

INDUSTRIAL VISION

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Vol 3 | 2016



**The Perspectives of
Modern Industrialization**

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**Understanding the Supply
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Vol 3 | 2016

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*Industrial Vision is an ISSN 2392-4330 certified annual industrial magazine published by Society of Industrial Engineering Students, 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.

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Date: 15-02-2016

Message from the Hon'ble Minister

I am indeed happy to congratulate Society of Industrial Engineering Students' for their publication of annual journal '*Industrial Vision: Innovation. Industry. Prosperity.*', the third volume. I congratulate the team for their endeavor through the publication which aims to drive profit, performance, and productivity of the industries through significant techno-commercial interventions.

Industries are the backbone for socio-economic development and our ministry is committed to support the path that these young industrial engineering talents are working for. The publication shall be fruitful to explore technical and commercial aspects of the Nepalese Industrial Sector.

Moreover, the vision shared in this publication will explore and identify constraints and opportunities, and provide measures both to remove the constraints and enhance opportunities of Nepalese Industrial Sector.

I wish for great success of this publication and suggest giving the longer sustainability for the industrial development agenda. I wish to work together to fulfill the mission of industrial prosperity applauding the contribution of Industrial Engineering students, scholars, the society, and their positive endeavors.

Som Prasad Pandeya
Industry Minister



Hon'ble Top Bahadur Rayamajhi
Deputy Prime Minister and Minister for Energy

Private Secretariate
Singha Durbar, Kathmandu
Nepal

Date : 2072/11/03

Ref No.: 07210731227

Message

I am very delighted to know that Society of Industrial Engineering Students (SOIES) Nepal, Institute of Engineering, Thapathali Campus is coming up with Industrial Vision volume III as a continuation of its annual magazine. I would like to congratulate the entire engineering students and the team behind it for successful endeavor.

Engineering is the backbone of entire industrial sector thus industrial sector is the backbone of economy. So, the engineering students will be an essential part for the development of the country. The theme chosen for this year 'industrial empowerment' is a very important issue for developing country like ours. We have to be empowered in technology and methods strengthening our technical know-how thus technological transfer is utmost important in this context.

I believe this issue of industrial vision will be a platform to discuss about industrial empowerment. It will also give insight to the students about new technology and it will equally benefit the industrial sector since they can envision the new technological changes they have to make and upgrade themselves.

My good wishes to the entire team behind this magazine.

Mr. Top Bahadur Rayamajhi
Hon'ble Deputy Prime minister and Minister for Energy
Singha Durbar, Kathmandu



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Message from CNI President

It gives me great pleasure to know that Society of Industrial Engineering Students (SOIES) is publishing the 3rd edition of its annual magazine 'Industrial Vision - Innovation. Industry. Prosperity.'. I congratulate the publishers for their untiring efforts and have no doubt that the latest publication will be appreciated by everyone in the Nepalese Industrial sector.

The contents of this magazine will be a handy reference source not only for the engineering students but also for professionals engaged in this sector. I remain confident that it will play an important role in promoting research and development among the engineering fraternity, who will be at the forefront of the efforts of rebuilding Nepal after the devastating earthquake.

The Confederation of Nepalese Industries (CNI), as the apex body of the countries' manufacturing and service industries believes that this magazine will contribute to national development by advancing the frontiers of engineering knowledge and we wish the SOIES team every success in this endeavor.

President

22th January, 2016



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Message from the Dean



I am ecstatic to convey my few words to the third edition of annual magazine 'Industrial Vision' published by the Society of Industrial Engineering Students' Nepal (SOIES-Nepal) in collaboration with Department of Industrial Engineering, Thapathali Campus.

As the world is moving towards knowledge based economy, Institute of Engineering (IOE) visions to be instrumental to effectuate this national goal of prosperity as education and skills are assumed to be of carrying ever-greater importance. Understanding this essence, IOE is striving to move forward which involves students not only in the acquisition of a formal qualification valued in society but also in the excitement of investigation, pursuit of ideas and the satisfaction that comes from applying knowledge. I believe our students through SOIES-Nepal and this publication shall carryover the mission of IOE eventually to subsidize for national development process.

I am delighted to see the tremendous effort made by the students which has been creating a broad platform for promulgation of achievements and establishing relation in industrial sector. I would also like to give my sincere gratitude to the publication team for their constructive endeavor.

Prof. Dr. Tri Ratna Bajracharya
Dean





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फ्याक्स- ९७७-१-४२४७३४०

Message from the Campus Chief



I am elated to know that the Society of Industrial Engineering Students' (SOIES Nepal) is publishing the third issue of their annual magazine "Industrial Vision". The first and second issues of the magazine were a fair reflection of Nepalese Industrial Sector.

The publication will be crucial for the industrial development. I am confident that the knowledge and information shared in this publication will prove as an invaluable guidance for Nepal's Industrial revival, growth and development.

Lastly, I, on the behalf of IOE Thapathali Campus family, would like to extend my congratulations to the whole team of SOIES Nepal and Industrial Vision for the publication of third issue of magazine.

Best wishes for success.

Krishna Prasad Pokharel
Campus Chief
TU, IOE Thapathali Campus



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Message from the Head of Department

It is a matter of delight that Society of Industrial Engineering Students'- Nepal is publishing the third volume of their annual national-level industrial magazine: '**Industrial Vision, Volume 3.0**'. I, on behalf of the department, believe that the presented research works and other insightful contents will address the broad spectrum of engineering and management practices in all industries.

Industrial Engineering is critical to socio-economic and socio-technical development. And, our department engages in the areas of Advanced Manufacturing, Ergonomics and Human Factors, Operations Research/Logistics, Production Systems, Simulation, and Systems Engineering /Product Development. With applications related to energy and environment, healthcare, communications, and transportation, the productivity of our program continues to grow. Thus, what industrial engineering aspires to be in future is determined by the joint effort of all stakeholders of industrial engineering.

This national-level publication represents the team's hard work to provide useful, interesting, timely and significant contents for industries. We're proud of your continuous endeavors.

Congratulations to the team once again.

.....

Er. Sudan Neupane
Head of Department
Department of Industrial Engineering
Institute of Engineering, Thapathali Campus



“ Innovation. Industry. Prosperity. ”

औद्योगिक इन्जिनियरिङ विद्यार्थी समाज - नेपाल
Society of Industrial Engineering Students - Nepal
(SOIES - Nepal)
IOE Thapathali Campus



Words from President

Establishing an idea and its actualization is a gigantic task but continuing the established culture in a more effective manner and with some more improvements is definitely full of challenges. Our seniors had made us proud by launching two successful editions of INDUSTRIAL VISION. There is no doubt that with two successful editions, expectations had certainly risen to pinnacle. So for us, we had this opportunity along with various challenging tasks as well, lying ahead to give continuation to this culture with significant improvements.

I am extremely delighted that this team of SOIES - Nepal has continued the culture and is publishing its third issue of INDUSTRIAL VISION. This volume will definitely enrich our previous volumes and ennoble Industrial Engineering which is our main motto since the first volume.

The team had to face lots of difficulties during the span of working for this magazine. Especially when the devastating earthquake hit the country and blockade due to different political ups and downs, the sponsorships collection task had been greatly affected. But our dedicated team and the support from seniors and different organizations had finally made it possible to continue the standards that our senior had set. We are proud that we didn't stop our journey.

I feel thankful to all those who support our work and encourage us by providing their advertisement at this time of crisis. I must thank all the advisors, faculty members of Department, professionals and everyone who provided their helping hands for this publication. We are indebted by your support and expect similar kinds of cooperation and coordination in the future too.

Uttam Karki
President, SOIES Nepal

INDUSTRIAL VISION VOLUME 3.0

Paving our way to excellence



There is always a motivation for doing things over and again with more efforts when you have received success earlier on high notes. With successful editions of two volumes of Industrial vision, we were in no sort of stopping this journey of enhancement. The encouraging words of mouth from all around have motivated us to carry on this journey with additional concepts and knowledge with another volume of Industrial Vision.

With globally dynamic environment, business and industries cannot sustain in the market sticking with one conservative idea, be that managerial or technical. Lots of loop holes that are hard to be seen, gluing with one idea are sure to be generated. Unless and until you are hypnotized with the same and old concept, pioneering is far even sustainability in the market only becomes brain aching. This is where the Industrial Engineers come to the picture. Industrial Engineers can manipulate almost all those tricky situations of managerial and technical problems.

The previous two volumes have introduced us in our national market. With this volume, our aim is to broaden our access not only in national market but international market as well. We have enriched our values to next level with our previous volumes. This volume is no doubt to open more platforms for industrial engineers globally.

The different articles enclosed in this volume have enfolded the scope of industrial innovation, technology and prosperity. They will enlighten all the students, engineers and stakeholders on the dynamic environment of industries. We hope all the concerned parties will be very much benefitted from this issue.

I would like to express my considerable appreciation to all authors of the articles in this issue of Industrial Vision. These contributions have required a generous involvement of time and effort. It is this willingness to make effort to share knowledge, concerns and special insights with Industrial Vision community at large that has made this issue possible and worthy enough. Thank you!!!

Bishal Jirel

Editor in Chief

Industrial Vision 3.0

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INDUSTRIAL ENGINEERING: ENGINEERING AND MANAGEMENT SOLUTIONS AT WORK

-Yushuf Shrestha

“An optimist will tell you the glass is half-full; the pessimist, half-empty; and the industrial engineer will tell you the glass is twice the size it needs to be.”

Overview:

Industrial Engineering is a branch of engineering which deals with the optimization of complex processes or systems. As a famous engineer Deming once said, “We should work on our process, not the outcome of our processes.” Industrial Engineers determine the most effective ways to improve the process using the basic factors of production - people, machines, materials, information, and energy to make a product or provide a service.

Industrial Engineering covers a wide spectrum of both engineering and management with fields like design, product planning, quality control, operations management, ergonomics, work study, computer simulation, and problem solving.

What do we do?

Industrial engineers (IEs) apply science, mathematics, and engineering methods to complex system integration and operations. They work to eliminate waste of time, money, materials, man-hours, machine time, energy and other resources that do not generate value.

“Industrial graduates are endowed with the necessary expertise, methodological competence, and problem-solving skills to cope with technological challenges under consideration of economic aspects, and to recognize and make creative use of promising business opportunities.”

Industrial Engineers are not merely engineers but also managers. The word "industrial" doesn't capture the

full essence of what we do. Industrial engineers are systems engineers who focus on the integration of people, materials, information, equipment and energy to design, implement, and improve systems. This focus on the big picture makes industrial engineering the most people oriented engineering discipline.

If there is a better way, IEs are the ones who find it.

Focus:

The main focus areas of Industrial Engineering are:

“If there is a better way, IEs are the ones who find it.”

Human Factors:

The Human Factors area specializes in exploring how systems fit the people who must operate them, determining the roles of people with the systems, and selecting those people who can best fit in particular roles within these systems. These are dealt by work study and ergonomic principles.

Quality Control:

Quality becomes an important factor in manufacturing and service industries for their business success and growth. Effective quality improvement programs provide a significant competitive advantage. Industrial Engineering deals with improving quality and productivity in manufacturing and service organizations using modern quality concepts, tools, and techniques to develop, implement and maintain systems.

Production System:

The Production Systems area develops new solutions in fields such as engineering design, supply chain management (e.g. supply chain system design, error recovery, and large scale systems) and manufacturing

(e.g. system design, planning and scheduling). It includes activities like material selection, process planning, selection of machinery, design of production lines and arrangement of machines, assembly, inspections and quality control.

Career Prospects:

The most distinctive aspect of industrial engineering is the flexibility it offers. Industrial engineers can work in any context or environment. Industrial engineering offers a number of career opportunities. Industrial Engineers can be designated to number of jobs since IE graduates design processes and systems to improve quality and productivity and hence their services can be rendered to any industry-service or manufacturing.

Lists of popular careers in Industrial Engineering are:

- Industrial Engineer
- Operations Research Analyst
- Project Manager
- Supply Chain Operations
- Material Management Subject Matter Expert
- Equipment Maintenance Supervisor
- Engineering Project Manager
- Business Process Analyst
- Operations Research Scientist (Price Optimization Analyst)
- Process Engineer
- Supply Chain Analyst

Yushuf Shrestha is pursuing Industrial Engineering (Batch of 2071) at Institute of Engineering, Thapathali Campus. He can be reached at yushufshrestha@gmail.com



SOCIETY OF INDUSTRIAL ENGINEERING STUDENTS' NEPAL

Society of Industrial Engineering Students' Nepal is a student-driven dynamic society dedicated solely to the support of the Industrial Engineering students and 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. It incubates leadership, explores creativity of the industrial engineering talents, builds collaboration possibilities, and leads innovative vision through industrial engineering discipline to be followed in mainstream of sustainable development.

'Be a leader. Be a visionary. Be an industrial engineer.'



HOW WE WORK

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



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

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



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

8th Executive Committee:

Uttam Karki	President
Shuveksha Sapkota	Vice-President
Saroj Lamichhane	Secretary
Prakriti Kaju	Vice-Secretary
Prajwal Khatri	Treasurer
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Yushef Shrestha	Member



INTERVENTION OF ENERGY EFFICIENCY TECHNOLOGIES IN STEEL ROLLING MILL SECTOR OF NEPAL

-Er. Sudan Neupane

Energy accounts for a significant share of the manufacturing cost in different industries. The efficient use along with conservation of energy is considered vital not just to avoid wastage of a precious resource, but also to slow down the rapid depletion of coal, oil, and natural gas resources. Nepalese industries are found to be using both electrical and thermal

rolling mills of Nepal, assuming planning period of 2015-2030, we will see some eye pleasing pictures. For this, the demand of TMT steel, its energy consumption and CO₂ emission are taken under consideration.

The demand scenario of TMT steel is classified as Business-as-usual (BAU), Medium growth (MG) and Higher growth (HG), and they

MT. Compared to BAU scenario, the cumulative scenario would rise by 21.5% for MG and 53.4% for HG scenario.

Now through LEAP modelling tool, we will be considering three energy fulfilling scenarios viz. Business-as-Usual Scenario (BAU), Efficient scenario (EF) and Fuel switching scenario (FS) with their impacts on fuel consumption and total emissions of CO₂ in the rolling mill sector of Nepal. In Business-as-Usual Scenario (BAU), we deal energy in the usual way in which we are currently using where as in Efficient scenario (EF), the objective is to observe the energy consumption pattern on decreasing the energy intensity determined by benchmarking the international standard. In Fuel switching scenario (FS), we observe the effects on the environmental emission due to alternative fuel penetration.

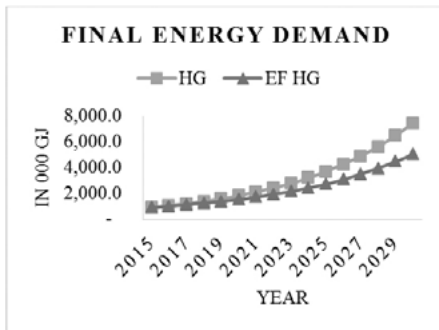


Fig: Final Energy Demand forecasted under different growth scenario

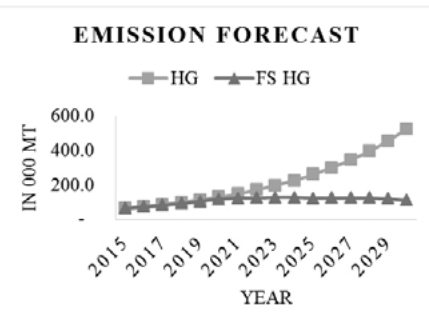


Fig: CO₂ Emission forecasted Under different growth scenario

energy inefficiently. So there is a huge possibility of improvements in consumption of energy pattern in industrial sectors. There is a huge demand of energy (electricity) in the industrial sector of Nepal but due to the crisis, the demand has not been fulfilled. Industrial sectors account for 7.9% share of energy (WECS, 2013). Their GDP share is 15.2% and the growth rate is 2.7% from 2000 to 2014 A.D. (Central Bureau of Statistics, CBS). In this context steel rolling industries, being energy intensive industries, have numerous areas for increasing energy efficiency and reducing emission of CO₂. The focus on energy efficiency is not only good for the environment but also profitable for industries, as it increases competitiveness and productivity. Therefore, by calculating the present potential energy saving and developing future energy demand using Long range Energy Alternative Planning (LEAP) modelling tool for the steel

are assumed 4.45%, 5.4% and 6.5% respectively.

Result of growth of energy and CO₂ emission as per different demand scenarios:

The energy demand for the base year 2015 in BAU, MG, and HG is 906.5 Tera Joule (TJ). The final energy would increase to 2906.4, 3703.4 and 4889.3 TJ respectively in 2030. The cumulative energy demand for BAU, MG and HG scenario would be respectively 33.14PJ, 40.289PJ and 50.85PJ, compared to the BAU scenario, the cumulative energy demand rise would be 21.5% for MG and 53.4% for HG scenario.

The CO₂ emission for the base year 2015 in BAU, MG and HG is 63.8 thousand MT. The final CO₂ emission would increase to 273.7, 370.5 and 524.4 thousand MT in 2030. The cumulative emission for BAU, MG and HG scenario would be respectively 2.33, 2.83 and 3.57 million

Results of Efficient and Fuel switching Scenarios:

The efficient scenario is constructed as an efficiency improvement in the technology employed and accordingly decreases in the fuel intensity in steel rolling mill. The efficient scenario studies the effects of technological improvement in BAU, MG and HG scenario. The EF BAU, EF MG and EF HG scenario projects the total cumulative final energy demand to be 25.34 PJ, 30.52PJ and 38.14PJ respectively. Compared to BAU scenario, with EF BAU scenario 23.5% of total cumulative energy consumption can be reduced. Similarly in MG scenario and EF MG scenario, 24.25% of total cumulative energy can be saved. Again comparing HG scenario with EF HG scenario, 25.1% can be saved.

INDUSTRIAL VISION

The result of fuel switching is considered only for emission reduction assuming that the penetration of alternative fuel in long run substitute the use of furnace oil and bituminous coal from the base year till the planning period (2015-2030). With switching of fuel, its effect can be summarized in emission reduction in different growth scenario viz. FS BAU, FS MG and FS HG. The FS BAU, FS MG and FS HG scenario projects the total CO₂ emission to be at 1.2 million MT, 1.74 million MT and 1.45 Million MT respectively. Compared to BAU scenario, in FS BAU scenario 46% of total cumulative emission can be reduced. Similarly, in FS MG and MG scenario, 38.3% of emission can be reduced. Again comparing HG scenario with FS HG scenario, 59.3% of emission can be reduced.

The result shows that with the introduction of energy efficient methods we will be able to improvise our energy consumption pattern and reduce CO₂ emission. The adaptation will not only set up a good culture in energy consumption pattern but it will also be a path leading us to prosperity. The sooner we walk in this path the quicker we will catch the pace of modernization.

