen any other subject than engineering maybe you could be more successful in life if you had chosen any other subject, so you are also taking a risk in life with your own research and study. Therefore, learn to take risks with optimistic mindset and learn from any failure that may come along. As from business perspective, first study and identify the gap in the market and make your first venture small but successful so it becomes a motivation for your journey further ahead.

Engineering Agility
THROUGH AUTOMATION

REPRESENTATIVE AUTOMATIVE INDUSTRIES

The industries highlighted for each province represent prominent examples of advanced automation technologies adopted across key industrial sectors. These industries leverage modern systems such as PLC, SCADA, CNC, industrial robotics, IoT, and digital process control to enhance productivity, quality, and operational efficiency.



Karnali
HYDROPOWER
Modern SCADA, remote monitoring, digital substations, automated turbine control

Gandaki
POWER GENERATION
SCADA-controlled power plants, automated turbines, digital monitoring, remote operation systems.

Sudurpaschim
CEMENT INDUSTRY
Automated cement grinding/packing or SCADA-operated hydropower facilities, depending on your story angle.

Bagmati
PHARMACEUTIAL MANUFACTURING
Clean-room automation, automated tablet production, blister packaging, laboratory automation, ERP-based production.

Koshi
POWER GENERATION
Modern PLC-controlled kilns, automated packing plants, conveyor systems, quality control laboratories

Lumbini
STEEL MANUFACTURING
CNC rolling mills, automated billet handling, PLC-controlled rolling, robotic material handling in selected plants.

Madhesh
SUGAR INDUSTRY
Automated milling, centrifuges, boilers, process instrumentation, conveyor handling, bagging systems.

TRANSFORMING INDUSTRIES THROUGH INTELLIGENT AUTOMATION.

WHO ABSORBS THE SHOCK WHEN THE SYSTEM IS NOT AGILE?

Lessons from illam's tea crisis



An Industry Built on a Single Thread

In May 2026, one procedural notice from across the border was enough to bring an entire Nepali industry to a halt within weeks. No storm, no disease, no collapse in demand for the product itself, just a change in paperwork requirements on the other side of a customs gate. What followed offers one of the clearest case studies in recent memory of what happens when an industry is efficient but not agile: it can produce a fine product for decades, and still be brought down by a single point of failure it never got around to fixing.

This article draws on reporting from the *Kathmandu Post, Republica, Nepal News, Khabarhub, The Wire,* and *Spotlight Nepal,* along with statements from *Nepal's Ministry of Foreign Affairs*, to trace what happened, who ended up paying for it, and what "agility" would actually require of an industry like this one.

> ***"Systemic excellence is not the absence of disruption; every export-dependent industry will eventually face it. It is about where that disruption lands when it does.***

What Happened?

On May 1, 2026, India's Tea Board introduced a new Standard Operating Procedure governing tea imports, requiring individual laboratory testing of every truckload entering the country. According to reporting in Republica, this replaced a far more workable system, in which a single certificate had been able to clear up to ten truckloads within about fifteen days. Under the new rule, as multiple outlets reported, laboratory results took upward of twenty days to arrive, tea already sitting in Indian warehouses could not be sold in the meantime, and any shipment that failed testing had to be destroyed or returned, triggering a second round of testing and a second testing fee, weeks later.

The timing could not have been worse. This fell during the "first flush," the season's most valuable harvest, when tea bushes are at their best and the entire year's income depends on moving product quickly. Because Nepal sends the vast majority of its processed orthodox tea to India, well above 90 percent by most industry estimates, there was effectively no alternative outlet once the primary route narrowed.

Within weeks, the backlog became severe. It was reported that more than 300,000 kilograms of Nepali tea sat stranded in Indian warehouses, unable to be sold, while over 700,000 kilograms of processed tea piled up unsold inside Nepali factories. Factory owners had already paid farmers for their green leaf; now the finished product wasn't moving, and neither was the cash needed to keep paying for the next harvest.

The result, as association leaders told at the time, was that factories simply could not keep running with warehouses full and no buyers able to take delivery. Fifty-three factories in Ilam's Suryodaya region shut down from June 15, followed within days by roughly thirty more factories and over a dozen tea estates in Jhapa. By mid-June, according to the *Kathmandu Post*, around 80 factories and estates across Ilam and Jhapa combined had ceased operations. The *Asia News Network* and the Post separately reported that an estimated 60,000 workers were left without income inside a sector that, according to industry figures cited in coverage of the crisis, ordinarily supports about 100,000 workers, 15,000 smallholder farm ing families, and roughly NPR 4.59 billion a year in export earnings.

How the Crisis Was Resolved

The system did eventually respond, though not quickly. According to *Spotlight Nepal*, pressure from members of parliament and from the Federation of Nepalese Chambers of Commerce and Industry pushed the government toward formal diplomatic engagement. Nepal's Ministry of Industry and Ministry of Foreign Affairs opened talks with Indian counterparts, and a task force was formed under the Prime Minister's Office to coordinate the response, as reported by *Khabarhub.*



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Roughly two months after the SOP first took effect, India's Food Safety and Standards Authority agreed to relax the testing requirements, and exports gradually resumed.

What is notable, though, is what did not change. No testing laboratory yet exists at the Panitanki customs point itself, as samples must still be transported to Kolkata for analysis, and Indian authorities retain full discretion to conduct random inspections at any time. Industry figures quoted in that coverage were candid that they remain cautious rather than reassured, because the structural vulnerability that caused this crisis is still in place. This was also not the sector's first such disruption.

Who Actually Absorbed the Shock

The decision that triggered this crisis was made in a regulatory office. The cost of it, however, did not stay there.

Reporting by the Asia News Network documented the human toll directly. At Giribandhu Tea Estate in Jhapa, worker Amber Bahadur Tamang described losing his household's only source of income overnight. A fellow worker, Khinamaya Bastola, told reporters that daily wages had been their only way of putting food on the table, and that the uncertainty over how to manage meals had become constant. At Tokla Tea Estate, worker Hari Bahadur Darji made an observation that captures the structural imbalance well: industrialists, traders, and government officials generally have some financial cushion to fall back on, while workers dependent on daily wages have none, essentially.

That asymmetry is the real story beneath the trade dispute. Smallholder farmers had already delivered their green leaf and were left waiting, uncertain when payment would arrive. Factory owners were caught between unsellable inventory and obligations to their communities.

Why This Was Not an Agile System

Agility does not mean an industry never encounters disruption; cross-border trade will always carry some risk of policy friction. Agility means an industry can absorb that disruption without its most vulnerable participants bearing the entire cost. On several counts, Nepal's tea sector was not built this way.

Dependence on a single market and route. With such a large share of exports moving through one country and effectively one crossing point, there was no alternate channel available the moment that route narrowed.

No independent testing capacity. Nepal had no accredited laboratory of its own at the border capable of certifying tea quality without relying on facilities across the border, meaning the industry's export timeline was never fully in its own hands.

No buffer capacity. There was no strategic storage system, hedging mechanism, or standing agreement designed to absorb a temporary halt in sales. Warehouses reached capacity within days of the freeze, not months.

A slow institutional reflex. Formal diplomatic engagement began only after sustained public and parliamentary pressure, weeks into the crisis. A system built for agility would have an early-warning and rapid-response mechanism ready before a disruption occurs, not assembled reactively once factories have already gone dark.

No safety net at the bottom of the chain. There was no emergency wage-support mechanism to activate the moment operations paused, leaving daily-wage workers with no protection at all.

Unresolved governance issues underneath. Nepal's tea sector has also carried older structural tensions, including long-running disputes tied to the 2000 privatization of the Nepal Tea Development Corporation, where a majority stake was leased to a private group for fifty years, and subsequent disagreements over reinvestment and local governance. An industry still working through internal governance friction is rarely well positioned to respond quickly to an external shock.

What Agility Would Actually Require?

Building resilience into this sector does not mean predicting the next policy change. It means designing a system that can bend without breaking when one arrives.

Diversify the export base. Developing buyers beyond India in Europe, the Gulf, and elsewhere and building Nepal's own branded, packaged tea for direct international sale, so that no single country's regulatory decision can freeze the entire industry at once.

Build domestic testing capacity. Investing in an accredited laboratory near the Nepal side of the border, so export certification does not depend entirely on facilities and timelines controlled by another country.

Create storage and financial buffers. Cold storage, flexible warehousing, and hedging arrangements that can convert a temporary export pause into a manageable delay rather than a shutdown.

Institutionalize bilateral monitoring. A standing Nepal–India trade mechanism that flags emerging friction early, so diplomatic engagement begins in days rather than after weeks of factory closures.

Protect workers structurally, not reactively. A modest, jointly funded emergency wage-support mechanism for periods when export disruptions halt production, so daily-wage workers are not the default shock absorbers of the entire system.

Resolve underlying governance gaps. Address long-standing disputes over investment, land, and estate management so the industry enters the next disruption structurally sound, rather than already carrying unresolved internal friction.

Systemic excellence is not the absence of disruption; every export-dependent industry will eventually face it. It is about where that disruption lands when it does. A well-designed system spreads the impact across diversified markets, buffer capacity, and institutional response, so that no single group is left to absorb the full cost of a decision made elsewhere.

Nepal's tea sector has weathered this kind of disruption before, and reporting suggests it is likely to again. Whether the industry has genuinely learned from this crisis will not be measured by how quickly exports resumed this time; it will be measured by whether, next time, the shock has somewhere else to go besides straight into the hands of workers who can least afford to carry it.

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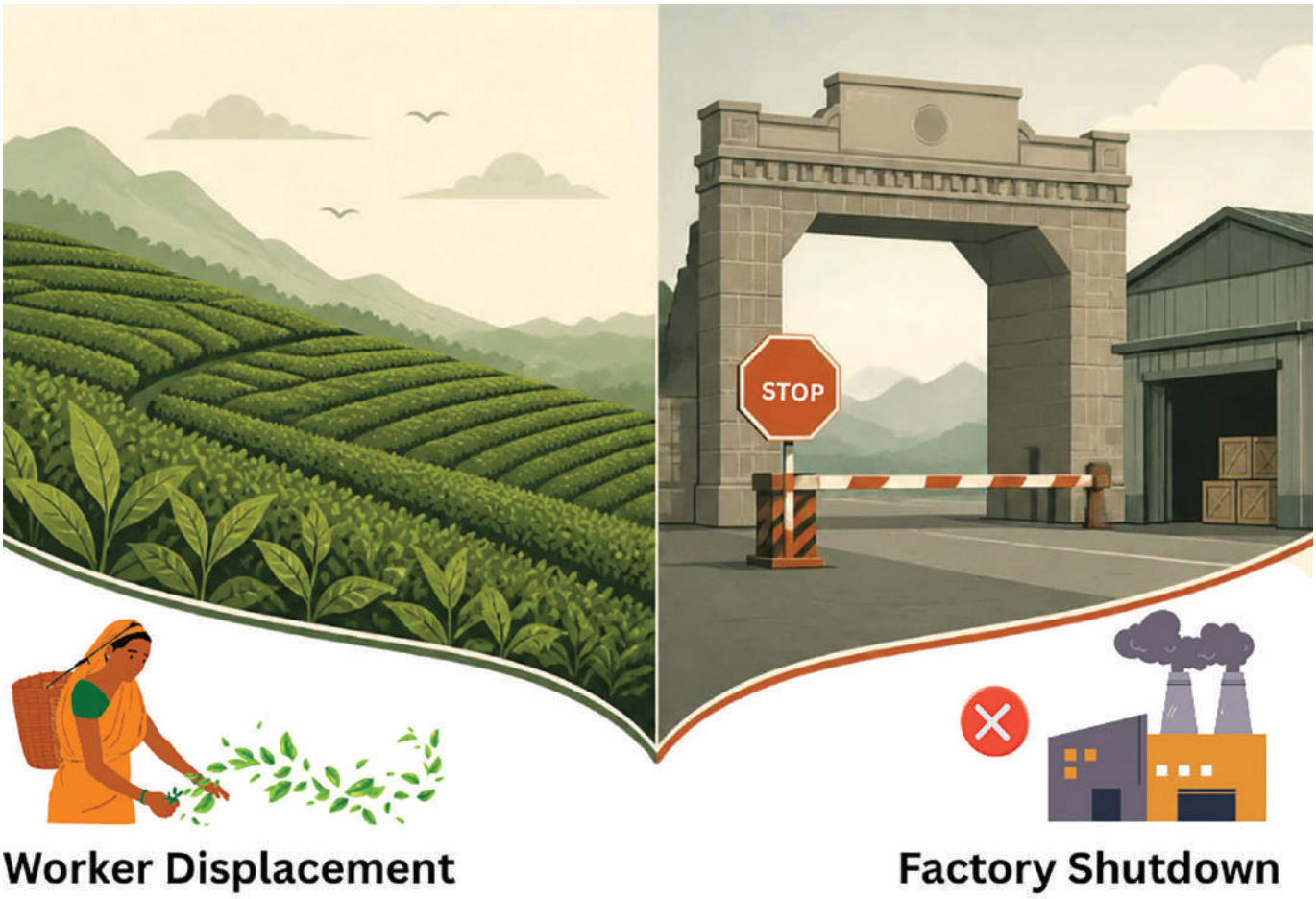
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BUSINESS MODEL CANVAS

MAP YOUR BUSINESS IN ONE VIEW



KEY PARTNERS

- suppliers
- collaborators
- technology vendors

KEY ACTIVITIES

- design
- promotion
- delivery

KEY RESOURCES

- team
- software
- templates

VALUE PROPOSITIONS

- simple
- premium
- fast

CUSTOMER RELATIONSHIPS

- direct support
- personalized service

CHANNELS

- website
- email
- marketplace



CUSTOMER SEGMENTS

- freelancers
- startups
- agencies

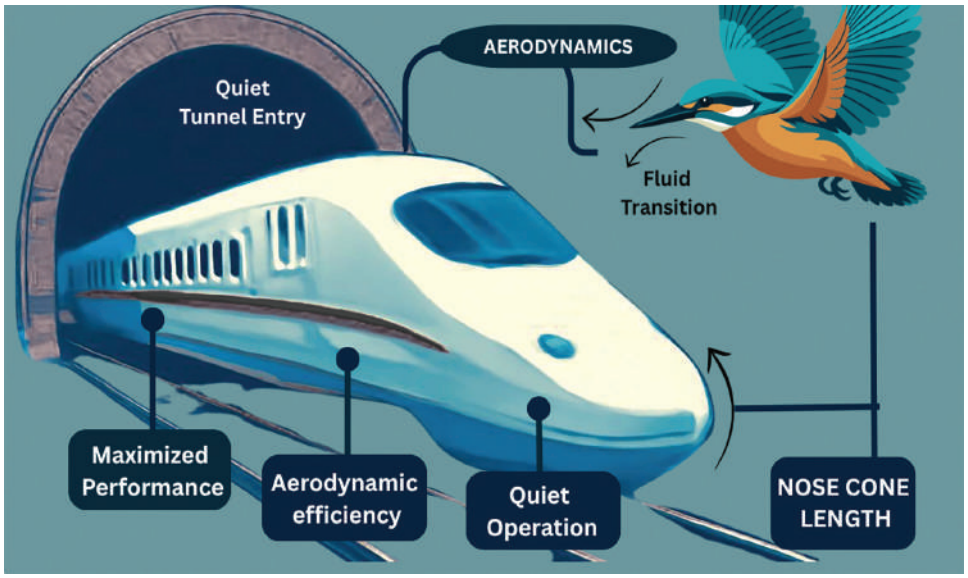
COST STRUCTURE

- software
- labor
- marketing

REVENUE STREAMS

- services
- subscriptions
- digital products

CARPE DIEM: SEIZE THE DAY



Art often mimics nature, and engineering is, in a sense, an art of problem-solving. Similar to the natural process of biomimicry, analogical thinking allows the user to find solutions to problems by looking at things completely unrelated to the problem at hand. Engineer Eiji Nakatsu developed a solution to the problem of loud sonic booms caused by trains by modeling the train's nose after a kingfisher's beak. It is not unusual for us to relate information from different topics to our own practice.

That would include relating something like the principle of Carpe Diem in developing an agile industry. One would assume, however, as soon as reading this statement,

What is Carpe Diem?

In 23 B.C. Horace, a Roman poet, coined this term in the first book of his Odes. The full sentence was "carpe diem quam minimum credula postero," which could be translated literally as "pluck the day, trusting as little as possible in the next one".

A novel thought, really, which was inspired by the concept of Epicureanism, which valued living in the present, for life is short, unpredictable, and the joy of today is far more valuable than the fear of tomorrow. Therefore, it encourages people to take deliberate actions and to recognize opportunities as they pass.

> ***"The future is not built on tomorrow's action but rather on today's.***

Since then, this phrase has inspired many English poets, such as Robert Herrick, and has very recently been popularized in pop culture by the 1989 film "The Dead Poets Society," encouraging living boldly rather than waiting for a "perfect time."

So you might be wondering, what does this have to do with anything engineering at all?