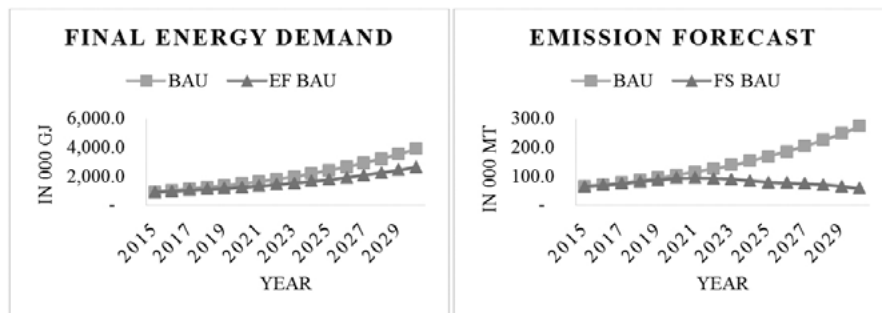


Fig: Results of Efficient and Fuel switching Scenarios for final energy demand and CO₂ emission as seen in BAU

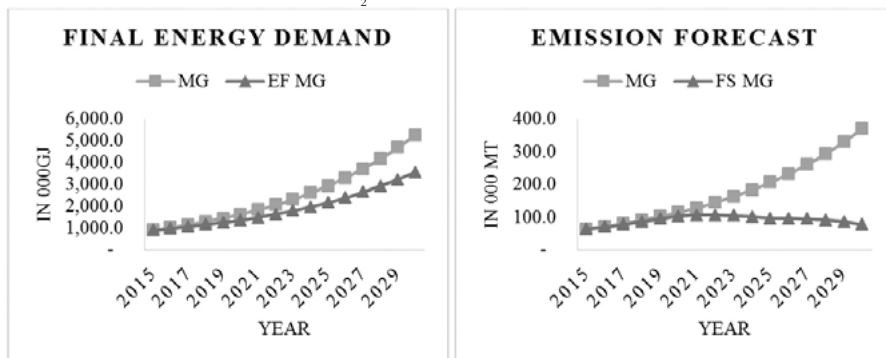


Fig: Results of Efficient and Fuel switching Scenarios for final energy demand and CO₂ emission as seen in MG

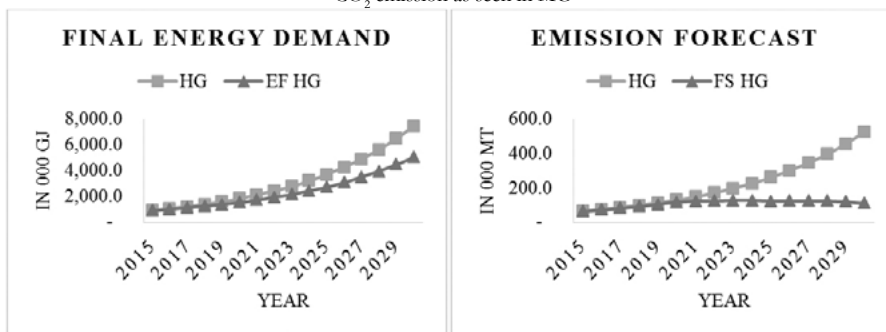


Fig: Results of Efficient and Fuel switching Scenarios for final energy demand and CO₂ emission as seen in HG

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कल इन्डिया...

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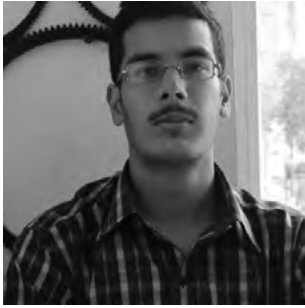
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FAIL-SAFE DESIGN IN AUTOMOTIVES

– Sandeep Tripathi

A circle can't fit where a square should be.

To design a fail-safe design means to develop a system which uses physical device or behavior shaping constraint to prevent any possible accident caused by any of a system's components. It is also known as poka yoke (mistake proofing) device as introduced by Shigeo Shingo, a quality expert for the inability of Statistical Process control. It was used to make the error or defect zero by preventing, correcting and drawing attention of human and adopted by the Toyota Production System as tool for lean manufacturing process. The fail safe design can be prevention based where defects or error is prevented or detection based where it is concerned with defects that already occurred. This article will focus on application of failsafe design on automobiles and will not go into details of various forms of failsafe design and practices. In any design, no component or device should fail to create a hazard. Fail-safe mechanism means that a device will not endanger lives or property when it fails. These fail safe device first when proposed by Shingo were supposed to be effective and inexpensive but with modern technology, it has evolved in its application and price.

Fail-safe design is integral part of automotive safety. Fail-safe system has found an important position in modern day automotive design, where safety of the driver/passengers is of prime concern. Fail safe system are constructed in such a way to prevent making mistakes while using such systems. As there is advancement in the technology and design of automobiles, more fail safe strategy seems to be implemented in the automobiles.

It can be an expensive component like a redundant engine or just a simple sounding alarm circuit playing music

when you back a car. Fail-safe is in the design of the key hole of the car, you can't just stick anything you like and start a car; it is in the ergonomic door handle of the car; it's everywhere.

One of the simplest uses of failsafe in the automobiles is in the car with manual gear, where the driver cannot start the car without depressing the clutch pedal, which is done to prevent unintended motion of the car. This is more of behavior constraint, where, the driver has to press on the clutch pedal in order to start the car while in gear. With time, drivers will get habituated to pressing of the clutch and the constraint is confirmed. Lawnmowers have a hand-closed lever to be held all times, if released, it stops rotation of blade. So it is also called dead man's switch.

"Fail-safe design is an integral part of automotive safety."

Heavy equipment which uses hydraulic fluid use solenoid valves or fuses as fail safe device, so when there is problem in say cylinder, the cylinder will not give up its holding ability and hit the personnel working around. In heavy duty vehicles electronic braking system (EBS) also known as brake-by-wire is used. In case the EBS system fails due to electronic signal not activating, the normal air brake control pressure comes into action so no accident occurs due to failure of brakes.

Similar to brake-by-wire, there is throttle-by-wire also known as electronic throttle control (ETC) system. If there is sign of problem or failure, the engine comes to idle in automobiles where this system is used. In case, extreme, electromagnetic radiation interferes with the control module, or there are voltage signals other than from engine control

module the engine shuts down instead of surging. This development on surge necessitates mentioning the unintended acceleration faced by Toyota cars in year 2009-2011, which still is mystery and was pain in the pelvis for Toyota. Among all problems accounted, firmware problem is of concern for us as not only the hardware but even the software is part of failsafe design. The software used in the automotive, should also be fail safe so as to make the automotive system failsafe in holistic way. So the German automakers have created automobile where driver's mechanical input to step in and override the throttle system. Thus, in case of ETC system malfunctions where the throttle opens itself; stepping on the brakes will close it.

ETC uses redundant components, like multiple sensors for one signal position to detect driver input or other factors. Redundancy is design engineer's nightmare, but it is a price to pay for a safe system. In a failsafe design, redundancy of components and parts has a positive connotation unlike other philosophies of design. The motive is to have a failsafe system, and it does not matter if you have two emergency stop switch positioned in your automotive especially in heavy equipments, as long as one works. If there is any possible malfunction or failure, it should not lead to extra risks is the philosophy of failsafe design.

In conclusion, automotive has embraced and widely used failsafe design to make modern automotive risk free and safe for its consumers.

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19 WAYS OF BEING ECO SMART AT YOUR HOME/BUSINESS

-Er. Prakash Acharya

Sad but true that we have been exploiting our resources since hundreds of years and come till 2016. For human interest, so many innocent wild lives have extinct, so many wetlands have disappeared, greenery has been a fantasy now, climate laws have changed and slowly gradually human civilization is threatened. It's time to rethink now, rethink on how we live, how we eat, what we buy and what we drive.

Being eco smart at our home/business shall not be a fashion or luxury but a need. Our small steps can lead us to a greener future. Greenery can be saved, fertility can be gained, marine life can rock and only then our generations will thank us for a green planet. It's for sure, they are not going to thank us while seeing green planet on the museum.

Here are some actions you can take to be eco smart your home/business:

1. Use of motion/occupancy sensors in corridor, compounds, staircase to conserve energy

Significant amount of energy at your home or business building might have been wasted and probably you are unknown about it. Have you ever noticed fans running even when there's no one inside the room? Lights are on even in the lonely corridor? Heater is heated in government offices, but officers are outside sunbathing? This kind of energy waste can be controlled with simple technologies. For example, using occupancy sensors, fans stop, and heaters stop when no one is inside room.

2. Use Water overflow stopper in overhead tanks

Overhead water collection tank is common in our country. We don't have regular water supply so we have

to collect. Yet, the question is, when water is so much scarce, why do we waste? In average, 50 liters of water per household is wasted due to tank overflow, which can simply be avoided with a cheap technology. Go, just buy it and save water, save mother earth.

3. Start composting, it's easy

Waste handling might not be your choice yet, but believe me it's not that crappy if you handle it promptly. Waste segregation is the first step, where decomposable waste can be collected in a compost bin to produce highly nutritious fertilizer for your garden. Your daily kitchen waste can be enough to produce compost manure necessary for your garden.

4. Collect plastic bags and return them to grocery for reuse.

Avoiding plastic bag is always better, but sometimes they are not totally avoidable. In that case, collecting and returning them to grocery store for reuse is bold step you can take to reduce plastic consumption. Who knows, grocery owner might have special discount for you then!!

5. Power your home with solar

Bring future to home, power your home with Mr. SUN. Solar is abundant and free! Feel the freedom of generating required power at your home itself. Isn't it something interesting? You save your energy bill while you save the planet in bonus.

6. Winter is chilling, solar geysers can be economic.

Solar geysers are one of the most reliable technologies among renewable technologies. If you are living in a region like Kathmandu or Pokhara, they will serve you hot water almost 350 days a year. Also,

these technologies need very rare maintenance and last long.

7. Replace bulbs with LEDs, they are available in reduced cost

Who says LEDs are expensive. They are available in same price to CFL now, while life and light of LEDs in comparison to CFL is triple. LEDs pays you back with long life and small energy bill.

8. A simple LP gas leak detector can save your life

LP gas in kitchen is sometimes a monster and takes lives. We have heard much news of accidents caused by LP gas leakage, although we can be safer in kitchen with a simple technology. Put a LP gas leakage detector in kitchen and get alarmed whenever there is threat.

9. Firefighter is not just a gas cylinder, sometimes it's a savor of your whole property

We are living in such a weak system that there is always threat of fire at our property. Unfortunately, if there is, then what to do. Fools cry, scream and run for help but smart people blow off fire with the fire fighter. So, prepare for the worst, bring a cylinder of fire fighter for safety.

10. Rooftop garden can create peace in you.

Gardening is one of the best things to do in earth. Rooftop gardening will make your terrace beautiful and create peace of mind in you. You will just love to see nature at your home.

11. Remember other side of a printed paper can be used for unofficial documents or writing.

In every reuse of 8000 sheets of paper, you are saving a tree. Reduce

paper waste to save greenery on earth.

12. Setting your PC monitor go off in few minutes while it's in idle mode can help you save energy for free.

A small step can be a giant leap with supporting roles. Shutting your computer off in the idle mode will save not only electric bill but also promote good culture towards energy.

13. Waste water treatment for reusing might be costly but worth it for environment.

Big Volume of water from our shower, kitchen and toilet flush is drained and wasted. The drain water from shower, laundry and kitchen can be recycled to be used for gardening and toilet flush. If every one of us is doing this, we would be able to save more than 60% of water of present consumption.

14. If you are making a new home, don't forget to include rainwater harvest technology.

In a city like Kathmandu where water is so rare, rainwater harvest technology can help a lot to reduce

dependency on national grid. Rainwater is cleaner and safer which can be used for shower, laundry, car washing and other cleaning applications.

15. If you are fond of SUKUTI, JHILINGA, SUN DRY TOMATO etc. then solar dryer are for you.

Solar dryer reduces drying down time and dries different food product in a hygienic environment. With solar dryer, you won't need to worry about dust, rain, bird's faucets and other kind of pollutions.

16. If you own a hotel, a master switch in each room will help you save a lot of electricity and money

A simple technique I highly appreciate is a key locket which works to ON and OFF a master switch of a hotel's room. This is just simple and awesome. In a hotel, there mostly is a situation where guest is outside the room and electrical appliances like TV, fan and lights are ON. So, master switch can help you avoid this kind of energy wastages.

17. Kawadi wala pays your one day meal, if you recycle newspaper bottles, old battery and metals once a month.

Waste can be wealth. Throwing old newspaper, beer bottles and scraps to municipality truck will give you nothing, but Kawadi wala will happily pay you for them. Your waste can create wealth for you, for Kawadi wala family, for collector's family and so on chain goes on.

18. Take a shopping bag from home, no plastic bags.

Saying NO to plastic bag is most holy thing we can do for planet.

19. Go Online.

Exploit technology, pay your electricity bill, water bill, and phone bills online. There are so many online payment platforms available even in Nepal. Avoid paper bills, recharge cards. Save paper, save trees and save energy.

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ROLE OF INDUSTRIAL ENGINEERS ON RECONSTRUCTION FOR ECONOMIC REVIVAL

– Prof. Dr. Govind Raj Pokharel

On 25th April a powerful earthquake and many aftershocks devastated Nepal. The overall economic cost of the damages are estimated to be US \$ 5.17 billion and the losses of US \$ 1.89 billion thus making the total disaster effects to US \$ 7.06 billion. The preliminary estimated recovery needs amount to US \$ 6.68 billion.

After second constitutional assembly election, while political parties were busy in drafting new constitution, simultaneously, Nepal had begun gearing up for a higher trajectory of economic growth with many game changing investment initiatives (Power Trade Agreement, SAARC Energy Framework, Hydro PDAs, Cement Industries, 5-Star hotels construction inaugurated, etc.). Nepal is in a firm path to achieving many of the Millennium Development Goals by the end of this year, including the target of halving absolute poverty. The country has targeted to meet the required criteria for graduation from its status as a Least Developed Country (LDC), possibly by 2022. However, the earthquake slowed down the momentum of progress on these fronts and partially dampened aspirations of a rapid sustained economic development of many Nepalese, especially youths’.

Government is starting activities for long-term reconstruction to rebuild not only the lost physical infrastructure but also robust and sustained economic, social sectors and living heritage in the affected areas. Nepal needs to follow the guiding principles of ‘Building back better’ brought into the prominence by Sendai Framework for disaster reduction in 2015. As Nepal is vulnerable and prone to multiple disaster risks, the reconstruction is a golden chance to create disaster resilient nation with robust inclusive and vibrant economy, integrated settlements and long lasting physical infrastructure.

Much anticipated reconstruction work based on the post disaster needs assessment (PDNA) report brought out by National Planning Commission (NPC) should focus on 21 sectors and subsectors. Reconstruction is multi-dimensional that focuses on the development of integrated settlement, innovative economic development activities, sustainable use of environmental resources where the use of industrial engineer can bring innovative ideas of making reconstruction an economic development agenda.

“Our industrial engineers can be part of the economic reconstruction and only through this we will have economic revival through reconstruction.”

Private sectors, non-governmental organisations, different development agencies and other stakeholders should have an opportunity to be the part of the rebuilding process. The reconstruction process must ensure that women take active participation in all stages. We can draw upon and adapt all the good practices applied and successful in other similar recovery and reconstruction programmes in Asia and elsewhere and will implement in Nepali way. The country will maximise the use of our own experiences and resources to support reconstruction and rebuilding, and during the process, we need to build the capacity of national and local stakeholders and institutions. National efforts especially economic reconstruction inbuilt with physical reconstruction need to be augmented by collaborating with involved external stakeholders and talent and skills available through its diaspora for effective service delivery system.

Villages and scattered settlements will be relocated on the grounds of safety and with the vision of integrated settlement development maintaining or even enhancing people’s livelihoods.

Industrial engineers’ engagement to study design and promote local SMEs in these settlements will boost local production of goods and services. Government needs to provide technical assistance, capacity building support through trainings to local people. Industrial engineers can carry out the quality and safety check of the houses constructed as they must be monitored through a third party audit and certification.

During the construction process huge amount of jobs will be created and industrial engineers can help to local potential SMEs to be capacitated so that they will create more employment opportunities. With this approach direct income of more than 25,000 rural people will be enhanced. Large amount of construction materials will be used where industrial engineers can be brought in to accelerate the production capacity of national industries, create employments and promote the supply chain network. This network can also be utilized to create market for rural products thereby raising income in the rural areas. Private sectors and SMEs of rural areas need to be mobilized to boost the local production and utilize generated cash for productive uses. With this synergy after involving industrial engineers in the rural reconstruction process the economic activity, consumption and production will boost.

Recognising the importance of Nepal’s heritage structures and irreplaceable cultural heritages, the reconstruction program will build them back with great care and will incorporate disaster resistant features wherever possible without major changes to the original features. Government has recognized that these heritage sites as living heritage which has social, historical and cultural values rather than mere archaeological curiosities. The reconstruction must adopt approach of keeping intact the

living heritage values of such sites and all the processes will be initiated with the involvement of local communities. Considering the fact that livelihoods have also been adversely affected in many of the heritage sites, care should be taken not only to restore the livelihood activities but also to improve the design, quality, and marketing of the products. Many SMEs, cooperatives (guthi), groups of women and different ethnic groups (formal or informal cooperatives should engage in either directly or indirectly in the livelihood activities undertaken in these sites, the reconstruction program will pay special attention to promote their skills and sustained income generating capabilities to expand as well as diversify their entrepreneurial scope. A partnership development approach with expert institutions or agencies, cooperatives and private sectors and Industrial Engineers within country or abroad will enhance to restore/rebuild and develop the affected heritage structures and sites simultaneously augmenting economic activities. Tourism sector needs rebuilding by focusing two aspects: improving facilities for social, cultural & adventurism and restoring our heritage sites. This sector can create large number of employment opportunities in a short term. Rebuilding infrastructure with economic activities in this sector can go simultaneously once massive information dissemination is done, 'Revenue from Rubble' approach needs to be adopted especially mobilizing local formal and informal cooperatives and groups. Tourists can be made eager to see 'Before and after the earthquake' of our heritage sites to revive the revenue generation activities. Increasing the basket of options for tourists through promotion of spiritual, adventure and site seeing tourism can create income for local people.

Economic reconstruction is not only to restore livelihoods but also to create sustainable, robust and dynamic economic activities for creating conditions for sustained economic growth. To promote recovery and sustain economic growth, the long-term policy demands a mix of various types of policy and financial incentives and other interventions through local institutions like cooperative and micro

finance. Assistance and relief to small and medium farmers through organised cooperatives needs to be provided for the loss of livestock, cattle, and poultry and their lost agricultural tools, equipment, seed and fertilizers. Financial incentives or seed money for farmer's cooperatives and commercial farmers need to be announced for re-starting business for recovery of small business, tourism sector, agriculture sector and hospitality businesses, cottage industries, shops, and small enterprises based on an assessment of the business plans. Training for skill imparting and upgrading for creating better employment/self-employment opportunities with a special focus on women, handicapped and marginalised must go together with reconstruction process. Cash for work and labour-based programs focused on rebuilding public and private assets will provide immediate cash benefits for poor communities so that local market becomes vibrant. Many of these activities in rural areas can be organised, facilitated and even supported by local cooperatives and private sectors.

This is also a right time to transfer new technologies and expand the businesses in manufacturing industries. The right incentive package can boost them. Innovative financing and entrepreneurial capacity building initiatives with business feasibility studies can be carried out in affected villages to motivate local people to go for the productive industries in rural areas. Self-employed people serve the humanity and country in three ways: Becoming free from being burden of the government, Employing few people and also reducing the load of the government to manage those employees, and Paying taxes to the state treasury so that public service

officials and development projects get resources.

Using the reconstruction as an opportunity government must provide better access to health, education, banking and financial inclusion by engaging cooperatives. Targeted livelihood support program through locally created organisations for these vulnerable groups will create the economic opportunities and empower them. With formal training, skill-testing certificates, marginalised groups will have better acknowledgement and dignity, which will enhance the access to better livelihoods generating opportunities. Saving credit schemes in banking system need to be introduced in affected areas by opening accounts in the name of beneficiaries who do not have such account. In remote areas mobile banking or business correspondence model must be encouraged.

So, during the physical, social and heritage reconstruction process, many innovative ideas, tools, instruments need to be applied to have inclusive, robust and dynamic economic reconstruction in earthquake affected areas of Nepal which can be replicated to other parts of the country later. Our industrial engineers can be part of the economic reconstruction and only through this we will have economic revival through reconstruction.

Prof. Dr. Govind Raj Pokharel is the former Vice Chairman of National Planning Commission and CEO of suspended National Reconstruction Authority, Government of Nepal. He can be reached at grpokharel@gmail.com.





TAKE ME DOWN TO THE SMART CITY

– Jonathan Wilkins

In 2015, market research firm Juniper Research declared Barcelona the smartest city in the world. As a result of the city's support for local public transportation and electric vehicles, there are now 500 hybrid taxis on the streets of Barcelona, as well as nearly 300 public electric vehicles and an estimated 400 private electric cars. Barcelona has also implemented a programme that calls for the intelligent networking of energy and water supplies, recycling, lighting and mobility systems. The aim is to improve quality of life and protect the environment.

Smart cities make use of digital technologies, networking and automation to enhance the performance of urban services and infrastructure. This reduces costs and energy consumption, while also increasing the quality of life for inhabitants.

Keeping CO2 in check

The number of people who live in cities is rapidly increasing, with the world's biggest metropolitan area, Tokyo, home to 37 million people. In fact, the United Nations estimates that nearly 60 per cent of the world's population will live in urban areas by 2030. This volume of growth could cause a lot of strain for urban infrastructure, with many cities already struggling to keep up with road capacity, water and energy supplies. The increase in urban populations also means that cities need to rethink the way they address emergency situations to ensure the safety of all inhabitants.

Energy efficiency plays a big part in the smart city. The International Energy Agency (IEA) reports that the close relationship between economic growth and greenhouse gas emissions is weakening. The reason? Power

is being produced and consumed more efficiently across different applications.

As industry moves into an era of smart factories, industrial automation is making energy efficiency a higher priority. For example, semi-conductor manufacturer Infineon Technologies is offering 8-bit microcontroller units for motor controls, pumps and fans in a bid to reduce energy consumption.

Innovations that bring together digital technologies and energy reduction are widespread. They include technology like smart sensors

“Smart cities make use of digital technologies, networking and automation to enhance the performance of urban services and infrastructure.”

and control systems that monitor and reduce the energy consumption of buildings and interoperable communicating devices, such as temperature and air quality sensors, variable speed drives and robots.

Technology for a new era

The smart cities era will be made possible by a move towards sustainability and reduced power consumption, both of which are being led by industrial automation. Sustainability, in terms of energy and resource efficiency is a key ingredient for the success of the global manufacturing industry.

Factories of the future will be driven by cloud computing, cyber security and mobile and wireless communication technologies. Accordingly, the need for higher productivity and greater efficiency is driving organisations to implement more interaction between the factory floor and enterprise level.

Miniaturised sensors and networks

that interconnect factory equipment can also help minimise power consumption and push us towards an era of smart cities. The quality of air and water, the movement of people and objects, the changes in weather, the road traffic and the production and consumption of energy can be measured using sensors. It can all be tracked and communicated in real time. It is through interconnecting physical objects, buildings, factories, vehicles, power generation plants and lighting systems that cities will become smart.

Smart energy, water and transport

Perhaps the biggest hurdle on the road to the smart city is integrating a wide range of systems and equipment from different vendors and different eras, into one coherent network. Every object in the network should be able to collect and share data. Monitoring and control systems need to be in place to archive the data. Predictive data analysis will allow operators to identify issues before they occur and take remedial action. No matter how you look at it, smart cities won't be able to exist without industrial automation and big data.

One area where most cities already need improvements is the smart grid. The strain on urban areas when it comes to electricity demands is only going to grow with increasing population numbers. To keep up with demand, the nature of the energy grid needs to change to allow energy inputs from new sources like renewables and cogeneration.

International standards, such as IEC 61850, are setting the foundations for smart grids. IEC 61850 refers to the design of substation automation systems and aims to minimise interface compatibility problems. It allows

substations in the entire grid to use the same communication channel for all data, in real time, through Ethernet.

In a similar way, water systems can benefit from industrial automation. Water supply and treatment processes can be optimised using sensors and intelligent electronic devices, in combination with SCADA and asset management technologies. Securely integrated water infrastructure monitoring should be able to detect real-time water leakages, unusual chemical levels and other faults or inefficiencies.

Urban transportation usually accounts for up to 40 per cent of total city emissions. By introducing electric vehicles, the carbon footprint of a city can be significantly reduced. Regenerative braking allows a vehicle – car, bus, train or light rail – to generate energy every time it breaks, something that comes in particularly handy in urban environments. However, electric vehicles are useless without the relevant infrastructures and smart

grids.

An intelligent urban transportation system should also include traffic signal management, monitoring of public transport levels and signage updated in real time.

Legacy systems and equipment are commonly found in energy, water and transport. Luckily, older industrial automation systems can easily be retrofitted with smart sensors and scalable controls, so a full refurbishment is not always necessary.

Building smart bridges

Buildings account for the largest share of energy consumed in most cities. Opportunities exist to make them more efficient and control energy usage intelligently. This can be achieved for example by automatically adjusting the window blinds when the sun is too intense or by linking lighting and air conditioning to occupancy. Energy efficiency solutions, such as variable speed drives, can dramatically reduce the energy required to run air

conditioning. Variable speed drives can minimize HVAC costs by 20 to 50 percent. Full building automation solutions intelligently control everything from window shutters to heating and cooling in response to weather, occupancy and energy prices.

Cities around the world must face the challenges of accommodating their increasing populations to become more sustainable, competitive and overall, nicer places to live in. Many intelligent power and automation solutions already exist to enable cities to automate their key public and industrial services. It may be a while before we have a world of smart cities, but the industrial automation industry is helping to push us along.

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FAULT DETECTION AND DAMAGE QUANTIFICATION METHODOLOGIES USING LAMB - WAVE SENSOR DATA

-Dr. Spandan Mishra

Fault detection technique has wide applicability in engineering problems ranging from quality control of a manufacturing process to structural health monitoring.

1. INTRODUCTION

The paper reviews state of art in condition monitoring using sensor data in structural health monitoring application. SHM is closely related with conditional monitoring. Just like human skin which is sensitive to damage and external stimuli, researchers in the field of manufacturing engineering are working to develop an intelligent material that is sensitive to external pressure and can even tell us when its damaged or will possibly damage. Ability to do so can save millions of dollar worth of money and of course human life.

2. LAMB WAVE BASED STRUCTURAL HEALTH MONITORING:

Propagation of Lamb wave has been found to be sensitive to the structural damage. Inference about degree and location of damage can be made by comparing lamb wave propagation characteristics on a damaged structuring with that on pristine structure (Lu, Wang, Tang, & Ding, 2008).

2.1. Physics of Lamb wave

Lamb wave can be used to monitor large volume of the structure due to the fact that lamb wave have ability to travel considerable distance and have the ability to cover large area along the line between transmitter and receiver (Diamanti, Hodgkinson, & Soutis, 2004). Lamb wave is characterized by two properties i) Phase velocity (c_p) ii) Group Velocity (c_g). Phase velocity is referred to as propagation speed of the wave phase at a given frequency (Rose, 2004).

$$c_p = (\omega/2\pi) \cdot \lambda_p \quad (1)$$

Where λ_p is the wavelength. Group velocity is the velocity with which actual envelop of the wave propagates through the space (Rayleigh, Rayleigh, & Lamb, 2009). A lamb wave signal consists of two modes a) symmetric mode b) Anti-symmetric mode.

Due to its higher sensitivity of A0 mode is widely used for de lamination detection while S0 mode is used for through hole and crack detection (C. . Wang, Park, & Chang, 1999). Interaction of lamb wave with the damage on a structure depends on the frequency of the wave, which has been demonstrated by (Alleyne & Cawley, 1992). Because of its sensitivity to de lamination, anti-symmetric mode is widely used to detect de lamination in composite (Chang & Mal, 1999) (S.S Kessler, Spearing, & Soutis, 2001). Similarly, fundamental symmetric mode is used to detect damages related to holes and cracks growth (C. S. Wang & Chang, 1999). The feature that makes Lamb wave very useful for damage detection is that whenever it reaches a region of dissimilar wave speed a portion of wave is reflected proportionally to the difference in their stiffness and density (Seth S Kessler et al., 2002). Analysis of the incident wave on the sensor can reveal some useful information about location and size of damage. A proper lamb wave mode should have following characteristics i) Non-dispersion. ii) Low attenuation iii) High Sensitivity iv) Easy excitability v) Good detectibility. vi) Toileless selectivity (Su, Ye, & Lu, 2006).

Piezoelectric sensors are used to generate the lamb wave. When voltage is applied to the piezoelectric patch it expands and contracts parallel to the surface, inducing bending moment in the structure which results in the generation of wave (Valdés & Soutis, 2002).

The disadvantage of Lamb wave method is that they require an active driving mechanism to propagate the waves, and the resulting requires mathematical interpretation. (Seth S Kessler et al., 2002)

Nonparametric damage detection technique doesn't require detail knowledge of the failure mode and can also deal with unpredicted failure pattern (Tseng & Naidu, 2002). Various statistics based index has been proposed; (Giurgiutiu & Rogers, 1998) Root

Mean Square deviation (RMSD) between two states to quantify damage index. $RMSD = \sqrt{\frac{\sum_{i=1}^N (y_i - x_i)^2}{\sum_{i=1}^N x_i^2}}$, where x_i and y_i are the data of the structure before and after damage has occurred. Three other forms of Damage Index are. Minimum average percentage deviation (MAPD), Covariance (Cov) and Correlation coefficient (CC) have been proposed by (Tseng & Naidu, 2002)

3. CONTROL CHART BASED CONDITION MONITORING

Control chart is process monitoring technique to assess stability of a process and distinguishing assignable cause variation from common cause variation. (Montgomery) Group of in control sample is taken to calculate the process mean and control limits. Suppose that a quality characteristic is normally distributed with mean μ and standard deviation σ . Consider a sample with $x_1, x_2, x_3, \dots, x_n$ with size n . The

$$\bar{x} = \frac{x_1 + x_2 + \dots + x_n}{n} \quad (2)$$

sample average is given by

Then $\bar{x}$ is normally distributed with mean μ and standard deviation $\sigma/\sqrt{n}$, thus the control limits are defined as

$$UCL = \mu + Z_{\alpha/2} \frac{\sigma}{\sqrt{n}} \quad (3)$$

$$LCL = \mu - Z_{\alpha/2} \frac{\sigma}{\sqrt{n}} \quad (4)$$

The control limits are driven by the natural variability of the process (Montgomery, 2005). Generally, the effective use of control chart will require periodic revision of the control chart limits. The expected number of samples taken before the shift is detected is the average run length, $ARL = \frac{1}{1-\beta}$ Where β is the probability of not detecting such a shift. Let x_{ijk} is the i^{th} observation on the j^{th} quality characteristics in the k^{th} sample. Suppose m such samples are available. The covariance between j^{th} and h^{th} quality characteristics in k^{th} sample is defined as:

$$S = \begin{bmatrix} \bar{S}_{11} & \bar{S}_{12} & \dots & \bar{S}_{1p} \\ \bar{S}_{21} & \bar{S}_{22} & \dots & \bar{S}_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ \bar{S}_{p1} & \bar{S}_{p2} & \dots & \bar{S}_{pp} \end{bmatrix}$$

The test statistic for Hotelling's T^2 control chart is given by

$$T^2 = n(\bar{x} - \bar{\bar{x}})' S^{-1} (\bar{x} - \bar{\bar{x}}) \quad (5)$$

A multivariate control chart based on Hotelling's T^2 also be plotted based on first A principle components (PC). $T_A^2 = \sum_{i=1}^A \frac{t_i^2}{s_{t_i}^2}$, where t_i is the principle component and $s_{t_i}^2 = \lambda_i$ is the estimated variance of t_i (Macgregor & Kourtl, 1995). By scaling each t_i^2 by its variance each PC term plays an equal role in the computation of T^2 and slight deviations in t_i 's which have almost negligible effect on original data will lead to out of control signal (Macgregor & Kourtl, 1995). The multivariate statistical process control chart has been popularly used on the features extracted from the signal for fault detection. Modal parameter identification technique plays an important role in frequency domain based damage identification technique. Various modal parameter like modal frequencies, modal shape or modal curvature are chosen as damage sensitive features (Z. Wang & Ong, 2008).

4. PATTERN EXTRACTION BASED FAULT DETECTION APPROACH

Developers have worked on similar sorts of algorithms which helps a machine to recognize patterns. Various Pattern recognition algorithms like Neural network, Principle Component Analysis (PCA) etc. are popularly used in Structural Recognition techniques have been successfully used to identify the type and the severity of damage. Damage detection usually is a three step process: 1) Data Preprocessing 2) Detection Algorithm 3) Damage Prediction (S. S. Kessler & Agrawal, 2007). Once the data has been acquired, de-noising is done to remove all the unwanted noise and preexisting artifacts.

4.1. Outlier based methods for fault detection

(Worden, Manson, & Fieller, 2000) have used the concept of discordancy to signal the deviance from norm. This approach uses the lowest level of detection, i.e. It only answers if damage is present or not. For univariate, data deviation statistic is given by $z_\xi = \frac{|x_\xi - \bar{x}|}{s}$, where x_ξ is the measurement corresponding to potential outlier, $\bar{x}$ is mean and s is the standard deviation. For a data with n observations and p dimension, the discordancy test is given by Mahalanobis squared distance.

$$z_\xi = ((x_\xi) - \{\bar{x}\})^T [S]^{-1} ((x_\xi) - \{\bar{x}\}) \quad (6)$$

Where $\{x_\xi\}$ is the potential outlier datum, $\{\bar{x}\}$ is the mean vector of the datum and $[S]$ is the sample covariance matrix. The statistic is checked against the threshold which is computed using Monte-Carlo

simulation. This approach is based on assumption that normal condition set has Gaussian distribution, a gross deviation from the Gaussian model may invalidate the model (Worden et al., 2000). For Non-Gaussian distribution alternatives like density estimates (Bishop, 1995) (L Tarassenko, Hayton, Cerneaz, & Brady, 1995) or auto-associative (Worden, 1997) (Pomerleau, 1993) networks should be used.

4.2 Wavelets:

Wavelet transform is a waveform with limited duration and its average amplitude is equals to zero (Su & Ye, 2009b). Wavelet is a function $\Psi(t) \in L^2(\mathbb{R})$ with properties $\int_{\mathbb{R}} \Psi(t) dt = 0$ and $\int_{\mathbb{R}} \Psi^2(t) dt = 1$. Scaling and wavelet functions needs to be selected where

$$\{\phi_{L,k}(t) = 2^{L/2} \phi(2^L t - k); k \in \mathbb{Z}\} \quad (7)$$

$$\begin{aligned} \{\psi_{j,k}(t) &= 2^{j/2} \psi(2^j t - k); j \geq L, k \in \mathbb{Z}\} F_a \\ &= \frac{\Delta \cdot F_c}{a} \end{aligned} \quad (8)$$

a, Δ, F_c and F_a are the scale, sampling period, center frequency and frequency corresponding to the scale a . Wavelet transform allows detailed analysis of the signal by unveiling signal characteristic such as singularity or discontinuity. There basically two types of wavelet transform: a) Continuous wavelet transform b) Discrete wavelet transform. The DWT is performed at discrete scales and time moments using two variables, m and n $a = a_0^m$ and $b = na_0^m b_0, n \in \mathbb{Z}$

$$DWT(m, n) = a_0^{-\frac{m}{2}} \int f(t) \Psi^*(a_0^{-m} t - nb_0) dt \quad (9)$$

Where a_0 and b_0 are two constants determining sampling intervals along the scale and time axis respectively. $DWT(a, b)$ is termed the *DWT coefficients* (Su & Ye, 2009a). The resolution is directly proportional to the density of decomposition. When a DWT is applied to a data set $Y = (y_1 \dots y_n)^T$ the vector of wavelet coefficients can be expressed as $\Theta = WY$. W represents orthogonal DWT, so the original $N \times 1$ vector Y can be recovered as $Y = W^T \Theta$. The original data can be expressed as sum of products of wavelet coefficients and their corresponding basis function (Lada, Lu, & Wilson, 2002). The wavelet based method for damage detection can be divided into three categories: i) Variation of wavelet coefficient before and after damage ii) Local perturbation of wavelet coefficient iii) Reflective wave by local damage.

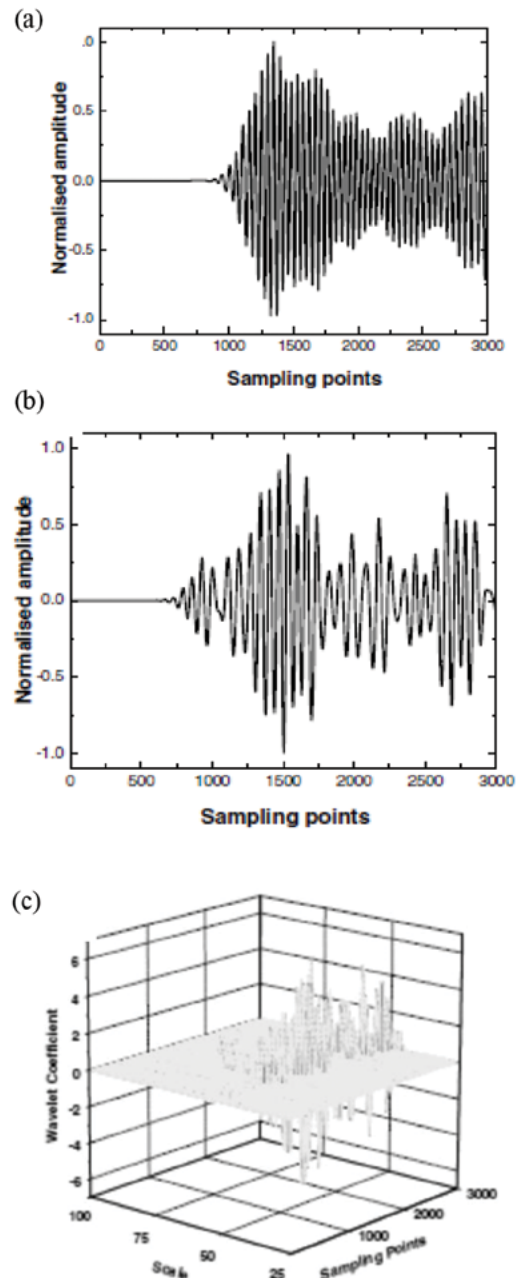


Figure (a) shows the raw time series signal (b) shows the time series signal after wavelet based thresholding. The compressed spectrum in both time-scale domains in shows figure (c).

4.3 Frequency domain based feature extraction:

Damage index of the signal can be computed from the features extracted in the frequency domain. Features that can be used to calculate the damage index include figure of merit (FOM) (Keilers & Chang, 1995) (Choi, Keilers Jr, & Chang, 1994) (Tracy & Chang, 1998), spectral density (Halabe & Franklin, 1998), peak of FFT amplitude, FFT coefficient (Monnier, 2006), variance and kurtosis (Staszewski, Boller, & Tomlinson, 2004) (Sohn et al., 2001). Damage Index using FOM method is defined as.

$$FOM = \text{Max}[fom_j] \quad (10)$$

$$= \text{Max} \left[\sum_{i=1}^{N-\text{frequency}} W_i \left(\frac{\log g_i^I}{\log g_i^{II}} - 1 \right)^2 \right]$$

($i = 1, 2, \dots, N$), where g_i^I and g_i^{II} are the magnitudes of the Fourier transformed signal at i^{th} frequency of N frequencies of interest for the states I and II of the structure. W_i is the weight assigned to reduce the noise effect, fom_j is a scalar quantity associated with j^{th} actuator-sensor path in the network. Discrete Fourier transformation (DFT) is used to express $F(\omega)$.

$$X_k = \sum_{n=1}^N x_n e^{-\frac{2\pi i}{N} kn} \quad (k = 1, 2, \dots, N) \quad (11)$$

Where X_k is the DFT of x_n . Fast Fourier transform (FFT) is a mathematical tool which improves the computation efficiency and reduces the number of computation from $2N^2$ to $2N \log_2 N$, where N is the number of sample points (Su & Ye, 2009a). Fast Fourier Frequency (FFT) coefficients can also be used to compute the damage index.

$$DI = \frac{\sum_{i=1}^n |F_i - FD_i|}{\sum_{i=1}^n |F_i|} \quad (12)$$

F_i and FD_i are the coefficients in the frequency band of interest of the Fast Fourier transform (FFT) in the initial state and the later state respectively. This DI represents normalized difference between moduli of the transmitted spectra. For a structure that's under continuous monitoring DI is continuously monitored, value of DI continuously increases with increase in the damage intensity (Monnier, 2006). The efficiency of FFT coefficient based DI has also been emphasized by (Vanli, Zhang, Nguyen, & Wang, 2012), this paper uses FFT coefficient based damage index to compute the optimal placement of sensor to minimized the maximum Probability of Non-detection (POND). The major drawback of frequency domain based damage index is that it requires us to define a time window in the signal to be transformed.