Let's take a familiar example,

At the end of every semester, right out of the exam hall, a common sentiment is shared by every student. "Next time I will study from the very beginning." Very few live up to this sentiment. And before you know it, it's days before the exam as you wait for the perfect time to start. Little things you leave behind to "do it tomorrow" always result in all the tasks piling up slowly, leading you to the very state you were in just a semester ago, as you once again think. "Next time I will start from the very beginning."

Now picture this: instead of a student studying for an exam, this is an engineer procrastinating to solve a very minor bottleneck in a factory. Every problem left unsolved, though minor create what we could only call a mimicry of the bullwhip effect in the supply chain, where the ripple of a small stoppage can cause some major losses to any factory.

What role do the engineers play in this case?

We have previously discussed that the key job of any engineer is "problem solving," and as Industrial Engineers particularly, adapting to the changes that occur and helping make the industries agile is one of our key responsibilities.

Agile industries, after all, never wait for a "perfect moment" to adapt, change, or continuously improve. They embrace the very essence of Carpe Diem and make the most of the opportunity they find in the present time, as every necessary redesign, problem-solving, and innovation begins with someone who seizes the day and acts instead of waiting.

When an industry becomes agile and adapts, it acts as one step closer to Systemic Excellence, but it is not achieved simply through isolated moments of brilliance, but rather through consistent action and improvement. And Carpe Diem reminds us that the future is not built



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on tomorrow's action but rather on today's. Hence, any bottlenecks that occur are resolved as quickly as possible before they can cause any significant impact. And following the 1:10:100 rule, we know that the quicker a problem is solved as they occur, the less loss there will be.

Let's talk about companies that have succeeded in "Seizing the day" with their ideas in the real world for more perspective. Starting with a company that has managed to set a precedent for many companies of the present, Toyota.

Toyota, as a company, has become a model example whenever any feats of industrial engineering are brought up. Practicing a term known as andon cord, Toyota famously pauses production lines immediately when a worker spots a defect, and it is fixed immediately before it spreads.

Along with its philosophy of Lean Manufacturing, getting rid of any unnecessary actions as they occur in the process of production, and finding ways to embrace "Kaizen" and continuously improve every day with the efforts and collaboration of every worker, speaks volumes about its capacity to seize the day, making it one of the most successful automobile makers in the world.

Similarly, an agile company such as Netflix, which made a switch to streaming even before the DVDs that their competitors were still using became obsolete by seizing the opportunity as it came, taking that leap of faith, and adapting to the changing technology without waiting for the market, could also be used as an example.

Another would be **Amazon**, who are constantly analyzing its warehouse operation to find ways to save even 5 seconds that pile up to be more time as they seize the day and save time today.

From these examples, you get a better glimpse of how Carpe Diem comes into play for us engineers and agile companies.

So what would be the conclusion?

What happens in the future is often the accumulation of every choice that was made in the present, whether it is big or small. In a sense, achieving systemic excellence is therefore not a singular action but every step taken from observation, planning, and application.

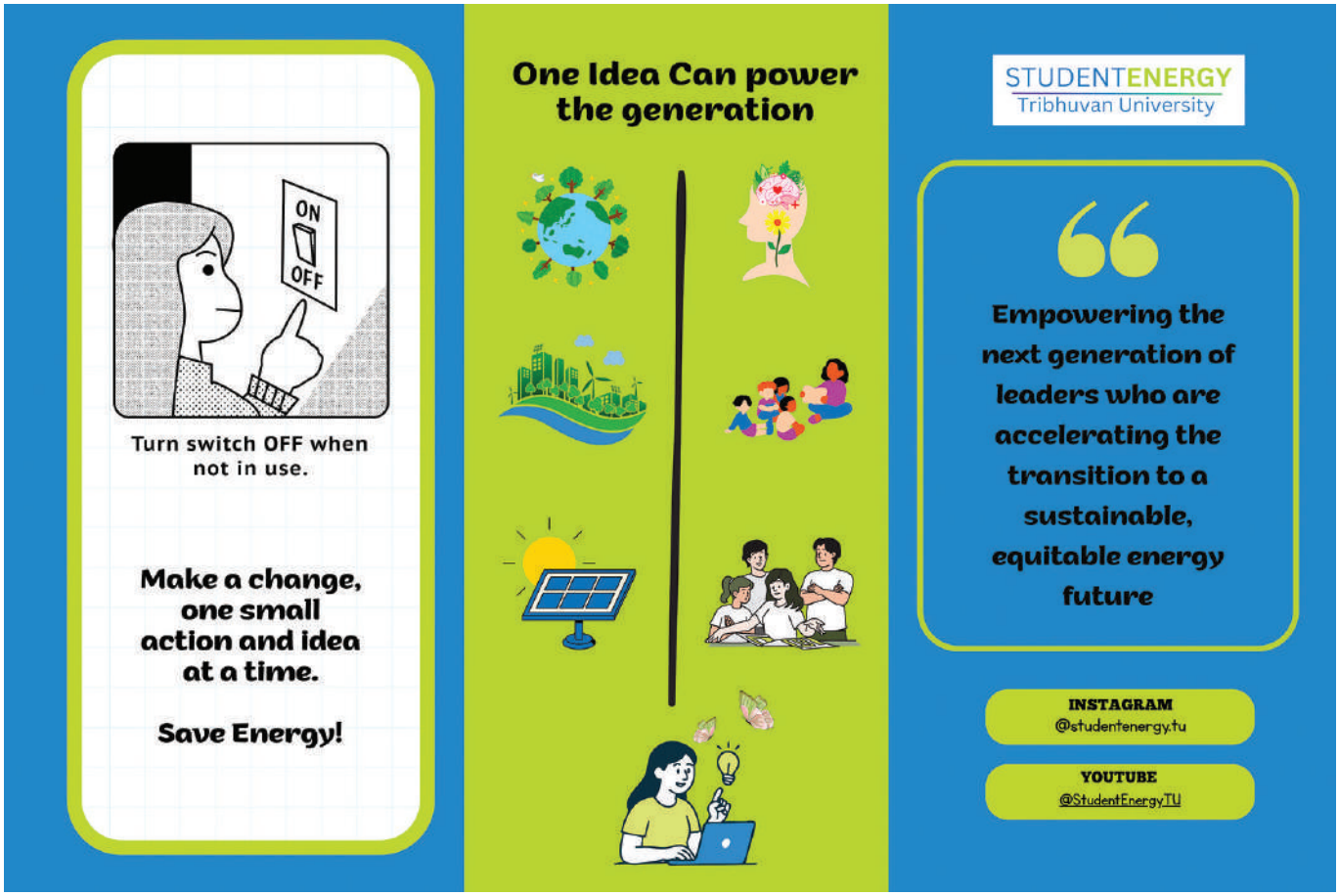
Industrial Engineering has always been about understanding that even the most complex systems are interrelated and are only strengthened by continuous improvement. Improvement is caused by someone identifying waste, system errors, bottlenecks, innovative solutions, better alternatives, optimization opportunities, and taking action as they recognize the opportunity to create a positive change.

Carpe Diem, in a sense, therefore becomes more than just a philosophy but also a principal way to look at engineering. Seizing every opportunity matters. For seizing every day matters.

An agile industry with Systemic excellence at the end of the day cannot simply be planned or predicted; it requires real action that we must take today.

So remember.

Carpe diem: Seize the day.



EVERY NEPALI IS AN ECONIMIST, WHETHER THEY KNOW IT OR NOT



Paul Samuelson, a contributor to modern economics, offered simple observations: "All your life, from cradle to grave and beyond, you will run up against the brutal truths of economics." At first, it reads almost like a joke, but when you sit with it for a moment longer, its weight begins to appear. To be born is to become an economic actor. From the first cry in a hospital, a child begins consuming resources, generating needs, and creating demand. Every human life, from its very first breath to its last, is a node in an economic network.

In Nepal, a nation of extraordinary geographic diversity with an equally complex economy, those insights carry even greater significance. Nearly 30 million people live in this landlocked country, which faces ongoing political instability and growing integration with the global marketplace. The economic forces that govern every citizen's day-to-day life (such as the price of fertiliser, the interest rate on microfinance loans, and the exchange rate that determines how much a son's remittance from Qatar is actually worth when it finally arrives home) remain misunderstood or entirely invisible. This is the challenge that economic literacy is positioned to address.

> ***"Systemic excellence relies on a workforce that can interpret economic signals—making economic literacy the foundational infrastructure of an agile, self-sustaining Nepal.***

Agility, at any scale, depends on the people inside a system being able to read the signals the system sends them: price signals, interest rates, and risk. A workforce or a farming sector that cannot interpret those signals cannot participate meaningfully in fast and adaptive decision-making, no matter how well-designed the surrounding institutions are. Economic literacy is, in that sense, infrastructure: the precondition that makes every other kind of systemic excellence possible. The rest of this article makes the case for why that infrastructure is missing in Nepal and what closing the gap could look like.