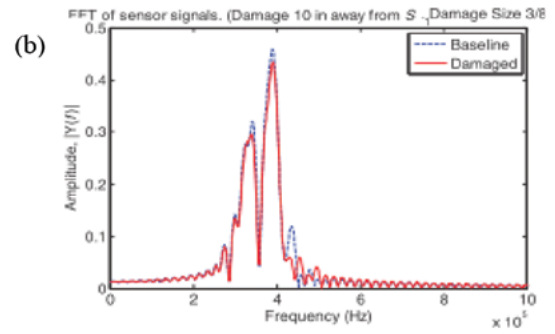
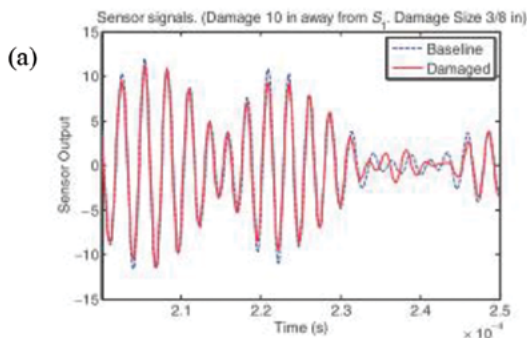


Figure 1 a) Time series plot for Damaged and baseline cases b) FFT plot for Damaged and baseline cases

4.4. Principle Component Analysis:

Principle component Analysis has been widely used for dimension reduction in process monitoring and fault diagnosis. using the dependencies between variables to represent it in a lower dimensional form, without losing too much information and in a form that is easier to interpret (Jolliffe, 2002). It is used to extract useful pieces of information from the matrix by representing it in terms of new set of orthogonal variables. Principle component is a linear combination of set of variables. Geometrically the linear combination can be viewed as rotation of the original system so that the new axes represent the directions with maximum variability and provide a simpler description of the covariance structure (Jolliffe, 2002). PCA computes the new set of orthogonal variables which are known as Principle Components, they are linear combination of original set of variables. The first principle component is supposed to have the largest variance. Principle components can simply be imagined as rotation of axis of variables so that the projection of variables on that axis is maximized.

(Yan et al., 2005) used Principle component analysis (PCA) based method to identify the damage. Occurrence of damage results in the change of vibration features like natural frequency, modal dampening ratio, and mode shapes etc. of the specimen. In practical situation structures may be

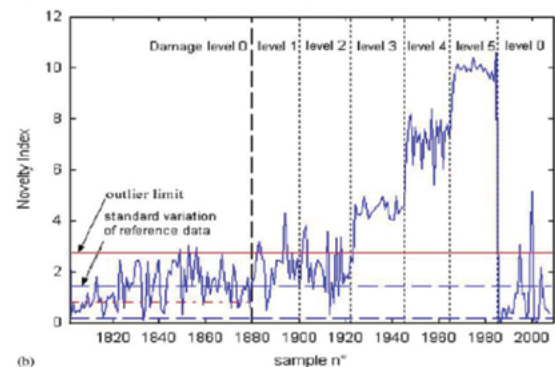


Figure 2: Damage detection in wooden bridge model concerning five level of damage

5. CONCLUSION:

Depending upon the degree of accuracy and extent of information required various fault detection tools can be used. Basic statistics like RMSD, covariance or correlation can be used to trigger the out of control processes; these statistics don't usually give the direction of change. Pattern recognition based tools like wavelets, principle component analysis, Fast Fourier transformation can be used to extract features from the original signal. Quality control tools like Shewart control chart or Hotelling's control can then be used further calculate the degree of variance from in control process.

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He completed Bachelors in Industrial Engineering from Thapathali Engineering Campus.

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विशेषताहरू

ब्याजदरमा ७५% अनुदान दिइने
अनुदान बाहेक रकम बैंकले लगानी गरिदिए
सोलार Equipment लै दियो को रुपमा रहने
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FACTORY DATA

-Greejesh Prakash

The way the world works is changing, and so the industry operation is. Since the first industrial revolution the industries has been operating conventionally, specifically in terms of data improvisation and information exchange. After the introduction of Industrie 4.0, the globalization of information (data) exchange and standard became very important to maintain the crucial developmental components of an industry such as Scalability, Interoperability, and Availability.

Factory Data is a concept of data operation and optimization within industry for the maintenance and virtual capitalization of industry. Factory Data as 'a collective term for technologies and concepts of value chain organization' which draws organized Cyber-Physical Systems, the Internet of Things and the Internet of Services assuming a number of contemporary automation, data exchange and manufacturing technologies.

The basic design of Factory Data is based on six design principles of Industry 4.0,

a) Interoperability

The ability of cyber-physical systems (i.e. work piece carriers, assembly stations and products), humans and Smart Factories to connect and communicate with each other via the Internet of Things and the Internet of Services.

b) Virtualization

A virtual copy of the Smart Factory which is created by linking sensor data (from monitoring physical processes) with virtual plant models and simulation models.

c) Decentralization

The ability of cyber-physical systems within Smart Factories to make decisions on their own.

d) Real-Time Capability

The capability to collect and analyze data and provide the derived insights immediately.

e) Service Orientation

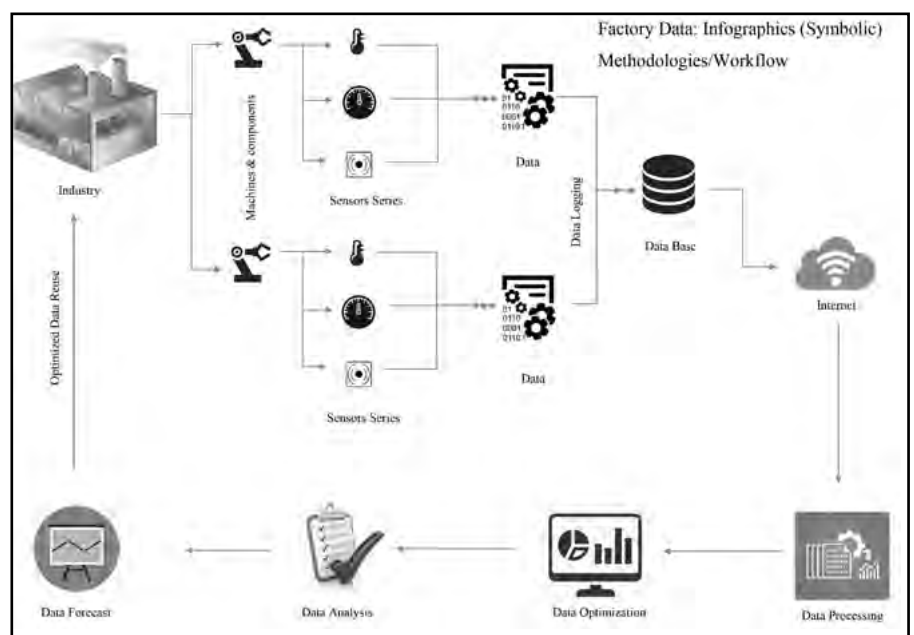
Offering of services (of cyber-

physical systems, humans or Smart Factories) via the Internet of Services.

f) Modularity:

Flexible adaptation of Smart Factories to changing requirements by replacing or expanding individual modules.

and then optimized data used in the same industry, which will help and industry to reduce industry downtime, maximize performance, ultimately leading to the improved efficiency. The obtained data on the internet database becomes a pool of data which can be legally be made available and accessible



The basic setup creates pool of data, data from the operation of various type of industries and their machine components. For the collection of data in industry the set up need not to be complex in rapport of technology integration. The data of the machine components in an industry can be obtained by integrating the sensors to the machine components which could be wired or wireless (depending upon the industrial setup), the series of sensors mainly contain heat sensor, vibrational sensor, noise sensor, pressure sensor, level sensors etc. which is mainly based over the type of component of machine where sensors will be integrated. And thus obtained data is stored to the database which is primarily internet based, a data base to log data of machine operation in time-series combination. Furthermore the stored data is processed according to the objective of optimization

to everyone regarding concept of open data.

Imagine an industrial world where every industry is connected in terms of sharing knowledge and information about production & maintenance, an industrial sectors where startup manufacturers can access the history of data for manufacturing & maintenance to improve their production, industry can access to their own performance with data and measure their potential in terms of productivity and production. It could break the barriers between the higher levels of management to the ground of workers for the better decision making in industry.

Factory Data is a final year project for Industrial Engineering Department. Greejesh Prakash can be reached at greejeshp@gmail.com



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'SOLAR ENERGY AND ENTREPRENEURSHIP'

An Interview with David D'Angelo



David D'Angelo is a serial, social entrepreneur with a penchant for solving global development challenges. He is the Founder and CEO of Somu Energy and member of the executive team at Nanosynth Materials & Sensors. His work has spanned the industries of big data, health care diagnostics, solar energy, micro finance, and diplomacy. David believes that action today builds a better and more promising tomorrow.

Idea of Somu Energy

Most families rely on kerosene to light their homes, and exposure to kerosene causes more than 1.5 million deaths every year. It is an expensive choice that costs families 30% of their annual income. The annual household expenditure adds up to \$433 billion worldwide. These statistics really fueled my desire to be a part of the solution and that's where the idea came from.

Then, we worked intently to create a solution which can provide clean, sustainable, and affordable energy solutions to people to eliminate the use of kerosene for lighting, improve people's energy access, and also empower entrepreneurs to run solar energy systems in rural villages.

Establishing Somu Energy

Finding capital as an early stage entrepreneur can be hard without visible traction that translates to product/market fit and sales. I was fortunate to have a few people in my personal network, who were angel investors and willing to place a bet on me when I was early in the ideation stage. Simultaneously, I sought out a team that could deliver the same level of passion and commitment to this enterprise and take the entrepreneurial leap to Nepal with me. One of the most important takeaways from this entire fundraising experience has been realizing that Investors will invest in you and not always the idea.

The future of Solar Energy Industry in the twenty to thirty years from now

Twenty to thirty years from now, we are going to see a lot of nanotechnology, robotics, 3D printing, and advanced AI. The price of solar energy systems will reduce through advancements, just like PCs, but at a slower rate. We are looking at a future where solar energy is going to be more cost effective, and the safest solution.

My hope is that we can make rapid advancements in battery technology because energy storage is a really promising field. Batteries have to be commercialized with advancements in lifecycle. An example would be, a group in Stanford made a battery with 10,000 lifecycles and it was able to charge phone in less than 10 minutes. So, we need these advancements in battery technology - advancements in the systems will help bring significant milestones in the energy sector.

Possible ways to revolutionize and industrialize the Solar Energy Industry

I think that solar technologies are commercialized in Nepal but what they lack is –the manufacturing capacity - it requires a shift to deregulation and an unlikely transition where Nepal could be cost competitive, in terms of scale and labor, with China or India.

It should be about trying to

promote the culture of innovation and engineering here in Nepal that is necessary for jump starting a revolution in technology development.

Challenges here in Nepal and the techniques being applied to overcome them

We are mostly being challenged by external factors that affect our ability to 'do business as usual'. Notably the supply crisis and a lot of regulation bureaucracy and iniquitous within the government are the challenges that are very difficult to address.

Ways to boost 'Entrepreneurship' practice

I think if you have a curiosity for entrepreneurship, you just have to go up and do it. You need to find people who you really enjoy being around because you will spend 18 or 20 hours a day with your team. You can't give up. You just have to keep going focusing on improvement and problem –solving, to do things better. You should also embrace failures and risks. Mistakes are good learning opportunities.

I'd encourage diving into some entrepreneurship book, trying to sit down the table with friends occasionally and brainstorm different business ideas, and engage with people's creative mindset. Then, don't look away from the opportunity to launch something and commit to

an idea. Give your idea a try.

Differentiating Somu Energy, and standing in the marketplace

Micro-franchising is an interesting concept. Most of the solar products require a prohibitive up-front cost. As an example, they'll come to the station and pay 10 rupees or 40 rupees for one charge that'll give them about three days of energy. That's where we are cost-effective. Aside from that, battery-swapping is an interesting model that was championed by Elon Musk in Tesla in United States.

We have about 1.5 batteries for every customer. We have about 32 batteries in each station that serves about twenty-two house-holds. We always have extra batteries to provide and the swapping process continues. Additionally, a lot of this has to do with the culture, the internal culture that you're hoping to cultivate with your team. We value innovation, creativity, openness, friendship, working-out every single day and share new ideas. The organizational culture and forward thinking also differentiates us.

Recommend to young engineers who want to work in the field of Solar Industry

I think you really have to focus on differentiation. New ideas will mostly evolve from new business models - creation and innovation. Secondly, you need to do a lot of market research. You got to figure out value proposition and customer segments. Those two things, when they are put together, are called product-market fit. Focus on it.

I will suggest taking a template such as business model canvas, and writing down your ideas. You got to do the value proposition, the products, the costs, the revenues, and you use that not as a business plan, but rather as a score card. Take that with you in the field, you develop small prototypes, and talk with people, interview customers, and figure out what are their problems, what they really need as a solution, how much are they willing to spend on it and test sell.

Explain your great idea, and explain that it's something that can grow and expand and it's worth pursuing. That's the approach, you got to use the right tools, and you should be heavily focused on experimentation, doing the small tests to assess the viability of your idea. And yes, "what you create has to be 10 times better than everything out there".

Flexible solar panels are kind of interesting, robotics based systems, sensors and directions of the sun are also some creative parts. Look up different articles on solar energy and batteries, and commercial viability.



Better to work with what we have and try to add accessories to technologies, business models, and build on it, because technology, in this space, isn't going to develop as fast as we think it will, unfortunately.

Special funding strategies that should be incorporated for industrial success

International competitions for students, because students are always looking for opportunities to learn, develop skills in marketing, operation, team-building and fund-raising. They're looking for opportunities to network with other professionals, and boost entrepreneurship practice.

Crowd-funding is great especially if you have a product because you can achieve validation without building anything at all. Or you can just create a landing page- just a simple website, one page that tells everything about your product and at the bottom of the page you say 'Buy now' or 'Sign up'. Attract some attention through media and use 'Google analytics'

to determine how many clicks you get, and learn how many people are interested in your product. This can enable you to develop some market validation and some cash for your company.

You should explore and expand your network and bring energy and optimism in your conversation, execute your mission and come up with good ideas, that'll be a key to success in pitching your idea and creating impact. Talk with investors and everyone you know, tell them about it, start your experiments, and talk bigger than you are. Investors see right through people who are confident. So, be confident, believe in your idea, believe in yourself and once you master confidence, you can master anyone else. This sounds so simple, but it's kind of difficult advice to like take in and project. But, it's true.

Future plans

First, we have to scale our business model and scale our product globally. Scaling our operations in eastern and western Nepal, to go to India, Indonesia, and to the continent of Africa where there is low electrification rates. We want to create impact in about 2 million lives over the next five years. We'll also be ushering in some technical changes to our systems to make our systems more efficient and multi-functional. That's what I perceive in the future for Somu Energy.

Message to the Industrial Engineering Society

I would like to thank the Industrial Engineering team for taking the time to curiously inquire about the work of Somu Energy. I wish your due diligence results in a better understanding of the innovation and talent required for building successful ventures in the context of Nepal.

David is the Founder and CEO of SOMU Energy, and can be reached at davidjdangelo@gmail.com.

SHOULD ENGINEERS GET AN MBA OR ME?

The question is not new – we can see many people who have successfully pursued Master of Business Administration (MBA) degree right after completing their Bachelor of Engineering (BE) degree or after gaining some years of professional work experience. Do engineers need an MBA degree? The answer largely depends on the engineers themselves.

It is already an established fact that there is an associated link between engineering and business management. Increased pace of industrialization, in the early years of 20th century, saw top universities establish business schools with objectives of producing professional managers for the industrial era. The Massachusetts Institute of Technology, the most well known university for applied sciences, created Sloan School of Management in 1914 – a testimonial of the affinity between the two disciplines.

Why do so many engineers opt for business management studies? There could be many relevant answers to this question. It is necessary to understand that engineering is a highly structured discipline that focuses on systematic problem-solving. Though this analytical capability is very highly valued in the business world, some engineers' decision to pursue business management courses stem from a desire or need to tackle larger and more abstract strategic problems instead of the structured ones like those of engineering. The business world, with its risks and uncertainties, does not provide opportunities for black and white answers, unlike in the world of engineering. It becomes imperative that managers understand and develop other more qualitative skills which engineers stereotypically lack.

Making the decision to get an advanced engineering degree or an MBA degree means taking a hard look at one self's personal orientation

as well as career goals. For a student strictly interested in scientific research it would be best to earn a master's degree in engineering and perhaps a PhD. Those who know they are not researchers but want to pursue a role of leadership in the organization may opt for an MBA. One road leads deeper into the field, the other to a less defined place. Most engineers pursued a business management degree after realizing that they have stepped further from the technical fields and more into the business side of things, which incorporates things like project management, forecasting, cost estimation, and proposal development.

Technology being inescapable component in most industries these days, engineers often becomes primary managers of change. Management skills become a must. The business leaders have the additional challenge of getting the leverage out of the successful deployment of technologies and professional management skills that support their business processes. Often, the best person who understands a broad class of technology which can generate strategic significance to an organization by its effective implantation is a person having a combination of both BE and MBA degree.

Regulatory requirements have also forced many engineers to undergo some kind of business management course. In Britain, for example, registration as a professional chartered engineer requires candidates to demonstrate leadership and management skills. Engineers operate in many different industries, in private and public institutions while many engineers have opted for entrepreneurial ventures. As part of the continuing professional and career development, pursuing a business management course will help them gain a theoretical and pragmatic view of business while honing and broadening their leadership and management skills.



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LEAN MANUFACTURING

- PERSPECTIVE OF MODERN INDUSTRIALIZATION

By Er. Sailesh Adhikari



“The primary idea behind lean manufacturing is to take full advantage of resource mobilization by decreasing waste, thereby realizing manufacturing superiority through the process improvising at same available resources but with changed worked practice and the economic quantity of the resources.”

Lean manufacturing is a modern culture of a manufacturing practice which includes continuous efforts to exclude a waste or any action that puts away resources without adding any value to the product. These wastes can be in the design of the product, any production process, and supply chain practice and after-sales services. The concept of lean manufacturing was first introduced and established by the Toyota executive Taiichi Ohno, after WWII restoration period in Japan. Later on, James P. Womack and Daniel T. Jones promote it in their 1996 book 'Lean Thinking' and now, it is the cultural practice of most of the big and middle-class industries throughout the world. The primary idea behind lean manufacturing is to take full advantage of resource mobilization by decreasing waste, thereby realizing manufacturing superiority through the process improvising at same available resources but with changed worked practice and the economic quantity of the resources. 5S is an established manufacturing practice, which is termed as the foundation of a lean-transformed organization. 5S encourages sequence of actions for reducing wastes that adds to nonconformities, faults, and accidents in manufacturing practice.

A simple definition of the 5S practices are described with their Japanese name below:

- *Seiri (Sort)*: Identity, separate the necessary, occasionally used, and unnecessary items.
- *Seiton (Set in Order)*: Arrange necessary and occasionally used items into clear designated storage positions.
- *Seiso (Shine)*: Thoroughly cleans the workplace and equipment. Cleaning is an inspection.
- *Seiketsu (Standardize)*: Visual aids, 5S manuals, 5S audits. Standardize 1-3S.
- *Shitsuke (Sustain)*: Practice 5S to the point where it is a natural part of your work.

To support the idea of lean manufacturing and control manufacturing process through a

lean transformation, James Womack, and Daniel Jones recognized a 5-step assumption in the manufacturing process completely in their book, Lean Thinking. These five steps characterize a continuous series of development and performance as the basis for the effective application of lean in the organization. The five steps describe in his book are;

- *Specify value*: Recognize the value of a particular product from the buyer's viewpoint. Value can only be well defined by the definitive customer though the producer manufactures it.
- *Identify the value stream*: Recognizing the total value stream for the individual product will explain three types of actions viz. the steps which create value, the steps that do not add any value but are mandatory with current methods and production machine and the steps those are nonvalue adding which can be excluded.
- *Create flow*: Formerly, when the value has been accurately quantified and the value stream for a particular product is completely recorded, we can redesign the production flow rearranging working elements in a continuous flow with nominal logjams so that no any further rework or stoppages is required in a lean transformation.
- *Establish pull*: After eliminating extravagant steps and continuous process flow has been established, it is necessary to determine the ability to deliver accordingly to customer demands. This will reduce inventory and cost associated with it. Letting consumers pull a product through the process is the manufacture's capability to be approachable with the consumer's needs.
- *Seek perfection*: As the company is successful to implement four values explained earlier, the next steps of process perfection are achievable and the company tends to perfect the methods and save economic by reducing waste of resources and time.

As we talked that lean manufacturing is the practice of reducing waste,

then we should be aware of the fact; what is the waste in given process, what are the different waste in given process and how we can define and determine the waste? Lean manufacturing explains seven deadly wastes of production which are the non value-adding events or processes and activities that impede productivity of the process and reduced revenue of a company. They are:

1. *Waiting*: Time spent waiting on something, or someone, to complete a task increase the cost. The process should be designed in such a way so that flow is continuous, and there are minimal buffers between different successive steps in the production process.
2. *Motion*: The redundant motion of the worker that does not add value to the product or service also increase cost. The process should ensure that work areas are sensibly structured to significantly reduce excessive worker motion.
3. *Over processing*: Over processing assign more energy or activity than it is needed to produce a product. Lean transformation suggests for best possible simplifications to the manufacturing process to significantly decrease processing time.
4. *Inventories and queues*: Additional or just-in-case inventory can consequence in an increase of cost and sometimes loss or a waste of the resources and capitals and may cause either storage of some part and excess of some. Lean transformation aims for just-in-time inventory that subsequently decreases idle time related with any inventory problems.
5. *Transportation*: Redundant movement of goods in processing creates higher chances of damages or delays with higher transit and also more resources and expenditure. Effective planning is necessary to ensure minimum waste in transportation.
6. *Overproduction*: Making more parts or information than it is required is other types of waste in an organization that requires extra

cost and effort. Lean transformation establishes a standard pacing material flow through the production process to match consumer demand.

7. Fixing defects and mistakes: Overall time and cost spent in refurbishing or reworking on the product are another waste. The cost of fixing defects or mistakes is a lot cheaper in terms of resource mobilization if it is addressed as soon as they are found.

After understanding the lean concept, it is most important to practice it as organizational culture. Before we implement lean in the floor, we should be clear about the fact that, it is teamwork and every individual has an important role in practicing lean effectively

In actual practice of lean in the floor, there are different arenas we should consider properly. On top of all, when your company is trying lean techniques at first you need to get lean knowledge into your company, either by hiring experts or by hiring outside experts as consultants. This approach is essential as education without application is so often a waste for all. The next thing is to rely on information based on data. Before making any decision, be sure to base on actual information from your own organization and to get a real view of your company the best source is data analysis of the past. Real-time data tracking is the best source to observe the position. In order to make a strategic Lean approach work in your organization, process operators have to work in process related teams, rather than their current functional ones because in lean implementation, teams need to become truly self-directed, allowing problems to pick the people required to solve them from within the teams rather than management picking the problems and assigning them to people to solve. Another basic practice of the lean manufacturing is the team leaders are responsible for creating awareness to the members and employee and they should ensure that all members of staff

are correctly coached. This avoids conflict and delivers a management group that can facilitate change with the teams working for them and so remove waste efficiently.

One of the key lean tools is that of “Value Stream Mapping”. This tool, when used correctly, enables the organization to create a map of both value and waste in a given process. This map can then be used to understand the waste and its causes before moving on to remove it so that value flows without interruption of waste. In next state, it is required to use Kaizen workshops to teach and make rapid changes. Be sure to employ talented and experienced facilitator who has a deep understanding of lean tools and philosophy but keep training focused on a specific problem. In value mapping, it is also necessary to organize around value streams to implement lean with perfect design. In most organizations, management is organized by process or function. In other words, managers own certain steps in a process but nobody is responsible for the entire value stream. In the second edition of the Lean Thinking, the authors recommend a matrix organization where there are still heads of departments but also value stream managers.

The way to get feedback for further steps it is necessary to develop two-way communication channels for everyone. This will aid in getting support through the involvement of people at various level by sharing their ideas to build synergy to move positively ahead in the lean journey. And, be sure of the fact that, if a company looks at Lean transformation as a “nice to do” in

spare time or as a voluntary activity, it will simply not happen. It needs to be mandatory and people need to be given the space to think about improvements they can make. A crisis may prompt a lean movement, but may not be enough to turn a company around. Once the crisis has passed it can be all too tempting to go back to business as usual.

For the successful implementation of the lean, it is necessary to show tolerant towards mistakes committed in a lean environment with a supportive and learning attitude by the team leaders. In addition, it requires patience with progress as this will be the key to getting results and try to create a blame-free supportive environment. As a team, you should have the courage to take risks at crucial stages to push things and resources to meet the plan and achieve results.

Lean is a continuous improvement practice and there is always a point to focus on for improvements. It's a long journey to any organization that requires passion and commitments. Every time when you finished with one level of improvements, the next level is your target. The concept of six-sigma is following after lean manufacturing. The aim of lean manufacturing is to build a culture of continuous improvement for sustainability and it goes on for the long run.

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ENERGY MANAGEMENT STRATEGIES

-Er. Roshan KC

“As a child I used to be scared of the dark, but now when I see my electricity bills I am scared of Lights.”

Energy has become the global topic of concern for all. With the energy demand trending to new heights, a greater need for operational efficiency, increasingly deregulated supply markets, and impending regulation of greenhouse gases has arisen. Suddenly energy management has been thrust to the forefront of long-term planning. Leading businesses are now looking at energy management as essential to their operations as accounting, supply management, or human resources.

Energy Management is simply defined as - “The strategy of adjusting and optimizing energy, using systems and procedures so as to reduce energy requirements per unit of output while holding constant or reducing total costs of producing the output from these systems”.

All too often, energy management occurs in the rear-view mirror. Only after bills arrive; do most businesses consider how energy use and spending might be better managed. Even then,

bills contain very little information & we think on how energy was used? – What equipment or processes drove consumption? What time of day saw the most use? Was consumption as expected, or are utilities running inefficiently? Here are some of the energy management checklists applicable for the industries.

SN	Area	Objective	Requirements	Expected Benefits
1	Electrical Parameter - Power Factor (PF)	To maintain constant PF of 0.99	APFC panel with sufficient capacitor rating at appropriate locations.	Avoid penalty Get rebate in electricity bill as per the rules of local electricity board.
				KVA maximum demand is minimum. Get benefit in electricity bill.
				Optimum utilization of transformer.
2	Electrical Parameter - Maximum Demand (MD)	To keep electrical maximum demand to minimum possible and sanction demand.	Sanction contract demand has to be in line with actual maximum demand.	Required for avoiding any penalty or higher demand charges in electricity bill.
			Maximum demand controllers that will switch off the non critical load in case MD approach the contract demand.	This is an engineering control to ensure that actual MD is within contract demand.
			Avoid simultaneous operation of high HP motors.	This will help to minimize the maximum demand.
3	Electrical Parameter - TOD Billing	To reduce the average electricity rate.	Planning of maximum possible operations during minimum tariff period.	Reduce the total electricity bill based on tariff structure of local electricity board.
4	Transformer	To reduce transformer, cable losses.	Use of energy efficient transformer.	Helps to reduce the transformer losses.
			Optimum loading of transformer.	Improves the efficiency of the transformer.
			Transformer should be near to the load centers.	Reduces the LT network and hence the cable losses.
5	Power Generator	To minimize the cost of generation.	Use of cost effective fuel. (HSD, NG)	Cheaper the fuel, lesser will be the cost of generation.

			Auto synchronization and auto load sharing facility. Optimum loading of generator.	Ensures maximum Units/lit of fuel.
			Audio, visual indication of electricity board power status.	Avoids idle running of generator.
		To increase the reliability of power availability.	Auto main failure start (AMF), Auto transfer switch facility.	Starts the Generator automatically during power failure and the load transfer is also auto. Power reliability increased.
6	Electric Motors	To minimize the power consumption and to optimize the efficiency of electric motors.		Full load efficiency of the energy efficient motors higher by 2 - 4% to standard motors.
			While replacing rewound motors or purchasing new motors go for energy efficient motor (EFF1).	Considering a 75 HP motor with average load of 70% and operating for 12 hr per day, 300 days per annum and electricity rate Rs 6.00 per unit(assume); per annum saving with EFF1 motor over standard motor would be Rs 13000 approximately. -Payback period is 2 year. (Efficiency difference assumed is 1.5 %)
			If the motor is constantly underloaded, connect it in star mode.	Improves the efficiency of the motor.
7	Air Compressors	To minimize power consumption and to optimize specific power consumption	Whenever speed variation is required use VFD.	At lower speed, power consumption is less.
			Delivery pressure setting should be minimum possible.	Reduction in delivery pressure by 1 bar would reduce the power consumption by 6-10%.
			Air leakages should be minimized.	Leakage through an orifice of size 1.6 mm will result into wastage of 0.8 KW power. It's equivalent to Rs 32000, assuming, operating hours - 8000, pressure - 7 bar and electricity rate - Rs 6 / KWh.
			Intake air temperature should be low.	Every 4°C rise in inlet air temperature results in a higher energy consumption by 1 % to achieve equivalent output.
			Location should be dust free and dry.	For every 250 mm WC pressure drop increase at the suction path due to choked filters etc, the compressor power consumption increases by about 2 % for the same output.
			Provide extra air receivers at points of high cyclic-air demand.	It permits operation without extra compressor capacity.
			A smaller dedicated compressor can be installed at load point, located far off from the central compressor house. Use two separate compressed air systems for widely different pressure requirements.	This avoids lengthy pipelines and hence losses. At high pressure air compressor consumes high energy.
			A periodic assessment of the FAD (Free Air Delivery) capacity of each compressor. If the deviations > 10 %, corrective measures should be taken.	Ensuring efficient air compressor.

8	Cooling Tower	Efficient system operation.	Follow manufacturer's recommended clearances around cooling towers	This ensures efficient operation of cooling tower.
			Consider energy efficient FRP blade adoption.	Saves fan motor energy.
			Clean the CT fills and nozzles regularly. Optimize blow down flow rate.	This ensures efficient operation of cooling tower.
9	HVAC	Minimization of power consumption and optimization of the efficiency.	Optimize the air-conditioning volumes by measures such as use of false ceiling.	Reduction in AC load.
			Set the room AC temperature optimally.	Lower temperature setting results in wastage of energy. Normally for human comfort setting is 24 deg C.
			Use evaporative cooling in dry areas.	It is less energy intensive as compared to AC.
			Go for water cooled chillers.	Better efficiency.as compared to air cooled chillers.,
			Use spare capacity of chiller for HVAC using fan coil unit.	Optimum, efficient and cost effective utilization of chiller.
			Optimum setting of chiller temperature.	A 1°C increase in evaporator temperature can help to save almost 3 % on power consumption.
			Minimize part load operations by matching loads and plant capacity on line; adopt variable speed drives for varying process load.	Efficient operation of chiller.
10	Lighting	Energy efficient lighting and to avoid wastage of energy	Proper insulation of cold lines.	Avoids wastage of energy.
			Use of energy efficient lighting - LED, CFL etc instead of incandescent lamps.	CFL saves 80% of electricity as compared to conventional incandescent lamp and has more life. Certain indicating lamps are 'ON' continuously. Using LED lamps ensures savings in electricity.
			Use high efficiency stabilizer for lighting feeder.	Saves lighting electricity consumption upto 10-15%. Improves life of light fittings.
			Provide timers for street lights, go downs and other similar areas.	Ensures proper utilization of lighting.
			Use day light by use of translucent sheets.	Saves lighting energy.
			Use electronic ballast in place of conventional ballast.	This saves up to 35% of energy.
			Use activity sensors to switch off the lights when not required.	Avoids wastage of light.
			Use solar system for lighting.	Saves electricity.

11	Pumps	Efficient operation of pumps.	Use correct line size, minimum sharp elbows, valves having full openings, low frictional pipes.	This reduces the system resistance and hence losses.
			Replace old inefficient pumps with new efficient pumps based on cost benefit analysis.	Avoids wastage of electricity.
			Downsizing the main pump and installing a booster pump for high level users.	Power requirement reduces.
			In case of over designed pumps, provide VFD or downsize/replace/trim impeller.	Avoids wastage of electricity.
			In pumping of liquid to multiple non-continuous users, control valves have to be installed at the users and install VFD for the pump.	Pump speed can be controlled as per load, ensuring optimum utilization of the electricity.
12	Fans and blowers	To avoid idle running.	Provide interlocks so that exhaust is operational only when intended operation is going on.	Avoids wastage of electricity.
			Provision for natural ventilation at operational area.	Avoids need for fans.
		Efficient Operation.	Provide VFD for dust collector / exhaust, in case of variable duty operation.	Fan / blower speed can be controlled as per load, ensuring optimum utilization of the electricity.
13	Process Equipment	To avoid unnecessary operation.	Provide timers to ensure unnecessary operation.	Avoids wastage of electricity.
14	Renewable energy	To reduce consumption of 'Electricity board' and DG set & promote to Renewable Energy	Use solar system for loads like lighting based on cost benefit analysis.	Alternate energy source.
			For heating application use solar energy based on cost benefit analysis.	Alternate energy source.

By adopting energy management strategies, businesses can regain control over their energy spending, turn costs into opportunities, reduce risk, and make smarter energy decisions. Smarter energy management has already helped thousands of commercial, institutional, and industrial customers put millions of investment back in their pockets through four key energy management strategies: reducing real-time demand for electricity, increasing energy efficiency, improving energy supply transparency, and mitigating greenhouse gas emissions. As the saying goes – “Saving is Generating” if we do so!

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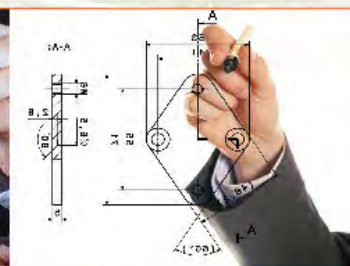
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3D PRINTING: THE FUTURE OF MANUFACTURING

– Bishnu Parajuli, Saroj Lamichhane

Manufacturing has been synonymous with factories, machine tools, production lines and economies of scale. So, it is startling to visualize manufacturing with no tooling, assembly lines or supply chains. However, this is exactly what is happening as 3D printing is reaching the world among individuals, small businesses and corporate departments, and ultimately is redesigning and revolutionizing the manufacturing industries.

3D printing was introduced to the world in 1980s but it has not been long since it started to make a huge leap in the field of manufacturing. Although Hideo Kodama of Nagoya Municipal Industrial Research Institute (NMIRI) is regarded to have printed the first object from a digital design, it is

its hidden potentials in all sectors of manufacturing from human tissue to spacecrafts. Conferences and seminars are becoming more common, and it has ignited broad industrial and consumer interest, with potential implications ranging from personal fabrication to disruption of traditional supply chains. The economic implications of 3-D printing are more significant: the McKinsey Global Institute Research

“3D printing can be done near the point of consumption, and implies a serious change to supply chains and business models through manufacturing innovations.”

(2013) suggests that it could have an impact of up to \$550 billion a year by 2025.

3D printing can be anything from plastic, liquid, carbon, ceramic, wood, and metals. This innovation in the manufacturing industry has power to transform the product design, development and manufacturing. It's a factory without a factory floor and it has created a podium for innovation, enabling manufacturing to flourish in uncommon areas and incubating a new generation of do-it-yourself (DIY) manufacturers.

How does it work?

3D Printing is like 2D printing but instead of ejecting ink on paper, 3D printers eject material and build up parts layer by layer. In order to print a 3D object, we need to have its model which can be either designed using CAD software or 3D scanner. 3D scanners use various technologies like volumetric scanning and modulated or structured light to generate a 3D model. After we feed the digital file to the 3D printer, 3D model is sliced by the 3D printer. The slicing enables the printer to print the parts of the model, layer by layer.

A new wave of innovation in the manufacturing industries:

3D printing overcomes the manufacturing limitations and design complexities and enables production of lighter and critical components of aerospace and automobile industries. The applications are emerging in medical and dental fields as its beneficiary along with gas and oil companies, and high tech companies.

3D printing has already been used to print toys, jewellery, candies, and various metallic parts. It has also opened new doors in the field of bio-printing as human ears, blood vessels, nose, prosthetic limbs, bones, and skin has already been 3D printed. The bio-engineers at the University



Charles Hull who is credited for the design of first 3D printer.

Status:

Things have improved in past couple of years as government and business houses across the world are becoming aware of its advantages. More researchers are delving to explore

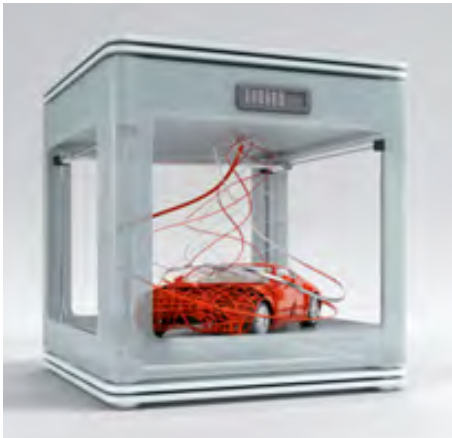
What is 3D Printing?

3D printing, long used for rapid prototyping is now used to create a 3D object using technique called additive manufacturing. The 3D object is created by layer-upon-layer printing approach until the entire physical product is designed from digital design. The material used for

of Louisville have already printed a coronary artery, small blood vessels of heart muscle and are hoping to soon print a functional heart.

3D printing can be done near the point of consumption, and implies a serious change to supply chains and business models through manufacturing innovations.

Manufacturing industries has long been adopting 3D printing to produce prototypes, but the developments in 3D printers has made a promising remark across industries and it is sure



to change the future of manufacturing industry. Gradual improvement in accuracy, size and quality has enabled 3D printing to be used to develop lighter parts for airplane, car bodies and topographical models. The 3D printing process generally takes several hours to complete depending on the size and complexity of the object to be printed. The relative advantages of 3D printing over conventional manufacturing are many, and more are yet to unfold. 3D printing not only enables manufacturing of complex shapes and geometry through unlimited possibilities in design but it also saves time and money through reduction in wastes, and cost through shorter design, process and production cycles. And, as the production is close to the demand, the supply chain is then simplified with much less inventory.

The economies of aftermarket services and the structure of the industries will endure a complete change when the 3D printers can manufacture the parts for replacements according to the demand. Large regional warehouses could be replaced when the on-site

additive manufacturing capabilities will be developed with relatively small facilities. In this way, the traditional supply chain management challenge can be solved, with increase in customization offerings to changing customers meeting their preferences and needs creating intelligent impacts at various levels of manufacturing.

The main challenge of 3D printing industry is to expand the technology to print more functional and finished products in high volumes. There are also censorship issues as people have also made guns that actually work. Also, the material choices are limited and it takes long duration of time to completely print a three dimensional object at present. It is essential that manufacturing industries realize their possibilities when the recent obstacles in 3D printing are overcome.

3D printing has been developing incredibly and generating excitement in past few years. Recently, researchers from MIT have developed a 3D printer which can print 10 materials simultaneously and they are aiming to print fully functional objects like circuit boards as soon as possible. Stratasys, a leading company in 3D Printing Solutions, introduced multi-material 3D printer for the first time in

2014, but the breakthrough achieved by the MIT researchers is sure to spark enthusiasm in many manufacturing industries and the admirers of the profound technology.

3D Printing is potentially predicted to have a greater impact on the world over the next 20 years than all of the innovations from the industrial revolution combined. The prospect of this additive manufacturing opens infinite opportunities and has the potential to change the course of human life. This technology is poised to enhance not only innovation in manufacturing industries but also deliver cost benefits. It might just be the technology that defines 21st century's breakthrough, which could bring forth massive changes in manufacturing and engineering processes.

It's quite straight forward and is ushering a new era!