What is economic literacy?

Economic literacy is not simply the ability to balance a household budget or withdraw a remittance received. It is a broader concept: the ability to understand how economic systems work, how individual decisions add up to a collective outcome, how policies create incentives and consequences, and how financial choices fit within the larger picture. An economically literate person understands supply and demand, inflation, taxation, investment, and trade not merely at an academic level but also through a practical approach to making informed decisions in daily life.

In the context of Nepal, economic literacy also includes understanding the remittances that sustain a large share of the country's GDP, understanding why rice prices fluctuate after a monsoon failure, and understanding how cooperative saving models work in rural communities.

Nepal's economic landscape

To understand why economic literacy matters so urgently in Nepal, one must first understand the country's economy. Nepal is classified as a least developed country by the United Nations, though it has taken significant steps toward reducing extreme poverty over the past two decades. The economy is dominated by agriculture and services and is highly dependent on remittances. In the fiscal year 2022/23, remittance inflows were approximately 23% of Nepal's GDP, one of the highest remittance-to-GDP ratios in the world (Nepal Rastra Bank, Economic Survey 2022/23).

This dependence on remittances is both a lifeline



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and a vulnerability. Millions of Nepalese travel abroad in search of work; they are making an economic calculation, sometimes a poorly informed one. Stories abound of workers deceived by fraudulent recruitment agents, trapped in contracts far below what was promised, or sending money home through informal channels. Each of these outcomes reflects a deficit of economic literacy.

Nepal's formal financial sector remains only partially accessible to its citizens. According to Nepal Rastra Bank data, financial access has improved significantly with the expansion of commercial banks, finance companies, and cooperative societies, but meaningful financial inclusion, particularly in remote hill and mountain districts, remains incomplete. Many households still operate largely outside the official financial system, relying on moneylenders who charge interest rates commonly reported to exceed 30% to 40% annually. Understanding why such rates are exploitative, what alternatives exist, and how to access them requires the kind of knowledge that only economic literacy can provide.

The remittance economy and the knowledge gap

When a young man from Morang leaves for Dubai, his family may receive a certain amount every month. This is transformative income for many households. But what happens to that money?

Research suggests that a large proportion of this income in Nepal is spent on consumption and daily lifestyle needs, rather than investment (Asia Foundation and Nepal Rastra Bank remittance surveys). This is entirely understandable; improving living standards is a legitimate use of income. But due to a knowledge gap, many families often miss the compounding opportunities that even a small investment can provide. A family that deposits NPR 5,000 each month into a fixed deposit account at a cooperative will accumulate, over ten years, a significantly larger sum through interest. Another family spends the same amount on social events and feasts to celebrate year after year. Neither choice is morally wrong, but the first requires economic knowledge to understand and execute.

This applies further when workers abroad choose between a higher-wage position in a country with no social protection and a slightly lower salary in a country with health coverage and regulated working conditions. When a returned migrant is deciding whether to use savings to purchase land, start a small business, or buy a taxi, economic literacy helps them assess risk, analyse rates of return, and consider sustainability in ways that intuition cannot.

Agriculture, smallholders, and economic decision-making

Agriculture remains an important livelihood for Nepal's population, with roughly 43% of the labour force engaged in farming (a share that has been declining steadily from the much higher levels recorded in earlier decades, according to the Central Bureau of Statistics). The economic decisions made by farmers, such as which crop to plant, whether to take a loan for seed and fertiliser, when to sell, and how to price, are often made without adequate information.

Many smallholder farmers in Nepal avoid formal bank loans and prefer to borrow from local moneylenders or a cooperative they trust personally. This preference is rational in the absence of economic knowledge when the bureaucratic requirements of a formal bank loan are unfamiliar, and the interest calculation seems vague. However, a farmer who understands that an agricultural development bank loan at 7% interest is cheaper than a moneylender's loan at 36% and who knows how to calculate the repayment schedule is in a far better position.

Similarly, many farmers in Nepal are unable to take advantage of price variability caused by seasonal factors. Paddy prices fall sharply at harvest time when supply is highest, then rise after a few months. A farmer who sells immediately at harvest because they need immediate cash and lack storage loses both opportunity and bargaining power. Economic literacy, combined with access to a storage facility, could allow farmers to time their sales better, which would ultimately increase their annual income without needing to plant an additional kilogram of rice.

Policy comprehension and democratic accountability

The scope of economic literacy extends beyond individual financial decisions. In a democracy, citizens are periodically asked to evaluate their government's economic performance. The country has seen rapid political changes from the end of the monarchy to the establishment of a federal republic, alongside a long record of economic promises and failures.

Without economic literacy, citizens are poorly equipped to assess whether a government's policies are working, whether claims about GDP reflect real improvements in living standards, whether a proposed infrastructure project represents legitimate development, or whether a trade agreement benefits Nepal. Populists exploit economic ignorance by promising magical solutions, blaming scapegoats, and concealing the actual mechanisms by which wealth is created and distributed. An economically literate public is far more resilient against political manipulation. It doesn't eliminate politics, nor does it resolve genuine disagreements about priorities and values, but it raises the quality of public conversation and makes it harder to fabricate data or deceive people with economic gibberish.

Conclusion

Paul Samuelson's observation that an individual's economic journey begins at birth reminds us that economic participation is not optional. Every Nepali, from the farmer in Humla to the tech entrepreneur in Kathmandu, is an economic actor, whether they have studied economics or not. The question isn't whether they will participate in economic activity but whether they will take part with understanding or without it, a question that matters as much for Nepal's industries as for its households.

The cost of economic illiteracy in Nepal is real and measurable: interest paid to moneylenders, remittance fees lost to informal channels, and agricultural earnings foregone through poorly timed sales. Conversely, the benefits of economic literacy are equally real: better individual decisions, healthier cooperatives, and a democracy equipped to hold leaders accountable.

Nepal is a country of great human capital, a young population, a culture of hard work and resilience, and growing international connectivity. In a country where tens of millions are navigating markets, labour migration, and democratic governance, improving economic literacy may well be the most urgent investment the government can make, both to uplift the country's economy and to transform every citizen's life.



Artificial intelligence (AI) is expected to reshape clinical practice broadly, from early diagnosis through personalized treatment (Meskó & Görög, 2020). My work focuses on a more specialized corner of the field, i.e. developing an AI system that convert raw physiological inputs; specifically, eight channels of forearm electromyography and the returning echoes from an ultrasound transducer, into continuous hand-motion commands in just a few tens of milliseconds, all while operating on the noisy signals that real sensors actually deliver. This is also the field that best explains where clinical AI is headed, toward systems that fuse multiple sensing modalities into one learned representation and run that model in real time, on the device, close to the patient rather than in a remote data center. The sections that follow this integration from the raw sensor signals, through the design of the models, and finally to the practical limits of running them in real time on actual hardware. My research on combining ultrasound and EMG for prosthetic hand control serves as a concrete illustration of the same approach.

Convolutional neural networks remain central to AI-assisted diagnosis because weight sharing gives them translation invariance; a learned kernel recognizes a pattern anywhere in an image, keeping parameter counts far lower than a fully connected network on raw pixels. Esteva et al. (2017) trained a CNN on more than 129,000 images to classify skin lesions at dermatologist-level accuracy; a 2026 systematic review of 100 studies found that harmonizing CT intensity and contrast before inference substantially improves how well an AI model based lung-nodule detectors generalize across scanners and institutions (Khan, Noor, Ashraf, Masud, & Aman, 2026); and outside imaging altogether, convolutional and transformer architectures applied directly to raw ECG waveforms now challenge image-based diagnostics for arrhythmia detection (Ansari, Mourad, Qaraqe, & Serpedin, 2023). Vision transformers extend this further, using selfattention so every image patch can weigh every other patch rather than relying on a local receptive field alone (He, Luan, & Hu, 2025), while multimodal vision-language models and portable low-field MRI are pushing inference from centralized servers toward point-of-care hardware (Yang, Ye, & Feng, 2025; Carriero, Groenhoff, Vologina, Basile, & Albera, 2024).

Prognosis is fundamentally a sequence-modeling problem as it asks how a patient's state is likely to evolve. Rizou, Grammalidis, Daras, and Dimitropoulos (2025) used a multi-task deep learning framework to jointly predict Parkinson's disease progression subtype and motor-symptom severity scores; Barros, Silva, and Pinheiro (2021) reviewed EEG-based prediction of schizophrenia, where small cohorts and non-stationary signals make generalization difficult; a 2025 systematic review found AI and machine learning models consistently outperform traditional severity scores for predicting ICU mortality, though few have been validated prospectively (Dhami et al., 2025); and Hou et al. (2026) fused pathology images, and clinical text through cross-attention to predict cancer prognosis more accurately than any single modality alone. The same bottleneck recurs across in all four studies; scarce labeled data and distribution shift across hospitals and instruments, which current surveys address with self-supervised pretraining, federated learning, and diffusion-based synthetic data (Goyal, Dogra, & Lepcha, 2026). My own work applies a related idea to physiological signals: a spectrally constrained VAE-WGAN-GP that generates realistic EMG and ultrasound recordings, replacing up to half a training set without harming cross-subject accuracy (Bastola & Tekes, 2026).