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INVESTIGATIONS ON OLD BRICK MASONRY BUILDINGS OF KATHMANDU

– Dr. Hari Ram Parajuli

Masonry temples and palaces which were constructed three hundred years ago are the main identities of Kathmandu, Capital city of Nepal, a Himalayan county. Masonry is the oldest construction material and has been used in various forms of constructions of residential and public buildings for the past several thousand years. Since they were constructed



before emerging any kinds of earthquake resistant design regulations, they are, perhaps, strong on taking vertical loads but very weak on taking lateral loads and have become the

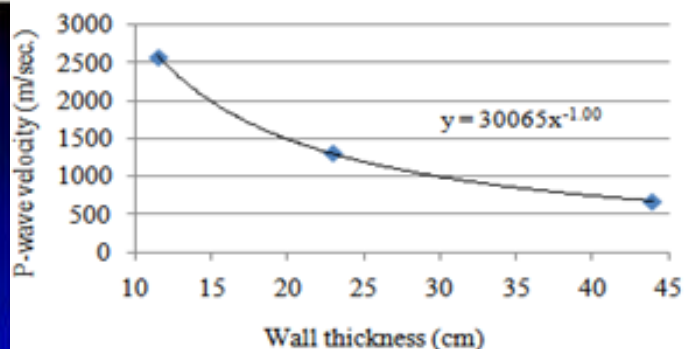
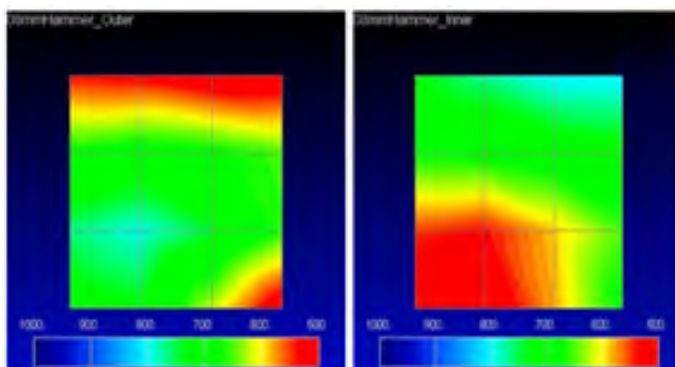
prime cause of deaths and destructions in earthquakes. Kathmandu has history of strong earthquakes occurred. A great earthquake occurred in 1934 which killed ten thousand people and damaged most of the residential houses, temples and royal palaces. Seismologists are predicting that there is huge seismic gap in the Himalaya which could produce great earthquake soon. Thus, evaluation of seismic hazard for the region, analysis of structures given the estimated hazard,

prediction of vulnerability and ultimately estimation of risk are the main tasks for seismic hazard mitigation strategy. Thus, as a part of seismic vulnerability assessment and disaster mitigation research project under GCOE (Global Centre of Excellence) project of Ritsumeikan University, a historical brick masonry house (Photo above) located in Lalitpur sub-metropolitan City of Kathmandu is taken as sample. The house is two - story, 16.5 m in length and 5.6 m in width. Wall is made of traditional brick with thickness 60 cm at bottom and 50 cm at top tapering slightly from bottom to top. It was constructed three hundred years ago. It sustained damages in earthquakes and was repaired many times. Recently, its original roof has been replaced by corrugated galvanized iron sheet and interior has been plastered by cement sand mortar. Now, it looks completely repaired hiding its original construction. In order to analyze the house material properties, its material property is investigated from elastic wave measurement. For the dynamic properties investigation, the building and the surrounding area was selected. At first, two non destructive tests were carried out on building and in the site to identify the material properties. Then using obtained material properties, the response of the building was evaluated in various ground motions.

Elastic wave measurement test

Determination of mechanical properties of existing masonry walls is fundamental pre-requisite for its characterization of seismic response which helps to identify the adequate strengthening measures. So, elastic wave

results show that as the wall thickness increases, its P wave velocity decreases. The joints and voids inside the wall sharply decrease its strength, as a result P wave velocity is found decreasing.



velocities were evaluated in the selected model building. Two sets of equipment - 16 channel and 2 channel sensor were used to measure the P- waves transmitted in the walls. The elastic wave tomogram obtained from 16 channel sensors are shown in Fig. 1. Using two channel portable - pocket AE equipment, velocities of various walls were measured (the obtained results are plotted in the Fig.2). The experiment

Structural analysis

The building was then modeled by finite element method considering the brick elements as linear elastic and the interfaces between them are zero thickness joint elements. Input parameters such as modulus of elasticity was taken from the elastic wave measurement results and spring constants for joints were calculated from the

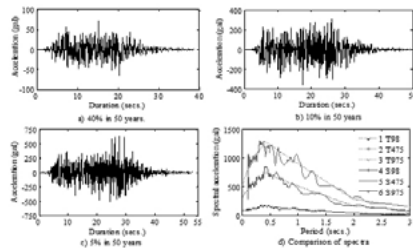


Fig. 3 Input ground motions for Kathmandu

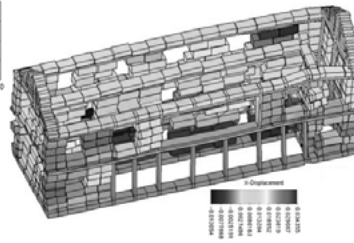


Fig. 4 Deformed model building

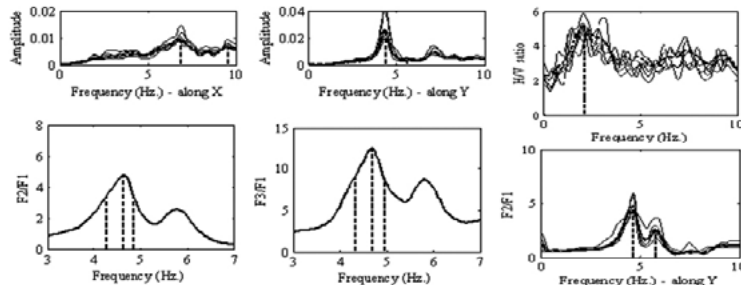


Fig. 5 Fourier spectrum from micro tremor measurements

differences between the elasticity of single brick and wall. Then the building was analyzed inputting El Centro and various simulated earthquakes. Non linear analyses of the building were run satisfying the famous Mohr - Coulomb failure criterion. It was found very weak even in low peak ground acceleration such as 0.3g. As a strengthening solution, a wooden frame was added from inside and reanalyzed in the same earthquakes. The analysis results show wooden frame can add significant strength to the wall to reduce the deformations. The deformed model after adding wood frame in El Centro earthquake is shown in Fig. 4 and. The strengthening solution modifying the

connections of existing elements and adding wooden frame inside the house can reduce the deformations significantly.

Micro tremor measurement

The second experiment was ambient vibration measurement of the building and ground. Ambient vibrations of the historical model building at various locations and at three other sites in nearby areas were measured by three seismometers. Predominant frequency of ground was estimated from H/V spectrum. Various natural frequencies of the building were estimated from Fourier spectrum, and damping of the masonry was estimated from random decrement and transfer function between ground floor, and first and second floors. Fourier spectrums of various cases are shown in Fig 5. Predominant frequency of the ground is found 2.1Hz, fundamental frequencies of the building are 4.3Hz, 4.7Hz 6.8Hz 7.7Hz along transverse and longitudinal directions respectively. The damping of the building is 6.4%.

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FIRE SAFETY INSIDE INDUSTRIAL PREMISES

- Shuveksha Sapkota

Are you a fire fighting Industrial Engineer?

Through centuries of centuries, human civilization had been using fire for different purposes which evinces how important is this thing in our life processes. Without the heat generated from fire, possibly we could not have traversed this long voyage of human civilization. But is it always that fire had been salutary to us? There is a saying "A match stick has a bigger head but no brain". There are certain junctures in our history where fire has been major cause for gigantic destruction. The conflagration that took place in 3 sep. 1966 A.D. in Pudding lane of London destroyed 13200 houses and 87 churches where more than 800,000 inhabitants lose their homes that marked the end of epoch. The death toll was obscured but the aftermaths were overwhelming. The inability to control the fire has ushered to that condition.

Fire in any place, be it in house or in an industrial premises, is sure to make colossal physical and human life damage if not taken under control in short duration. Particularly in industry, where you

"A better safety criterion and prepared plan can greatly assist industries to avoid unexpected losses due to fire that caters ready escape from fire area during a fire and inhibit spreading fire."

have different kinds of flammable objects, controlling a fire is a difficult task. Fire is truly an all-encompassing threat so prevention and protection is mandatory so that it does not turn into a catastrophic event, devastating business and the lives of workers. It is a total insanity of an individual to think that the fire can be controlled with water only. As a technical person of an industry, you should have adequate knowledge regarding control mechanism of fire which is preeminent to ameliorate a safer working environment. Water is not an effective agent for all kinds of fire classes. A fire not overseen in proper time will lead to conflagration with insufferable human and property losses. Therefore knowing the traits of fire and its control mechanisms are of immense importance as an engineer inside industrial premises, which is a fire risk zone. Fire can be sundered into different classes. In general, fire classes according to fuels and their control mechanism are catalogued as-

1. Class A - The fire involving combustibles and organic solids like wood, paper, rubber, fabric etc. This kind of fire can be

controlled by water only

2. Class B - The fire involving flammable liquids such as gasoline, petroleum oil, grease and paint. This kind of fire can be controlled by Carbon dioxide and Mono Ammonium phosphate.
3. Class C - The fire involving flammable gases like propane and butane. This kind of fire can be controlled by Carbon dioxide and Mono Ammonium phosphate.
4. Class D - The fire involving combustible metals like potassium, sodium, aluminum and magnesium. This kind of fire can be controlled by Sodium carbonate, salt, graphite, bicarbonate and sodium chloride based chemicals.
5. Class E - The fire involving electrical equipment such as motors, transformer and appliances. This kind of fire can be controlled by Carbon dioxide and Mono Ammonium phosphate but not with water, foam and chemicals which are conductive in nature.
6. Class F - The fire involving cooking oils and greases such as animal fats and vegetable oils. This kind of fire can be controlled by Potassium acetate.

There are different kinds of fire extinguishers which will contain these variant chemicals for extinguishing the fire and recent years have seen a substantial re appraisal in the use of extinguishers. You need to spot what kind of possible fire could take a place inside your industrial premises and purchase the required one for the fortuitous hazardous predicaments. After fire takes place,

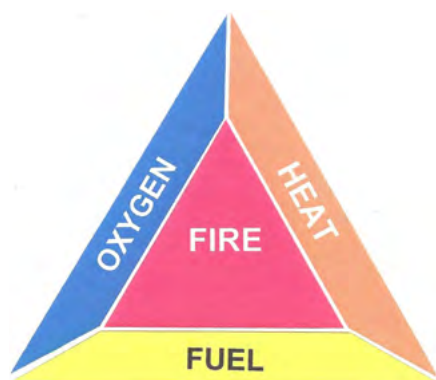


Fig. Fire Triangle

Before you control the fire, you should be acquainted with the mechanism of fire. A fire is initiated when there is presence of fuel, oxygen and required amount of heat. Initiation of fire is not conceivable if any of the three components is debarred. It is better apprehended by fire triangle as shown in the diagram.

the time lapses between the advent of fire brigade and initiation of fire you must have appropriate tools to control the fire before it becomes too furious. It is said that prevention is better than cure. Therefore it is surpassing to keep one of the following fire extinguishers to avoid the possible damages-

fire control and hazard analysis plan should be made to avoid losses from conflagration in any industry. Here are some prevalent steps:

- Information system: Regarding fire and types of extinguishers and safety measures.
- Emergency Exit: It should be constructed at different places.
- Conventional alarm system:

S.N.	Fire Extinguisher type	Works by	Effective for Class
1	Pressurized Water	Cooling	A
2	Carbon dioxide	Smothering	B and E
3	Multipurpose dry chemical	Smothering	A,B,C and E
4	Halon	Smothering	A,B and C
5	Combustible Metal	Smothering	D
6	Wet Chemical	Cooling/Smothering	A and F

Cooling is the process by which you will decrease the heat from the burning fire where as smothering, also known as blanketing, is the process by which you will cover the fire with another material to deprive of the oxygen necessary for combustion. Therefore, if you stop the completion of fire triangle you will be able to stop the fire. In general,

Epitome for fire safety either bells or computerized remote alarms and sensors

d) Assembly Point: The place outside the industry so that everyone comes at the place for safety.

e) Fire extinguisher, sprinkles: Workers should be given guidelines to use this.

f) First aid and facility: First aid

provision and facility should be at proper place.

g) Ambulance/ Vehicle: Ambulance or Vehicle should be made accessible in case of emergency.

h) Fire doors: Should be designed for emergencies compartmentalizing fires.

Fire is not a common phenomenon that is to be taken with ease and calmness. So, a better safety criterion and prepared plan can greatly assist industries to avoid unexpected losses due to fire that caters ready escape from fire area during a fire and inhibit spreading fire. So never take shortcuts with your safety, not even for a second! "Protecting production, saving lives; Life is rare, live with care".

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Do you know the OSHA labeling requirements for your workplace?



BIOHAZARD



WARNING
Confined Space
Enter by permit only



CAUTION
Forklift Area
Keep Aisle Clear



EYE WASH
Emergency Eye Wash Fountain
Keep area clear.



Restrooms



Fire Extinguisher
Extintor de Incendios



NOTICE
Hard Hats Required in this area!
Safety Code #173

⚠ DANGER	Immediate hazard which will result in death or serious injury. White letters on a red background.
⚠ WARNING	Could result in death or serious injury. Black letters on an orange background.
⚠ CAUTION	May result in minor or moderate injury. Black letters on a yellow background.
NOTICE	Relevant general information. White letters on a blue background.
GENERAL SAFETY	Suggested general safety measures. White letters on a green background.



GALAICHA WEAVERS AND ERGONOMICS

– *Dison Maharjan*

Galaicha, a handmade Tibetan rug woven in Nepal has created a distinct mark in international market. With its unique design, finest knots, colorful outlook and supreme quality it holds

five active carpet weaving workshops in the Tabriz, Iran were selected for the purpose of this study. A random group of 200 weavers were selected from these workshops to participate in

weavers was 26.75 years. On the basis of the data collected through 50% of the weavers complained about pain in their lower back in last 12 months time. Similarly, 43.8% complained that they had felt pain in wrist and upper back but they had taken only a day or two of works leave during last 12 months due to these symptoms.

We weren't satisfied by the result of the study because we had expected to have complains of over 70% in areas like lower and upper back. Some of the reasons could be:

- Enrollment of small number of weavers in the study.
- The industry we choose provide good facilities for the weavers and the working environment was good. The lighting system of good for the weavers as transparent roof plates lightened the space during daytime and sufficient artificial lighting system was installed for the dark. The table below also shows the level of satisfaction of weavers with the environmental condition of workplace.
- The weavers weren't interested in answering. And psychologically doomed by recent police enquires on child labour because many of

Body region	Symptoms In last 12 months (%)	Total leave grants for the workers due to symptoms in last 12 months (days)
Neck	18.8	46
Shoulder	43.8	388
Elbow	31.3	92
Wrist / Hands	43.8	69
Upper Back	43.8	320
Lower Back	50	365
Thigh	25	46
Knees	31.3	92
Ankles / Feet	25	46

an identity of Nepal in international business arena. The carpet weavers have huge role in achieving this fleet. Sadly, poor working environment, ignorant about the effects of improper posture during work, long working shifts are very good reasons for weavers to be affected by MSDs (Musculoskeletal Disorders) in near future. The situation then, is an irreplaceable loss of valuable assets of the nation. The weavers are left alone in their hardship.

MSDs (Musculoskeletal Disorders) are injuries and disorders that affect the human body's movement or musculoskeletal system (i.e. muscles, tendons, ligaments, nerves). And manual workers or labors are in risk to be affected by MSDs. According to an article by Jalil Nazari, Nader Mahmoudi, Iman Dianat, Richard Graveling on Working Conditions in Carpet Weaving Workshops and Musculoskeletal Complaints among Workers in Tabriz – Iran, the most commonly complained body parts were the neck (78.7%), lower back (68.1%), ankles/feet (63.8%), hands/wrists (55.3%), upper back (53.2%), shoulders (48.9%) and knees (48.9%). The study was conducted during a six-month period from July 2010. Twenty

this study. These data mentioned above justify the fact that carpet weavers are

“The owners of the carpet industries should be encouraged to provide proper working environment for the weavers citing the benefits of better ergonomics as it is an integral part of maximizing the investment in employees.”

really in risk to be affected by MSDs. By referring the methodology of the article, similar study was carried out at Corner Galaicha Udyog, Jorpati by

Environmental condition of workstation	Carpet weavers (%)				
	Very satisfied	Somewhat satisfied	Neutral	Somewhat dissatisfied	Very dissatisfied
Lighting	31.5	25	12.5	18.5	12.5
Cleanliness	50	12	25	6.5	6.5
Thermal and Air conditions	18.5	6.3	25.5	18.4	31.3

my team of four members where we observed following facts. In our study, only 16 weavers were included working in the factory among which 10 were women and 6 were men. The mean work experience of the weavers was 10 years and average age of the

the weavers asked us if we were from NGOs.

This was just a small cameo of whole picture. If all carpet weaving were to be included in survey, it is pretty sure the condition of our weavers is worse than the condition of the weavers of

Iran. When we visited the industry, the weavers were in utmost surprise to know about the proper working posture and its long term advantages. So, concern authorities should, now onward, begin their works on raising awareness on importance of proper working posture for the carpet weavers and even train and encourage them to follow exercise and routine of breaks during work. Along with, making them realize the advantages of doing so. The owners of the carpet industries should be encouraged to provide proper

working environment for the weavers citing the benefits of better ergonomics as it is an integral part of maximizing the investment in employees.

The woven carpet is best suited raw. Raw and fresh hand work, away from buzzing machining and that's what it makes it class apart. The art and experienced handwork is no less than precious stones. So, proper implementation of ergonomics in work stations and by the weavers themselves can ripe a good outcome in global rug market. It will not only help shine our

country and help in economic growth, it would provide weavers strength to work for additional 7-8 years as compared to now. That means the art of weaving is preserved for some more years to come.

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My Greetings and Best Wishes
to SOIES Nepal and
Team Industrial Vision for the
successful publication of
Third Edition of annual magazine
INDUSTRIAL VISION

asian
engineering
college



Executive Director
Binod Kumar Shrestha
Asian Engineering College
Sankhamul, Kathmandu
Phone No. 01-4783350, 01-4783981



LAYOUT STRATEGIES

– Riti Newa

An interesting article featured in the NY Times Daily a few years back. The article titled “McDonald’s Looks for Competitive Advantage with its New High Tech Kitchen Layout” talked about how McDonald’s, the leading fast food chain in the world, had plans for a high tech kitchen layout to facilitate mass customization process. The new layout ensured an approximate cost saving of \$100 million per year on food and an improved customer service. It is quite fascinating how a large fast food enterprise as that of McDonald’s directly links the Layout to an advantage. Most of the times an industry be it service or manufacturing, tends to overlook the fact that their layout plays a major role in the overall productivity and efficiency.

Layout in the simplest of terms can be defined as a plan or design of something that is laid out. More

competitive strategic advantages of any kind of industry.

Talking about one of the leading brands in smartphones, Apple’s iPhone recently ended the year 2015 as the top selling brand in U.S. and China. But the Apple hit the headlines sometime back for a much more intriguing issue. In 2014 Apple Inc.’s right to trademark its retail store layouts throughout the European Union got approved a

“The layout strategies of an industry establish its competitive priorities in terms of capacity, processes, flexibility, cost and quality of work life, customer contact and image.”

few years after it got its store layout trademarked in U.S. Why would Apple which has massive brand recognition go through such trouble to patent a store layout? But firstly let’s take a look at an interesting fact that though as a

whenever a new iPhone model is out people make beelines out the Apple store days before they open. Very rarely does a customer return empty handed from an Apple Store. So does the Apple’s decision to trademark its store layout have something to do with the customers’ loyalty? It is quite obvious that the retail store layout of Apple ensures a better customer service causing customers to spend more. So Apple’s decision to patent its layout does make sense.

Be it service industry or manufacturing, it is quite clear that layout decisions are crucial. The strategic layout decisions in a manufacturing industry are important for its optimum productivity. An example for employing strategic solutions to the current layout is given below based on a group project we conducted in a metal fabrication industry with the current and proposed layout.

Prevention of backtracking: In the proposed layout the backtracking of the material is reduced. The tool collection machine position has been changed to make it easily accessible to the die cutting machine to reducing the idle time because of the backflow from the die cutting to welding units. The backflow in the final finishing steps is prevented by the placing the oven and the temporary storage relatively nearer removing the initial placement causing backflow.

Manning issues: The majority of work force is involved in the finish process so the space requirement for the finish process is managed so as it is least disturbed by other processes and is relatively near to the final powder coating unit to eliminate any unnecessary transport.

Space Requirements: The space requirement for the optimum use of flywheel press is met by provision of separate corner for the machines to operate efficiently. A separate space is allocated for the storage of raw

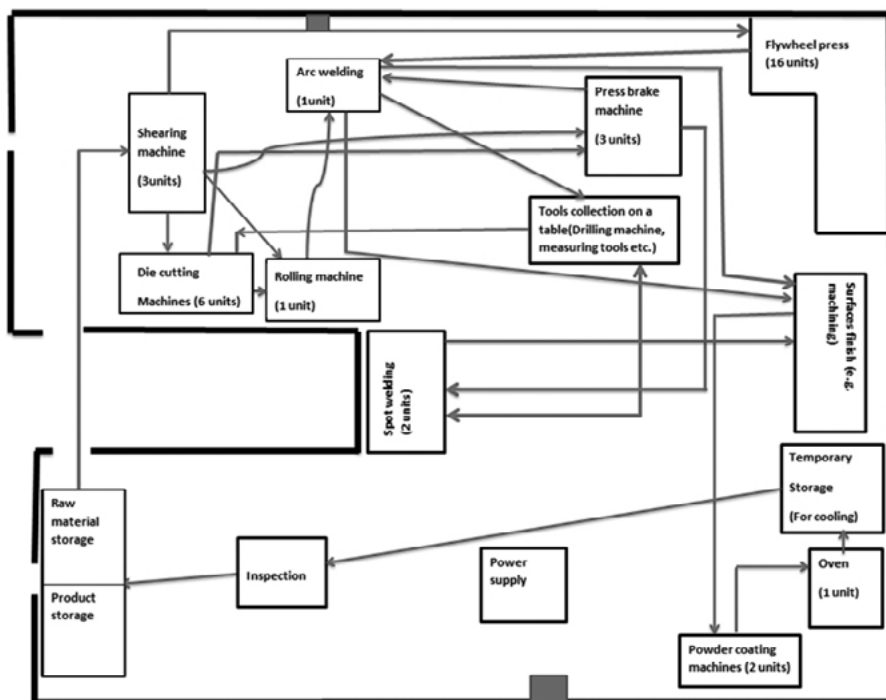


Figure 1 Current Layout

specifically a plant layout is the arrangement of desired machinery and equipment of a plant, established or contemplated. Layout design and the strategies prove to be one of the key

vendor, Apple was at the top of the leader boards in the U.S. and China, the IOS struggled to return to the market share it saw in 2014. It is quite plausible for iPhone to be topmost selling as

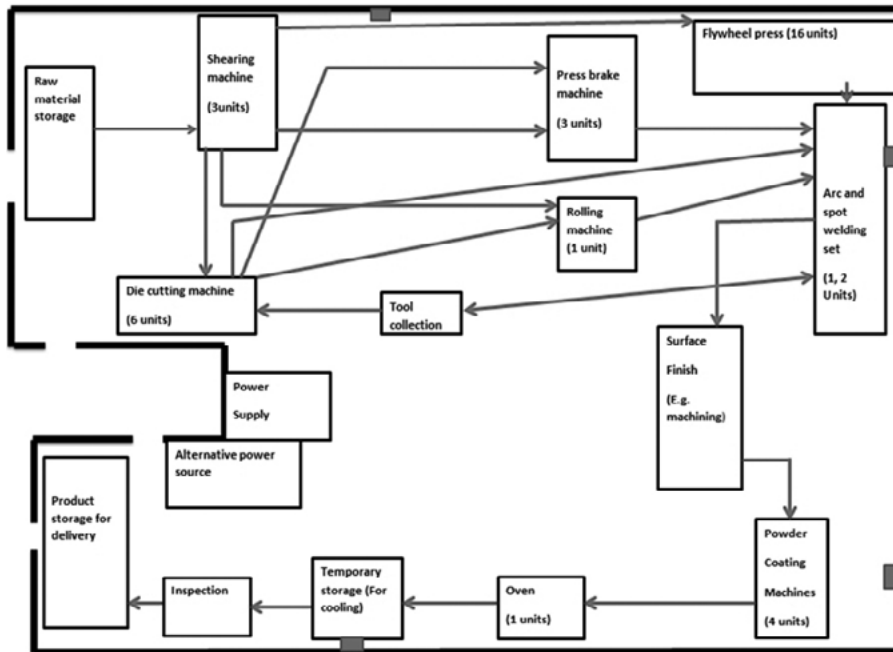


Figure 2 Proposed Layout

material in the initially unused area that to prevent the unwanted transport of raw material from warehouse to the operating units.

Safety and Health issues: The welding units are provided with proper ventilation that helps to provide proper lighting as well as aeration. The oven is placed relatively farther from the powder coating unit so that

the labor employed in the process are not subjected to the heat radiated. The tool collection table is placed in an appropriate position so as it doesn't come in the way of flow of material and hence prevents the subsequent danger from piercing and measurement tools.

Machine Failure issues: The alternative power supply unit is also

introduced in the layout for the backup power supply at cases of power cut off to prevent the machines for being idle. The ventilation is placed near the welding units, the powder coating units and the cutting units for proper aeration for proper running of the machines.

Larger workspace: In the proposed layout the workspace area is increased for the proper placement and easy maintenance of the machinery, so that the machine can be operated more efficiently.

The layout is generally an overlooked aspect in most industries but the benefit of a strategic layout is easily manifested by the subsequent success of famous enterprises as McDonalds, Apple, Wal-Mart etc. after their employment of strong layout strategies. Hence the layout strategies of an industry establish its competitive priorities in terms of capacity, processes, flexibility, cost and quality of work life, customer contact and image.

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SANJEN JALAVIDHYUT COMPANY LIMITED
सानजेन जलविद्युत कम्पनी लिमिटेड




Sanjen(Upper) Hydroelectric Project

Installed Capacity :	14.8 MW
Annual Energy :	85.87 GWh
Design Flow :	11.07 m ³ /s
Head :	Gross: 161.30 m
Peaking Pond Capacity:	70 min
Headrace Tunnel :	1.38 km (3.5*3.75)m ²
Surge Tank :	40.0 m (h), 6.0 m (dia).
Penstock Pipe :	478 m(l), 1.1 ~ 2.5 m (dia)
Turbine :	Horizontal Francis 3 nos
Powerhouse :	Surface Type
Transmission Line :	132 kV 6km

Sanjen Hydroelectric Project

Installed Capacity :	42.5 MW
Annual Energy :	251.94 GWh
Design Flow :	11.57 m ³ /s
Head :	Gross: 442.00 m
Headrace Tunnel :	3.63Km (3.5*3.75)m ²
Surge Tank :	50.0 m (h), 5.5 m (dia).
Penstock Pipe :	1100 m(l) 1.1 ~ 2.5 m (dia)
Turbine :	Pelton, Vertical Axis 3 nos
Powerhouse :	Surface Type
Transmission Line :	132 kV 2 km

Sanjen (Upper) Hydroelectric Project (14.8 MW)
Sanjen Hydroelectric Project (42.5 MW)



ISO 9001:2015 QUALITY MANAGEMENT SYSTEM CONCEPTS AND PRINCIPLES

-Er. Khagendra Bahadur Basnet

Introduction:

International Standardization Organization (ISO) is an independent, non governmental international organization with a membership of 162 national standard bodies which formulate standards used in world-wide market place.

ISO develops standards by experts coming from the industrial, technical and business sectors with relevant knowledge. ISO formulate standards and related documents, and address economic, environmental and social dimensions.

What are standards?

A standard is a document that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and service are fit for their purpose. They give world class specifications for products, service and systems, to ensure quality, safety and efficiency.

What is Quality Management System (QMS)?

The quality management is coordinated activities to direct and control an organization with regards to quality. The set of interrelated or interacting elements of an organization to establish policies and objectives and processes to achieve those objectives with regards to quality is quality management system.

There are several standards in the ISO 9000 family that provide a vehicle for consolidating and communicating concepts in the field of quality management. The ISO 9001:2015 Quality Management Systems - Requirements is among them.

This standard has been revised fifth time in 2015. ISO 9001:2015 QMS requirements cancels and replaces the

4th edition (ISO 9001:2008), which has been technically revised, through the adaptation of revised clauses, sequences and adaptation of revised quality management principles and of new concepts. ISO 9001:2015 intended that implementation of this standard enable organizational capability to developed quality planning with adequate support and operation for quality improvement through periodic performance evaluation. These all are strongly backed up with leadership in every level of organization to ensure customer satisfaction from organizational products and services. The compliance of ISO 9001:2015 QMS requirements is the basis for organizational QMS certification where as other ISO 9000 family standards are supporting guidance documents for organizational quest for quality improvement.

The primary purpose of ISO 9001 certification is to give confidence to customers that products and services meet the needs and expectations of customers and other stakeholders and improve the capability of organizations to do this.

ISO 9001:2015 QMS is based on the seven quality management principles and three fundamental concepts such as:

1. Process approach,
2. PDCA (Plan – Do – Check – Act) cycle
3. Risk based thinking.

Seven Quality Management Principles are:

1. Customer focus

The primary focus of organizational quality management is to meet its customer requirements and to strive to exceed customer expectations. For sustainable business organization has to attract and retains the confidence

of customers and other interested parties. The increased customer value, satisfaction, loyalty brings repeat business and hence enhanced reputation of the organization that means more customer base which increased revenue and market share.

2. Leadership

There should be development of leaders at all levels of organization who establish unity of purpose, direction and create conditions in which people are engaged in achieving the organization's quality objectives. Creation of unity of purpose, and the direction and engagement of people enable an organization to align its strategies, policies, processes and resources to achieve its objectives.

3. Engagement of people

Competent, empowered and engaged people at all levels throughout the organization are essential to enhance the organization's capability to create and deliver value. In order to manage an organization effectively and efficiently, it is important to respect and involve all people at all levels. Recognition, empowerment and enhancement of competence facilitate the engagement of people in achieving the organization's quality objectives.

4. Process approach

Consistent and predictable results are achieved more effectively and efficiently when activities are understood and managed as interrelated processes that function as a coherent system. The QMS consists of interrelated processes. Understanding how results are produced by this system enables an organization to optimize the system and its performance.

5. Improvement

Successful organizations have an ongoing focus on improvement.

Improvement is essential for an organization to maintain current levels of performance, to react to changes in its internal and external conditions and to create new opportunities.

6. Evidence-based decision making

Decisions based on the analysis and evaluation of data and information are more likely to produce desired results.

7. Relationship management

For sustained success, organizations manage their relationships with interested parties, such as providers. Sustained success is more likely to be achieved when the organization manages relationships with all of its interested parties to optimize their impact on its performance. Relationship management with its provider and partner networks is of particular importance.

Developing the QMS using fundamental concepts and principles:

Any organization's characteristics resemble to humans as living and learning social organism. Both are adaptive and comprise interacting systems, processes and activities. The context for organization in which it operates is dynamic and it should adapt to their varying context by developing the ability to cope with changes.

In order to implement the QMS organization should recognize all the systems, processes and activities involved. It needs to be flexible and adaptable within the complexities of the organizational context.

QMS is a dynamic system that evolves over time through periods of improvement. ISO 9001:2015 QMS requirements provides guidance on how to develop and manage those activities that are either already in existence or new in the organization and their suitability regarding the context in which organization operate.

1. Process approach:

Organization adopting QMS should understand and manage its interrelated processes as a system contributes to the organization's effectiveness and efficiency in achieving its intended results. There should be organization

to control the interrelationships and interdependencies among the processes of the system, so that the overall performance of the organization can be enhanced.

The process approach involves the systematic definition and management of processes, and their interactions, so as to achieve the intended results in accordance with the quality policy and strategic direction of the organization.

Management of the processes and the system as a whole can be achieved using the PDCA cycle with an overall focus on risk-based thinking aimed at taking advantage of opportunities and preventing undesirable results. Figure below shows how processes are developed for QMS.



2. PDCA (Plan-Do-Check-Act) cycle:

The PDCA cycle can be applied to all processes and to the quality management system as a whole. Figure below illustrates how ISO 9001:2015 QMS requirements' clauses can be grouped in relation to the PDCA cycle. There are requirements regarding the planning the organizational quality issues by understanding the internal and external context.

The PDCA cycle can be briefly described as follows:

- a) **Plan:** establish the objectives of the system and its processes, and the resources needed to deliver results in accordance with customers' requirements and the organization's policies; and identify and address risks and opportunities.
- b) **Do:** implement what was planned;
- c) **Check:** monitor and (where applicable) measure processes and the resulting products and services against policies, objectives and

requirements and report the results;

- d) **Act:** take actions to improve performance, as necessary.

3. Risk-based thinking:

This is new concept for QMS requirement incorporates in this fifth revision. Risk-based thinking is essential for achieving an effective quality management system. To conform to the requirements of ISO 9001:2015, an organization needs to plan and implement actions to address risks and opportunities. Addressing both risks and opportunities establishes a basis for increasing the effectiveness of the quality management system, achieving improved results and preventing negative effects.

Conclusion:

ISO 9001 based QMS is implemented and certified by more than millions organizations in 187 countries. ISO 9001:2015 QMS adaptation is strategic decision for an organization since it incorporates the risk based thinking to address the opportunity and associated risk arise due to context of business environment along with process approach focus on managing the activities most efficient and effective ways and PDCA cycle for improvement.

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“धन कमाउन व्यापार गरौं,
धर्म कमाउन दान गरौं।”

“ईज्जत पाउन समाजसेवा गरौं,
ती सबै पाउन उद्योग गरौं॥”



उद्योग मन्त्रालय
उद्योग विभाग
त्रिपुरेश्वर, काठमाडौं



PUBLIC PRIVATE PARTNERSHIP IN CONTEXT OF NEPAL

- CA Pradeep Sigdel

The World Bank defines a PPP as “A long-term contractual arrangement between a public entity or authority and a private entity for providing a public asset or service in which the private party bears significant risk and management responsibility.”

Public-Private Partnerships (PPPs) is an innovative option used for delivering a public service. It is a contractual agreement between a public entity and a private entity, whereby the private entity performs part of a government organization's service delivery functions, and assumes the associated risks for a specified period of time. In return, the private entity receives a benefit/ financial remuneration according to

for the better allocation of risk between public and private entities, taking into account their capacity to manage those risks.

There is no doubt that PPPs is one of the alternatives for providing improved and innovative public services. Citing these advantages,

“A long-term contractual arrangement between a public entity or authority and a private entity for providing a public asset or service in which the private party bears significant risk and management responsibility.”

after 1990s the Nepalese government introduced the new initiatives of liberalization and privatization

private sector involvement in the Infrastructure Development.

Why need of the policy?

- Sustainable Economic Development,
- Infrastructure Development and Utilization of private sector knowledge,
- Expertise and technology for the overall Economic Development
- To make total expenditure of (10 Trillions) 6-7 % of GDP in infrastructure (current 3-4 % of GDP).

Priority Sector for PPP model

PPP Policy has set the following priority sectors for the PPP projects:

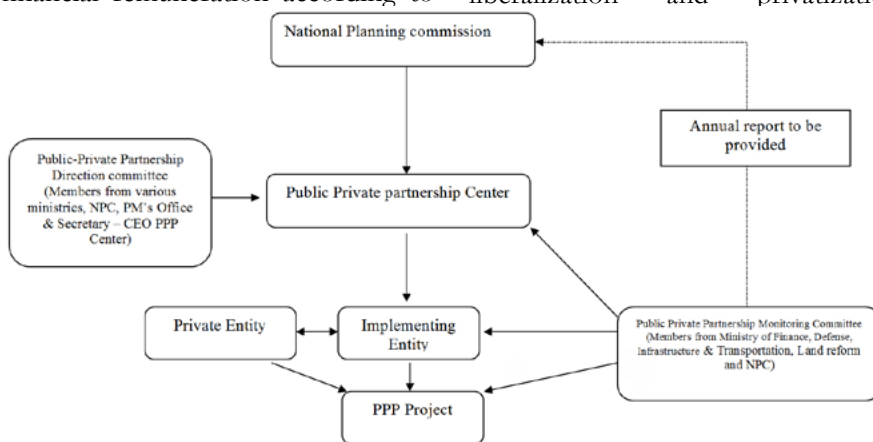
- Infrastructure and transportation (Bridge, Road, Airport, Railway, Cable car, Ropeway and all dry port.
- Energy Sector (Generation, Transmission and Distribution of Energy) including other forms of energy
- Telecommunication
- Urban and rural environment sector (Waste Management, Drinking water, drainage and sanitation program)
- Education, Health related infrastructure & services, Tourism Infrastructure (other than hotel & residence)
- Service/Facility based urban infrastructure.

Special Provisions

Special provisions have been provided for promoting the Public Private Partnerships.

1. Unsolicited Proposals

This is a written application for a new or innovative idea submitted by private sector on the initiative of the offer or for the purpose of obtaining a contract with the government. Interested Private sector can directly identify and make a request to Implementing Agency for the



PPP Structure suggested by PPP Policy, 2072.

predefined performance criteria. In the concept of partnership, partners should have mutual needs and a mutual objective. Both partners have to be honest and focused on their objectives for partnership to work.

The government enters into PPPs to attract private capital investment; to increase efficiency and use available resources more effectively; and to reform sectors through reallocation of roles, incentives, and accountability. PPPs can, if implemented under the right circumstances, improve service provision and facilitate economic growth of the country. They allow

when with Privatization Act 2050 Opening doors for privatization of the Government Owned Entity. Recently, GON announced Public Private Partnership Policy in the Year 2072 which has added additional fuel which can enhance the overall economic growth of the country.

Need of PPP policy

GON target for the upliftment the country from least developed country to Developing country till 2022 can only be achieved when there is sufficient investment in Infrastructure. So, PPP policy shall play an important role for enhancing

implementation of the projects. Following proposals can be taken into procedures for bidding:

- Previously Identified projects but no successful proposals received
- Only use of Propriety goods which are available in private sector only
- Projects declared as strategically important by cabinet of ministers

2. Land Acquisition and lobbying with government entity

GON/ Implementing Agency shall make necessary land available for the project. No agreement of PPP shall be entered unless 80% of the necessary land is acquired by the implementing entity. Further the GON via Ministry of Finance shall establish revolving fund for the acquisition of land for the project. Further, Approval on environment and other related field shall be fully supported by implementing agency.

3. Viability Gap Fund (VGF) & Project Preparation Facility Fund (PPFF)

Finance Ministry shall establish a Viability Gap Fund to support the projects which are not economic viable but important national growth. The Fund shall be provided to the financially unfeasible projects in nature of capital grants approved from PPP Direction Committee with the recommendation of PPP Center. Further, a separate fund namely Project Preparation Facility fund shall also be established by MOF to support project assessment, Feasibility study and other required consulting services. Separate Directives for the operation of VGF and PPFF shall be formulated within one year after the implementation of the policy.

Challenges

The main challenge is to attract investment in PPP Model and management of PPP projects. The lack of knowledge and expertise in the field of implementation of PPP Projects, lack of proper manpower and limited resources available has created a major constraint in the

implementation of PPP Projects. The procedural hazards in PPP Policy may take a sufficient time for the execution of the PPP projects. The Policy fails to monitor mechanism regarding the identification of PPP Projects. Monitoring part has been made on the execution level only; however it is necessary to monitor whether the implementing entity has identified all the possible projects that can be operated in PPP model.

Infrastructure development is an inevitable component of economic and social growth of every country. Participation of private sector shall not only enhance the volume of capital investment but also ensure the enhancement of management capabilities and technical expertise in the infrastructure development.

Although the government via its policy has opened the door for PPPs, the implementation part is much more challenging and a strong commitment is required from both public and private sector for the enhancement of the Infrastructure projects in Nepal.

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My greetings and
best wishes to SOIES Nepal
and Team Industrial Vision
for the successful publication
of third volume of
annual magazine
INDUSTRIAL VISION

- Principal





REVENUE MANAGEMENT AND OPERATIONAL RESEARCH

– Er. Abiral Raj Baniya-Chhetri

Revenue Management

Coined as the “number one emerging business strategy” by the Wall Street Journal, Revenue Management is the art and science of price-driven profit maximization. Before we begin, consider following scenarios:

- a) Ram & Hari, travelling in an airline from Kathmandu to Dhangadi, recently talked with each other. While Hari paid Rs. 6,000/-, Ram paid 11,000/- for this trip. Has Ram been cheated?
- b) Ram pays Rs. 700/- for a seat in public jeep when travelling to his home during Dashain (Kathmandu to Hetauda). He paid only Rs. 400/- a month back. The fuel price is constant during these times. Has Ram been cheated?

cheated or not?