Treatment increasingly resembles a control problem. Wu, Chen, and Qin (2025) combined transformer encoders, multi-scale convolutional networks, and attention over drug pathway interactions to predict how individual cancer cells respond to a given anticancer drug, and a broader scoping review of 142 studies shows graph neural networks, transformers, and causal machine learning increasingly used to predict clinical-trial safety, efficacy, and phase-transition risk from trial protocols and patient data (Teodoro, Naderi, Yazdani, Zhang, & Bornet, 2025). Roggeveen et al. (2021) went further, framing sepsis management as a Markov decision process and training a reinforcement-learning policy that mapped patient state to a fluid or vasopressor action; then validating that the policy transferred across health systems on different continents. Assistive and prosthetic devices drive this problem into real time. EMG-driven deep learning has moved from convolutional classifiers on raw surface EMG (Jafarzadeh, Hussey, & Tadesse, 2019) to armbands that fuse sEMG with IMU, force myography, sonomyography, and other modalities for better cross-session generalization (Zhang, Hong, Dong, Yang, Zhang, & Dang, 2026), while forearm ultrasound captures finger movements sEMG alone tends to fail to capture (Lee, Ko, Jang, Lee, & Yoon, 2025). My dissertation combines both: a CNN–LSTM attention-fusion model for continuous hand-motion estimation, and a VQ-VAE that compresses ultrasound RF data by roughly 92%, making imaging-grade control feasible on a wireless, battery-powered device (Bastola, Huynh, Tekes, & Tekes, 2025; Bastola & Tekes, 2024).

Engineering Considerations: From Sensor to Real-Time Inference

What matters most to engineers is often not the final accuracy, but the real-world constraints the system had to encounter to deliver it. Raw EMG is typically bandpass-filtered before extracting time-domain features such as mean absolute value, RMS, and simple square integral, a step that caps whatever accuracy the downstream model can reach (Karim et al., 2026). Architecture choice then trades off latency, accuracy, and interpretability. In medical imaging, quantization-aware



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training compresses a classifier's weights and activations to lower-precision representations, cutting model size and inference latency for edge deployment while preserving the saliency-map interpretability clinicians rely on to see which regions of an image drove a diagnosis, recently demonstrated for real-time endoscopic image classification running directly on edge hardware (Lavaei, Abadi, Beigzad, & Maleki, 2025). At the more applicable end, NeuroEdge streamed 192-channel high-density EMG through an ESP32 to a Sony Spresense microcontroller and ran a compact 1-D CNN entirely on-device, reaching 90% accuracy at 83 ms latency with no cloud dependency (Chudinov et al.,2026). On the data side, compression architectures like VQ-VAE and generative augmentation like VAEWGAN-GP address the two problems that dominate deployment, bandwidth-dependent sensor streams and poor cross-subject transfer, without requiring more clinical data collection (Bastola & Tekes, 2024, 2026).

The remaining issues are as many data-engineering problems as algorithmic ones. Rare conditions are not represented relative to their true prevalence, and models trained on one population, device, or cohort often transfer poorly to another such as a trained model on one group of population can underperform in another, where disease prevalence and data differ, just as an EMG model trained on one armband may need recalibration for a new user. Interpretability tools, regulatory validation, and real-time, low-power hardware constraints remain the engineering problems standing between today's AI research and hardware deployment.

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CIRCULAR ECONOMY: Turning Industrial Waste Into Value



Every day, industries generate large amounts of waste such as metal scraps, plastic, paper, glass, food waste, and wastewater. If these materials are simply thrown away, they increase pollution, waste valuable resources, and raise production costs. Fortunately, many industries are now adopting the idea of a circular economy, where waste is treated as a valuable resource instead of a useless byproduct.

But what if this "waste" could become a useful resource?

This is the idea behind the Circular Economy. It is an approach that keeps materials in use for as long as possible instead of throwing them away. It helps industries save money, reduce pollution, and protect the environment. In the past, there was a system of taking raw materials, making a product, using the product, and throwing it away. But now the concept of circular economy is developing gradually; this system follows the principle of reduce, reuse, repair, recycle, and recover.

What is a circular economy?

A circular economy is an economic system that focuses on reducing waste by keeping materials in use for as long as possible. Instead of the traditional 'take, make, use, and throw away' approach, it follows the 5R principles: Reduce, Reuse, Repair, Recycle, and Recover. This approach helps conserve natural resources while creating economic and environmental benefits. This approach helps conserve natural resources while creating economic and environmental benefits.

A circular economy is a system where products and materials are used again and again instead of becoming waste. Think of it like nature. In nature, nothing is wasted. Fallen leaves become compost, compost nourishes the soil, and new plants grow. Similarly, industries can use old materials to make new products. People use resources wisely, make long-lasting products, repair and reuse them, and recycle and recover materials.

> ***"Every piece of waste has the potential to become a valueable resources***

How the industry turns waste into value

Industries turn waste into value by collecting, sorting, and processing different types of waste. Metal scraps can be melted to produce new machine parts, plastic waste can be converted into plastic pellets, paper can be recycled into notebooks and cartons, food waste can become compost or biogas, and treated wastewater can be reused in industrial processes. These practices reduce disposal costs and lower the demand for raw materials. Many industries around the world have successfully adopted circular economy practices. Aluminum can be recycled repeatedly while using about 95% less energy than producing new aluminum. Plastic bottles are transformed into furniture, pipes, and polyester fibers for clothing. In the construction industry, fly ash is mixed with cement to produce bricks and concrete. In Nepal, several metal workshops and paper recycling businesses also recover valuable materials instead of discarding them, showing that circular economy practices can work at both small and large scales.

During manufacturing, different types of waste are produced, such as Metal scraps, plastic pieces, paper and cardboard, glass, food waste, wastewater, and many more. Instead of sending these materials to landfills, industries separate and collect them. The collected waste is sorted according to its type because each material needs a different treatment. Now, rather than spending money to dispose of waste,



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industries earn value from it. This creates many benefits like Lower production costs, Less pollution, reduced use of natural resources, extra income from selling recycled materials, and A cleaner environment.

In the context of Nepal, we can see some real-life examples of the circular economy:

- **Aluminum Industry:** Aluminum cans are recycled repeatedly without losing quality. Recycling aluminum saves around 95% of the energy needed to produce new aluminum from raw ore. Metal scraps produced during manufacturing are collected, melted, and reused to make new products such as machine parts, tools, and steel bars. This reduces the need for mining new metals and saves energy.
- **Plastic Recycling:** Used plastic bottles, containers, and packaging are cleaned, shredded, and melted into small plastic pellets. These pellets are used to manufacture new products like pipes, chairs, furniture, and even polyester fibers for clothing.
- **Food Industry:** Food waste from restaurants and food processing industries is converted into compost or biogas. Compost improves soil fertility, while biogas provides a clean and renewable source of energy.
- **Construction Industry:** Fly ash, a waste product from power plants, is mixed with cement to produce concrete and bricks. This reduces waste disposal, lowers construction costs, and decreases the use of natural raw materials.

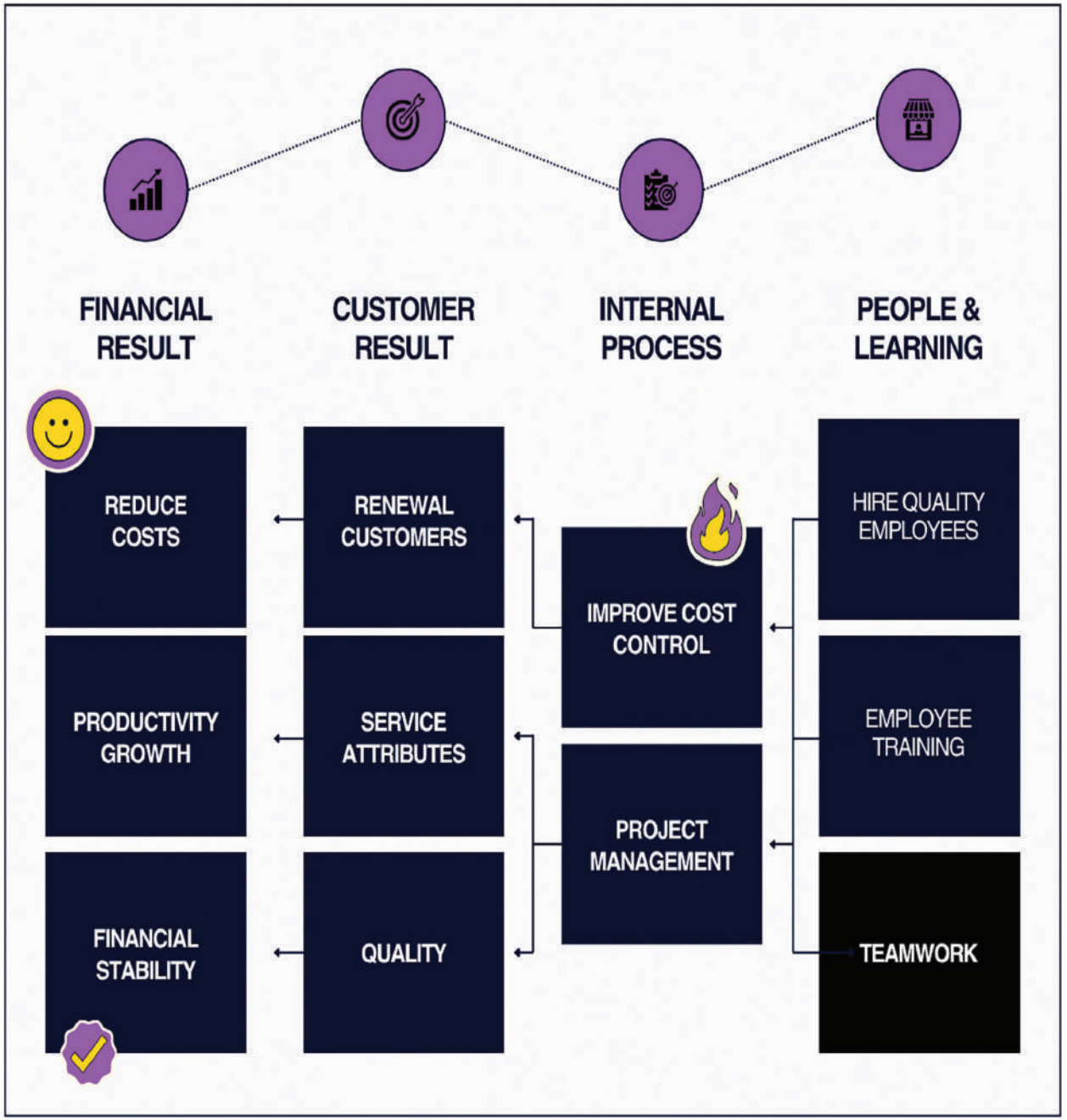
The benefits of a circular economy are significant. It reduces pollution, saves energy, protects natural resources, lowers production costs, creates employment opportunities, and supports sustainable industrial development. Businesses also gain financially by selling recycled materials and improving production efficiency. Industrial waste should not be viewed as a problem but as an opportunity. By adopting circular economy principles, industries can transform waste into valuable products while protecting the environment and strengthening the economy. Every piece of waste has the potential to become a useful resource when managed wisely.

Turning industrial waste into value means giving waste a second life. Rather than throwing materials away, industries should collect, sort, process, and transform them into useful products. The circular economy is changing the way industries think about waste. In place of throwing valuable materials away, companies can repair, reuse, recycle, and recover them to create new products and reduce environmental harm. This approach not only protects the planet but also improves business efficiency and profitability.

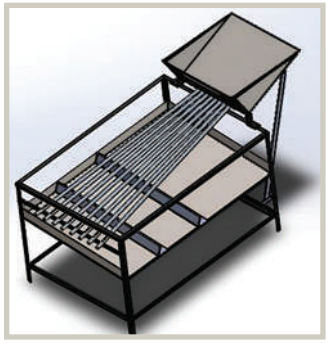


STRATEGY MAP





Final Year Industrial Projects : Batch 2078

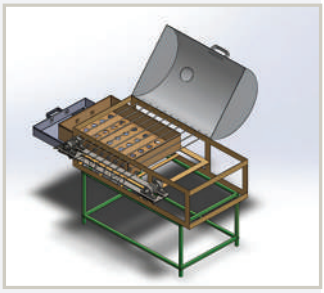


Design, Fabrication, and Testing of Adjustable Fruits Sorting Machine

This project focuses on the design, fabrication, and testing of an adjustable fruit sorting machine developed to address the challenges of manual fruit grading in Nepal's agricultural sector. The machine operates entirely on a gravity-driven mechanism without requiring electricity, making it an affordable and sustainable solution for farmers, cooperatives, wholesalers, and local vendors. It features adjustable sorting pipes that can accommodate different fruit sizes, allowing efficient grading of fruits such as oranges, apples, guavas, and lemons. The machine is capable of sorting fruits significantly faster than conventional manual methods while reducing labor requirements and minimizing post-harvest losses caused by improper handling. Fabricated using locally available materials, the design emphasizes low cost, portability, ease of maintenance, and user-friendly operation. By improving grading consistency and product quality, the project contributes to enhanced market value of agricultural produce while supporting sustainable farming practices and encouraging the adoption of affordable mechanization in Nepal's post-harvest processing sector.

Team Members: *Abhijit Shrestha, Bimal Gurung, Birendra Prasad Shah, and Sabin Ghimire*

Design, Fabrication, and Testing of Meat Grilling Machine



To enhance the efficiency and consistency of traditional charcoal grilling, a semi-automated meat grilling machine was designed, fabricated, and tested. The machine incorporates a motor-driven chain and sprocket mechanism that continuously rotates multiple skewers, ensuring uniform heat distribution and consistent cooking while preserving the authentic smoky flavor of charcoal. Constructed with a durable mild steel frame, the system also includes a charcoal tray, ash tray, chimney, bearings, and a low-speed DC wiper motor for smooth and energy-efficient operation. Compared to conventional manual grilling, the developed machine significantly reduces operator effort, improves cooking consistency, enhances workplace safety, and increases productivity for small restaurants, food stalls, and household applications. Designed using locally available materials, the machine provides a practical and cost-effective solution that combines traditional cooking methods with mechanical automation, making it suitable for small and medium-scale commercial grilling operations.

Team Members: *Pratha Shrestha, Pushpa Adhikari, Rajina Bhusal, and Unik Shrestha*

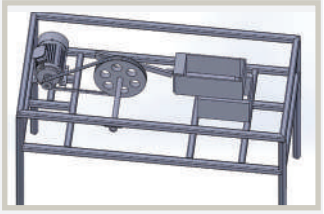
Design, Fabrication, and Testing of Groundnut Shelling Machine



This project aims to design, fabricate, and test a low-cost groundnut shelling machine that addresses the labor-intensive and time-consuming nature of traditional shelling practices. Developed primarily for small-scale farmers and rural agro-processing enterprises, the machine utilizes a rotating shelling drum, concave sieve, reciprocating separation mechanism, and belt-pulley drive system to efficiently crack shells and separate kernels without requiring complex equipment. The design prioritizes affordability, ease of operation, and the use of locally available materials, making it suitable for widespread adoption in Nepal's agricultural communities. Testing demonstrated that the machine improves shelling efficiency while reducing physical effort, processing time, and post-harvest losses compared to manual methods. By enhancing productivity, improving kernel quality, and supporting value-added agricultural processing, the project offers a practical mechanization solution that can contribute to increased farmer income and sustainable rural agricultural development.

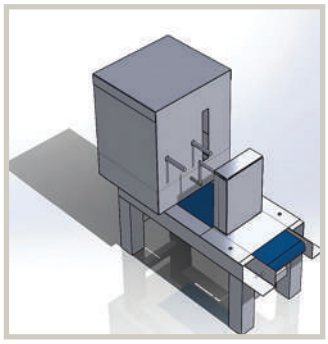
Team Members: *Aashika Kafle, Anupa Adhikari, Roshika Bhantana, Shailendra Jung Keshari Chand, and Yashodha Bhujel*

Design, Fabrication, and Testing of Can and Bottle Crushing Machine



With the increasing need for efficient solid waste management, this can and bottle crushing machine was developed to reduce the volume of recyclable plastic bottles and aluminum cans. The machine employs a crank-slider mechanism that converts rotary motion into linear motion, generating a compressive force of approximately 1500 N to effectively crush standard PET bottles and aluminum cans. By reducing waste volume by up to 70–80%, the machine significantly improves storage, handling, and transportation efficiency while lowering collection and recycling costs. Designed using locally available materials, the system offers a simple, low-cost, and user-friendly solution suitable for households, community recycling centers, and informal waste workers. The project promotes sustainable waste management by encouraging recycling, reducing landfill dependency, and minimizing manual effort during waste processing. With its compact design, low maintenance requirements, and adaptability to Nepal's waste management system, the machine demonstrates an affordable engineering solution that supports environmental conservation and strengthens community-based recycling initiatives.

Team Members: *Aditya Adhikari, Bishnu Dev Yadav, Dhiraj Dahit Tharu, Sejal Sigdel*



Design, Fabrication, and Testing of Automated Cotton Wick Making Machine

This project focuses on the design, fabrication, and testing of an automated cotton wick making machine aimed at modernizing the traditional production of cotton wicks (batti), an essential component of religious and cultural practices in Nepal. The developed machine integrates stepper motors, servo motors, an Arduino-based control system, and automated mechanisms for thread feeding, twisting, cutting, and conveyor transfer to produce cotton wicks with consistent dimensions and improved quality. Experimental testing demonstrated an average production rate of approximately 12 cotton wicks per minute, representing nearly a 33% increase in productivity compared to conventional manual methods while significantly reducing repetitive physical strain on operators. Designed using affordable and locally available components, the machine provides a practical solution for cottage and small-scale industries by improving efficiency, reducing labor dependency, and ensuring uniform product quality. Beyond productivity enhancement, the project supports women-led micro-enterprises and demonstrates how low-cost automation can preserve traditional practices while fostering sustainable local manufacturing and economic empowerment.

Team Members: *Nikhil Aryal, Sanskriti Giri, Shraddha Baral, and Yauman Kumar Somare*

Design and Fabrication of a Closed-Loop Dehumidification Chamber for Bamboo and Wood Drying



To overcome the limitations of conventional bamboo and wood drying methods, a closed-loop dehumidification chamber was designed and fabricated for controlled moisture removal. Traditional sun drying requires several weeks and often results in cracking, warping, fungal growth, and inconsistent material quality. The proposed chamber integrates controlled heating, forced air circulation, thermal insulation, and a Vapor Compression Refrigeration System (VCRS) to accelerate moisture removal while maintaining uniform drying conditions. Prototype testing demonstrated a significant reduction in drying time with improved energy efficiency and enhanced preservation of the structural and mechanical properties of bamboo and wood. The modular and scalable design makes the system suitable for furniture manufacturers, bamboo artisans, lumber treatment facilities, and small-scale processing industries. By reducing dependence on imported dried materials, lowering transportation costs, and promoting efficient utilization of locally available resources, the project offers a sustainable and cost-effective engineering solution for Nepal's growing bamboo and wood processing sector.

Team Members: *Gaurab Mani Gautam, Mukesh Deuba, Sulav Kumar Karki, and Suresh Tamang*

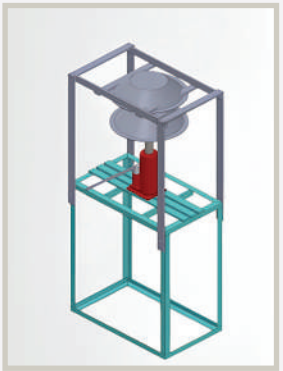


Design, Fabrication, and Testing of Sand-Plastic Brick Making Machine

This project presents the design, fabrication, and testing of a sand-plastic brick making machine developed to convert plastic waste into durable construction materials. The machine utilizes a rotating mixing chamber equipped with a 1700 W ceramic heater, a belt-pulley drive system, and a 1 HP motor to uniformly melt and mix shredded plastic with sand before discharging the mixture into molds for solidification. The developed system offers a practical solution for addressing the growing challenge of plastic waste while producing lightweight, moisture-resistant, and durable bricks suitable for paving and non-load-bearing construction applications. Performance testing demonstrated that the fabricated bricks possess smooth surface finish, good dimensional accuracy, low water absorption, and satisfactory compressive strength due to the effective bonding between molten plastic and sand. Constructed using locally available materials, the machine is simple to operate, energy-efficient, and suitable for small-scale recycling enterprises. By transforming discarded plastic into valuable construction products, the project promotes sustainable waste management, supports circular economy practices, and contributes to reducing environmental pollution while encouraging resource-efficient manufacturing.

Team Members: *Rajan Shrestha, Rupesh Sigdel, Sabal Dahal, Sujan Tamang*

Design, Fabrication, and Testing of Disposable Plate Making Machine



To address the environmental challenges posed by conventional plastic tableware, a disposable plate making machine was designed, fabricated, and tested to efficiently process biodegradable materials such as carton, sal leaf, and bamboo sheath. The machine employs a manually operated hydraulic pressing mechanism integrated with a temperature-controlled heated die capable of processing biodegradable materials such as bamboo sheath, areca leaves, and recycled carton sheets. The heating system ensures uniform temperature distribution, enabling the raw materials to be molded into durable disposable plates with consistent shape and surface finish. Performance evaluation demonstrated successful production of biodegradable plates with average cycle times of approximately three minutes while maintaining reliable operation and satisfactory product quality. Designed using locally available materials and simple manufacturing techniques, the machine provides an affordable and user-friendly solution for small-scale industries, women's cooperatives, community enterprises, and rural entrepreneurs. By utilizing agricultural residues and recyclable waste materials, the project supports environmentally responsible manufacturing, creates opportunities for value addition and income generation, and encourages the adoption of biodegradable products that contribute to reducing plastic pollution and promoting sustainable development.

Team Members: *Aashish Bhandari, Bimal Katuwal, Bishal Chaulagain, and Samrat Bhattarai*

BUSINESS FUNDING PLATFORMS

INTERNATIONAL PLATFORMS

North America: Wefunder

Wefunder is the place where the best founders raise money from the people who already believe in them VCs, angels, customers, users, operators, insiders, and their wider network creating the kind of signal that attracts even more investors and great employees. Wefunder has funded entities like Levels and Atom Limbs that are now worth millions of dollars.

Europe: Crowdcube

Europe's leading equity crowdfunding platform empowering founders to raise the capital they need to make a lasting difference in the world. The platform provides an innovative approach to fundraising, connecting ambitious entrepreneurs with a vibrant community of investors who are passionate about supporting meaningful ventures. Crowcube has worked with the likes of Monzo, ZOE, Qonto, Heura and more, could be a platform to take your business to the next level.

Asia: Makuake

The platform is highly curated. Makuake provides extensive hands-on support and mandatory pre-screening for every campaign to guarantee quality, safety, and reliability to Japanese consumers. Heavy hitters like Sony or Konica Minolta use Makuake as a stealth test lab to gauge consumer interest for experimental product concepts before putting them into mass production. Famous success stories on Makuake involves Sony corporation's FES watch, EcoFlow Delta Pro, SwitchBot K10+ and so on.

Australia: Birchal

A trusted crowd-sourced funding platform empowering founders to raise capital, build communities, and grow faster. With over 75% market share, they've been at the forefront of CSF since 2018 raising more than $225 million across 350+ campaigns, backed by over 130,000 investments. Birchal helps founders connect with investors who believe in their vision, and we help investors discover and back the brands they love. Together, we're redefining how capital is raised and invested in Australia. Success stories on Birchal includes ZeroCo, Earthletica and more.

NATIONAL PLATFORMS

Dolma Fund Management

Dolma Fund Management specialization lies in making Impactful Investments across the Healthcare, Technology, and Renewable Energy sectors. The fund is designed to generate sustainable private sector employment and stimulate further Foreign Direct Investment into Nepal. Dolma Fund Management has portfolio of 15 companies including third-party logistics company like Upaya. Dolma invests as a strategic partner, sharing risk with entrepreneurs and promoters.

One to watch

One to watch works with small and medium sized companies focusing on basic needs - food, infrastructure and health-care, companies that create impact as well as profits. Firstly, they source potential companies through their accelerator programs including our signature impact accelerator. In this program, ten companies are accelerated each year and make them investment ready with the objective of bringing FDI into these companies. Their highly qualified on ground investment management team supports our investee companies to grow, by providing guidance, performing and reporting periodic asset performance measurements while supporting post-investment movements.

Team Ventures

TEAM Ventures is an alternative investment firm promoted by a dynamic group of businesspeople with experience across multiple sectors, their mode to success is built on a collaborative approach that harnesses the power of great teams to generate the best ideas and strategies. They are industry agnostic & their approach to investment is based on a disciplined due diligence process that calculates risk while identifying the catalysts for increased value to deliver sustainable return over the long term. Successful investment ventures invested through Team Ventures involves Foodmandu, Wiseyak solutions etc.

Business Oxygen(BO2)

Business Oxygen (BO2) is a SME venture fund in partnership with International Finance Corporation (IFC), and White Lotus Centre Pvt. Ltd. It specializes in providing finance to SMEs that cannot access finance from BFIs due to a lack of collateral. BO2 looks for businesses that are ready to scale up their operations. BO2 has made 16 investments in small and medium enterprises across six different sectors of Nepal's economy. Companies that were able to scale up their production through BO2 comprises Fusemachines, Dalle Restaurant, Gandaki Urja and many more.

IE PROFILES



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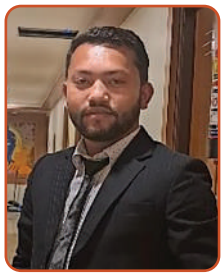
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Contributors | Industrial Vision Vol. 11

SOIES NEPAL HIGHLIGHTS

BEST STARTUPS IN NEPAL

Himalayan Dog Chew

Founded by Nepali entrepreneurs, Himalayan Dog Chew transformed traditional Himalayan Chhurpi into a long-lasting, lactose-free dog treat, creating a new category in the global pet industry. Today, it is one of Nepal's leading agricultural exports, promoting Himalayan heritage while supporting rural dairy farmers.

Khaalisisi

Founded by Aayushi KC, Khaalisisi is a Nepali CleanTech startup digitizing waste management across the country. By connecting households, schools, and businesses with informal scrap collectors ("Khaalisisi Friends") through a digital platform, it streamlines the recovery of paper, plastics, glass, and e-waste. The platform empowers local waste workers economically while diverting tons of recyclable materials away from landfills into a circular economy.

Chyangra Pashmina

Representing Nepal's finest luxury export, Chyangra Pashmina turns the ultra-soft inner wool of native Himalayan Chyangra goats into world-renowned cashmere products. Protected by a registered international trademark across more than 40 countries, the industry combines centuries old hand-spinning traditions with ethical, sustainable sourcing. Managed under the Nepal Pashmina Industries Association (NPIA), it supports thousands of local artisans while delivering globally coveted, premium garments.

Himalayan Java

Founded in 1999 by Gagan Pradhan, Himalayan Java is the pioneer of Nepal's specialty coffee movement and café culture. From a single outlet in Thamel, it has grown into an international franchise network with dozens of locations, integrated coffee farms, and barista training academies. By sourcing locally grown beans and commercializing domestic coffee processing, Himalayan Java transformed a tea loving nation into a thriving specialty coffee market while taking Nepali beans to the global stage.

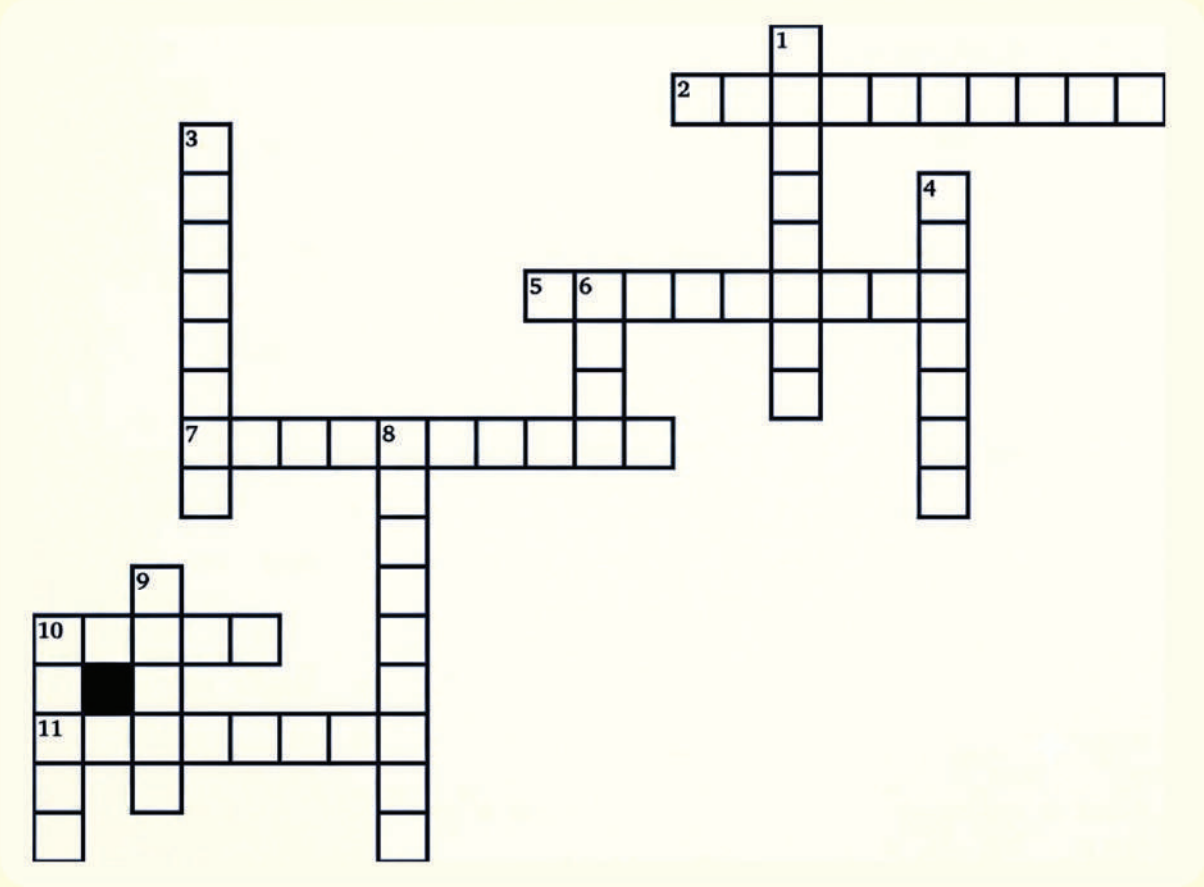


Fusemachines

Founded by Dr. Sameer Maskey, Fusemachines is an enterprise AI solutions provider that made history as the first company of Nepali origin to list on the NASDAQ (ticker: FUSE). Beyond delivering AI software for global clients, it actively empowers Nepal's tech ecosystem by upskilling local talent through its AI Fellowship program.

INDUSTRIAL VISION VOL. 11

CROSSWORD PUZZLE



DOWN

1. The specific type of premium, high-value agricultural product that Nepal exports globally alongside large cardamom, ginger, and Himalayan coffee.
3. A supply chain phenomenon where small changes in retail demand get amplified into massive swings in manufacturing orders, compounding buffers down the chain.
4. The flagship Nepalese pilgrimage destination and UNESCO World Heritage Site used as a primary case study for high-traffic, low-yield tourism leakage.
6. The sporting federation that faced a major institutional governance crisis and subsequent international suspension in June 2026.
8. The biological phenomenon of self-organization through environmental traces, which serves as an alternative to rigid, top-down command-and-control structures.
9. The specific Nepali feature film released in 2014 that accidentally turned a quiet Himalayan village into a major tourism landmark.
10. A platform-independent, standardized communication protocol that enables interoperable data exchange across modern manufacturing systems.

ACROSS

2. The historic factory established in 1936 AD that marked the formal inception of modern industrialization in Nepal.
5. The specific term coined in pop culture by the 1989 film The Dead Poets Society that encourages "seizing the day" and taking immediate action rather than waiting for a perfect time.
7. A modern engineering discipline that sits precisely at the intersection of people, processes, and systems, crucial for mapping industrial dependencies in Nepal.
10. A Japanese term meaning "big room"; a collaborative workspace environment developed within the Toyota Production System to enhance cross-functional coordination and transparency.
11. An economic system or paradigm focused on turning industrial waste into value by keeping materials in use through the 5R principles.

INDUSTRIAL VISIT



BATCH 2079



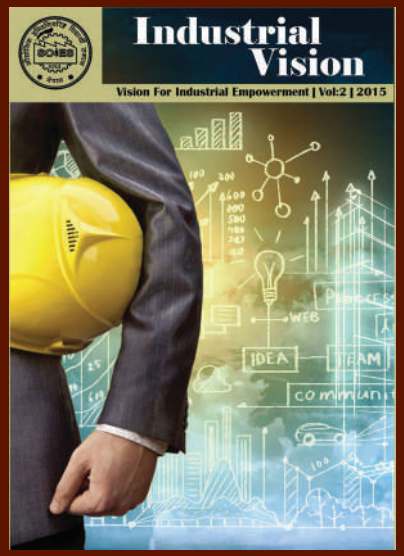
BATCH 2080



BATCH 2081

THE LEGACY OF INDUSTRIAL VISION























"IN THE PAST THE MAN HAS BEEN FIRST; IN THE FUTURE THE SYSTEM MUST BE FIRST."

-Frederick Winslow Taylor
Father of Scientific Management

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