Before you judge, let's study about the following 3 pictures, and spot the similarity among them:

“RM is basically all about understanding supply & demand dynamics of market for your product, and managing inventory and price of your product accordingly.”

The answer is: all of the above things are perishable (a perishable service is one that cannot be used after a certain time.), meaning:

- If you can't fill an airline's seats for a flight, you lose the potential revenue that you could have generated.
- Once a concert show has started, you can never sell the ticket again.

lost. A rental car left idle during a day is a revenue loss. Airline seats, hotel rooms, rental cars, grocery, etc. are some of the examples of perishable services, all having common characteristics: segmented market, fixed or constrained capacity, perishable inventory, finite selling horizon, reservation-based sales and fluctuating sales. And inventory management of such perishable products is the scope of Revenue management (RM). RM is about selling the right product to the right customer at the right time for the right price.

RM is basically all about understanding supply & demand dynamics of market for your product, and managing inventory and price of your product accordingly. It means



- c) On Tuesday, Hari pays Rs. 100/- for a plate of momo at MoMo Palace. Ram visits the same place on Wednesday, but pays Rs. 150/- for the same. Has Ram been

- The vegetables or fruits that go unsold with the risks being damaged.

Similarly, the revenue from a hotel room left empty for a night is

charging different prices for the same product (say air-ticket) at different times i.e. adjustment of pricing variables over time in response to emerging and changing patterns of

consumer demand. Though reducing price when there is low demand and increasing prices to exploit high demand seems straightforward, RM goes one step further and determines price & supply optimization via forecasting, i.e. how much price to reduce and how much product to sell in discounted prices.

Of course, there are ethical and legal limits while playing with price. For e.g. the government might fix the ceiling price for a ticket for Kathmandu-Dhangadi to be 12,000/- In that case the airlines can release their seats in market anywhere between say 6,000/- to 12,000/- depending upon demand and supply. If there are some events (say national games) happening at Dhangadi, the supply spikes. Seeing that the demand is very high, there may be only high fares available. But during low demand times, the same airlines might be finding it hard times even to sell low fares.

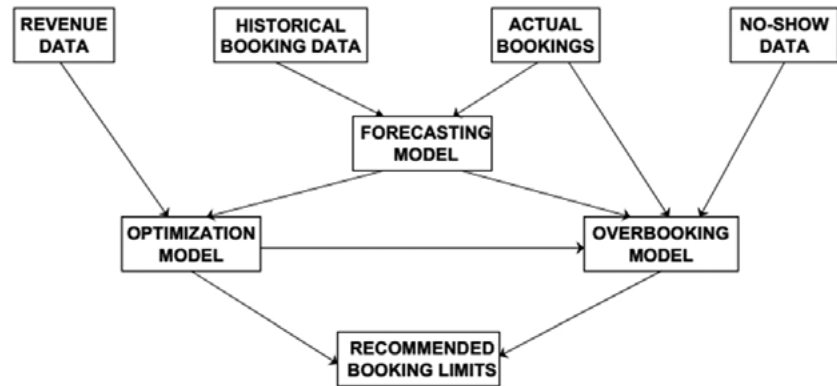
So, understanding the market dynamics is very important, both as supplier and customer. You don't need to go through journals to understand about basic market dynamics. You might have heard many times from your parents that you can get vegetables at cheap price during the late hours. So, some quick tips for buying an airline ticket:

1. Plan and buy your seats as early as possible. Generally, only high fare tickets are available at last hours.
2. Compare the ticket prices via online fare comparison sites. You might inquire the airline offices via phone to know which one is offering the lowest fare.
3. For the busy times (e.g. festivals/marriage lagans, etc.), expect the prices to go up.

The scope of RM practice includes hotels, airlines, hospitals, cruise, railway, car rental, broadcasters, telecommunication companies, etc. Discount offered in advanced purchase of tickets offered by airlines, weekend discount by hotels, different tariffs by power generation and distribution companies, 'early bird' schemes, etc. are some of the examples.

Operations Research (OR)

RM practices include demand forecasting, capacity control/allocation, and dynamic pricing. For the purpose, OR tools are used. And the quality of RM decisions depends on accuracy of OR tools.



For example: given a scheduled flight, capacity and prices, how many bookings to accept by each fare type to maximize flight revenue (i.e. fill each seat with highest possible revenue)? Operational Research tools help makes such decisions.

How?

Most of the things studied in OR focuses on reduction of costs. RM for the most part looks at the revenue side of the equation. So, the extension of OR tools are used for the purpose. OR helps companies adopt systems that assign prices, inventory, and capacity dynamically according to the demand. A simple OR model might be as follows:

In this case, different data sets are used to build booking limit model for different fare classes in the airlines. Such models dynamically suggest the booking limit based on changing conditions. For example, the model might suggest booking limit for the cheapest fare class to be 10, but if demand seems more than normal times, the model might suggest decreasing the booking limit to 8. Such analytics-driven OR and RM techniques have proved the companies (like CSX Railway, Canadian Pacific Railway, Netherlands Railways) to improve their bottom line significantly.

Though, RM software based on

OR is used by companies, it can be also practiced via advanced excel application for the following purposes:

- Forecasting demand based on historical trends.
- Dynamically adjusting the inventory as per the market demands

and competitor activities.

- Variable pricing by monitoring real-time performance.
- Strategic discounting like variable discounting, group booking, price-based segmentation.
- Managing overbooking based on no-show trends.

To return to the questions put at the beginning: the market rule of supply and demand have been used and Ram has been charged accordingly. But all the times, suppliers need to make sure that their pricing is within government established floor and ceiling price.

Notes: In the article, the discussion about RM and the application of OR is made only cursory. The views in the article are based on author's professional experience. For in-depth understanding of RM, the readers are advised to make further readings.

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In the News (2015-16)

Mercedes-Benz retiring robots from product line

Mercedes-Benz offers the S-Class sedan with a growing array of options and the carmaker's robots can't keep up. With customization key to wooing modern consumers, the flexibility and dexterity of human workers is reclaiming space on Mercedes's assembly lines.

"Robots can't deal with the degree of individualization and the many variants that we have today," Markus Schaefer, the German automaker's head of production, said at its factory in Sindelfingen.

Mercedes's Sindelfingen plant, the manufacturer's biggest, is an unlikely place to question the benefits of automation. The complex processes 1,500 tons of steel a day and churns out more than 400,000 vehicles a year. That makes efficient, streamlined production as important at Sindelfingen as at any other automotive plant. But the age of individualization is forcing changes to the manufacturing methods that made cars and other goods accessible to the masses. While robots are good at reliably and repeatedly performing defined tasks, they're not good at adapting.

With manufacturing focused around a skilled crew of workers, Mercedes can shift a production line in a weekend instead of the weeks needed in the past to reprogram robots and shift assembly patterns, Schaefer said. During that downtime, production would be at a standstill. The world's second-largest maker of luxury cars isn't doing this in isolation. BMW AG and Volkswagen AG's Audi are also testing lightweight, sensor-equipped robots safe enough to work alongside people. We're moving away from trying to maximize automation with people taking a bigger part in industrial processes again," said Schaefer. "We need to be flexible."

Full article at: <http://www.bloomberg.com/news/articles/2016-02-25/why-mercedes-is-halting-robots-reign-on-the-production-line>

A collaboration between 3D systems and Hersheys upgrades DIY chocolate

CocoJet is a partnership venture between 3D Systems and The Hershey Company: a printer that streams delicious liquid chocolate, according to design specs, just as a regular 3D printer streams filament. Users can choose between dark, milk or white chocolate and between pre-programmed designs or confections of their own creative devising.

CocoJet's release into the wild is still forthcoming, so it's too soon to tell exactly what effect on-demand, personalized chocolate might have on markets. It could put stress on the custom candy makers and bakers it's aimed at, by putting DIY power in the hands of their core consumer base. After all, why pay somebody to make 1,000 chocolates for your wedding when you can print them out while your fiancée is hand-signing invitations?

On the other hand, it could go the opposite direction just as easily. Creative bakers and chocolatiers could design intricate and compelling treats blurring the line between snack and statue, in turn, offering goodies untrained consumers simply can't match. Either way, the end result for big and small events calling for advanced chocolate technology is sure to be impressive.

3D Systems demonstrated its ChefJet series at CES. This is a professional-grade set of fully functioning food replicators just a step or two behind what you might see on Kirk's Enterprise.

Ford to launch Ford Pass parking app and 'Ford Hub' spots in major malls

In addition to space in the garage, Ford Motor Co. wants a spot on consumers' smartphone screens. And it wants to promote its new types of mobility services in major shopping malls.

In April, the automaker plans to launch a platform called Ford Pass that gives users the ability to reserve parking, pay for transportation costs through their vehicle or phone, earn rewards and call a "Ford Guide" for free help reaching destinations. It is announcing Ford Pass, as well as partnerships with McDonald's, 7-Eleven, Park Whiz and other companies that are part of the platform, at the Detroit auto show today.

Ford Pass is an ambitious piece of CEO Mark Fields' effort to refashion the 112-year-old manufacturer as a mobility company and build customer loyalty amid challenges from ride-hailing and car-sharing services. In a statement, Ford said it "aims to do for car owners what iTunes did for music fans."

After buying a vehicle, executives say, most people spend about four hours a year at a dealership, often for repairs or other reasons they don't enjoy. With Ford Pass, the company hopes to connect more directly with customers -- and ideally, noncustomers -- during the hundreds of hours they spend in their vehicles and help them get around.

"The idea is to build a long-lasting relationship with customers," said Elena Ford, the company's vice president for global dealer and consumer experience.

Full article at: <http://www.autonews.com/article/20160111/OEM06/160119996/ford-to-launch-fordpass-parking-app-and-fordhub-spots-in-major-malls>

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**Expanding and exploring diverse arenas of our fraternity,
they are our frontliners expanding the framework beyond
physical boundaries.**



BOILER MAINTENANCE AND SAFETY

– Angela Sapkota

A boiler is a closed vessel or a furnace in which water or other fluid is heated to generate steam. The major function of a boiler is to generate steam but the fluid inside the boiler doesn't necessarily boil. The boiler is the heart of the steam system. The typical packaged boiler is powered by a burner which sends heat into the boiler tubes. The hot gases from the burner pass backwards and forwards through a series of tubes to gain the maximum transfer of heat. Once the water reaches the saturation temperature, steam bubbles are produced, which rise to the water surface causing vaporization. The steam is released into the space above, ready to enter the steam system. This is a short overview of a steam plant/boiler.

The National Fire Protection Journal (NFPA) reports annually that catastrophic fires and explosions cost industry, hundreds of millions of dollars annually. But they do not mention the causes behind such explosions. Such explosions and accidents are caused 10% due to unsafe act and remaining 90% due to the fault of the working employee inside the plant house. And, unfortunately the society and the individual companies usually act on these kinds of issues only after the occurrence of some tragic events. Here is an accident case of boiler in Nepalgunj Plywood factory.

Case: Two killed, Six injured in Nepalgunj Boiler Blast

Kathmandu, 19 Feb 2012: Two persons were killed and six were injured in a boiler explosion at a plywood factory at Khajura. The explosion damaged an adjoining

house, causing damage to the factory. In this post no cause of the explosion was mentioned properly. Such accidents and explosions are the result of carelessness, which causes plant breakdown and ultimately failure. So precautions are very much essential before working

“Proper boiler maintenance, servicing and inspection is not only a safety issue, it also can be a significant economic matter.”

inside a boiler house because a small mistake may end up the life of the operator or worker working inside the boiler house.

Proper boiler maintenance, servicing and inspection is not only a safety issue, it also can be a significant economic matter. Boiler downtime might force manufacturing plants to shut down plant operations and the production process, and every hour that production is stopped can cost huge amount of money. Personal safety is an item that is first and foremost in the design, construction, operation, and maintenance of industrial manufacturing facilities. Sometimes serious and fatal injuries are caused by catastrophic equipment failure that stems from years of seemingly innocent neglect or poor operation and maintenance.

There are major two causes of boiler failure. The first one is short-term maintenance errors that cause immediate failure, accidents or incident and the second one is long-term maintenance practices that done over longer period of time, allows a condition to develop which results in larger damage, failure or

a serious accident. Some common failures of boiler are fuel explosions and low water condition which can cause severe damage to the boiler house. Fuel explosion in furnace is one of the most dangerous situations in the operation of a boiler. Fuel explosions can also occur if insufficient air is supplied for the amount of fuel being burned. Also, poor atomization of oil can cause an accumulation in the furnace and create a localized volatile mixture of unburned fuel, which can result in an explosion. Timely maintenance, periodic inspection and safe handling and operating procedures can eliminate fuel explosions. Similarly, during low water condition the steel tube boiler starts to melt because the boiler furnace temperatures exceed 1800 F, and the physical properties of carbon steel change dramatically at temperatures above 850 F.

During proper working condition of boiler or say when there is enough water, a boiler can withstand these furnace temperatures due to presence of water in all tubes of the furnace at all times when a fire is present. So maintaining water level plays vital role in efficient working for the boiler. Now days to prevent low water condition modern boilers are equipped with automatic low-water trip switches. Low-water trips protect boiler pressure parts by shutting down the fuel combustion process, eliminating high temperatures in the furnace when the natural circulation cooling process is interrupted. The common reasons for these water trip failures are inoperative trip switches and circuit problems in the switch. To prevent this trip switches

should be blown down regularly to remove potential sludge buildup. Other causes behind boiler failure include drum control valve failure, feed water pump failure, drum level controller failure, safety valve problem etc. Periodic maintenance should be done in order to keep the boiler parts in good condition. Employees and operators should be trained properly and only certified operators should be given to work on the plant house. Any fuel leakage should be rectified immediately and the defective fuel valve should be replaced as soon as possible. A boiler inspector should be engaged to examine the piping system at the time; the boilers are being examined. The boiler inspector should thoroughly examine the safety

devices and equipments at each statutory examination of boiler. The alarms, equipments and devices must be tested after the steam is raised. Most importantly, the owners should provide adequate training to the operators for safe operation of the steam system and proper operating procedures and safety precautions should be conspicuously displayed and readily made available in the vicinity of the steam system/boiler. Plans for adequate maintenance, proper instruction and supervision procedure should be developed and implemented for safe operation of boilers. And, effective communication and co-ordination required for safe operation of boilers should be included in the instruction to the operators. It

is said that “regular inspection of boilers is the law, most often governed by the state”, but in some cases governed by municipality and city. Boilers must be inspected by certified inspectors according to a mandated schedule. The day-to-day maintenance and service of boilers is the responsibility of plant engineers or plant too.

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गुणस्तरीय पहिचान | मजबुत जडान | वर्षौसम्मको शान

अम्बे सिमेन्ट

यो देशको शिर
उच्च राख्दै...





INDUSTRIALIZATION & ECONOMIC PROSPERITY THROUGH SKILLS DEVELOPMENT AND EMPLOYMENT CREATION

– Er Ravi Kumar Mainali

Nepal is facing big challenges on poverty and unemployment due to political instability for the last almost two decades. Now after declaration of new constitution, new Government has formed and almost settled the unrest situation after long protests in Tarai Region. Therefore, this is high time now to explore the opportunities on country's accelerated economic growth so that how quickly we address and rehabilitate the most burning issues.

Nepal is producing about half million unskilled labor force and going for overseas employment and they all are naturally & unfortunately assigned for 3Ds (Dirty, difficult and Danger) works as they don't have any skill and competency for higher level or safe/easy jobs. Everyday 1200 to 1,500 people are going abroad for unskilled employment and on an average 2 dead bodies are received back to country unfortunately. However, on the other side, it is noted that foreign employment has been contributing almost 25% GDP as a national income.

In this scenario, how can we accelerate the skill development activities massively? So that more and more skilled & competent manpower can be developed towards employment/self-employment/entrepreneurship within the Country. This will ensure better livelihood of poor people. Thus, Technical Education & Vocational Training (TEVT) comes in the main picture. There is a strong need of proper institutionalization of TEVT massively to create huge mass of skilled manpower for creation of better employment opportunities

within the Country and abroad. However, some training programs are supported /organized by some international donor agencies like ADB, World Bank, UNDP, SWISS Contact etc, but, which are not enough for all potential people. Nepal needs to attract more and more Foreign Direct Investment (FDI) to invest in employment intensive industries in order to create huge number of employment. It is noted that one important criterion for attraction of FDI in Nepal is availability of expert/skilled local manpower. It is bitter fact that we have very less number of expert/skilled local

“Nepal can have great privilege of having great market potential in India and China to tap more than one-third population of the entire world with a privilege of short distance transportation.”

manpower as we have to mainly depend on India and other countries for very common skills like tailoring and construction works. There are no close interfaces between Academia / Training Institutions-Industries. We all must identify gaps between the expectations of industries management from Graduates and courseware/competency level of trained Graduates. There might be requirements of entire restructuring/transformations of hardware & software of teaching-learning methodologies like Competency-Based Training (CBT) in order to get prepared our Graduates for globally competitive employment market. In fact, competent human resource strength was well-demonstrated by South Korea four decade before when this country was poorer than Nepal in the context of self-reliance.

Therefore, South Korea got great success to invite huge numbers of FDI towards massive industrialization and employment that lead to present prosperous Korea. Similar situation for our country would be very conducive environment to attract FDI for rapid industrialization and employment creation in order to develop peace & prosperous Nepal.

Actually, all engineers can play vital role for all aspects nation building and developing process. More importantly for TEVT sectors, we all engineers from all stream/faculties may be instrumental to promote skill development and employment creation through TEVT activities on various trades and occupations. Basic infrastructures like uninterrupted sufficient supply of electricity, proper road access, communications, quality & productivity policy and investment friendly labor policy & laws etc are prerequisite requirements to attract Foreign Direct Investments. Especially, Industrial Engineers can play pivotal role to have proper advocacies on those issues in order to promote congenial industrial environment.

Now, the post conflict national movement should be “Movement for Economic Prosperity” without much delay. Our country is much behind in productivity & prosperity as compared with other neighboring countries in South Asia. Bhutan is much ahead in hydropower and it is self-reliance on energy and there is no load shedding in all over Bhutan. Over 90% surplus energy is sold to India. Due to surplus energy and massive tourism promotion in Bhutan, it has many fold higher

INDUSTRIAL VISION

Per Capita Income as compared to our country. There are many large establishments of multi-national corporations at southern Bhutan as there are good infrastructures set up like uninterrupted electricity supply, good road access and communications etc.

All engineers as catalysts for nation's development, we must explore many possibilities to create multiplier effects on economic prosperity like hydropower development, tourism development, modernization in agriculture, herbal processing and other manufacturing of basic consumable commodities with better quality and productivity so as to compete in export market across the region. Moreover, climate of capital city Kathmandu is God gifted place neither hot nor cold

throughout the year. Therefore, we may have great potential to promote sports tourism, religious tourism, education tourism and other adventurous tourism. Nepal can have great privilege of having great market potential in India and China to tap more than one-third population of the entire world with a privilege of short distance transportation. Our labor market is considered as cheap and people are honest also. If we can produce and deliver quality products in competitive prices, we have our domestic market for 28 million people and in all across South Asia and China covering more than one-third of global population.

To sum up above, all Engineers should have proper vision how to get prioritized for developmental movement of the country. We all

should align and integrate with all concern stakeholders towards economic prosperity with tangible outcomes.

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INDUSTRIAL DESIGN

Designing a better world.

– Pratik Rayamajhi

Design is something that represents creativity and innovation. It shapes ideas to become tangible, practical and attractive propositions.



Designing is often misinterpreted as the process of just giving aesthetic features to existing product or wrapping a product with a beautiful casing. Actually, Industrial Design (ID) is the professional service of creating or improving products and systems that optimize utility, value and appearance for the mutual benefit of user and manufacturer.

Historically, in the industrial sector, individual craftsmen determined the form of a product based on their own manual skill or the restrictions set by their clients. The experience accomplished by those craftsmen through their own experimentation and traditional knowledge passed on through trainings or apprenticeship. The models and designs developed by the experienced workers or craftsmen were duplicated and the tasks were repetitive, thus lacked innovation and improvement.

It uses technologies and materials. It involves research and requires inspiration, thus evokes changes. Industrial design is global,

it's about you, and it's about me. It's about everyday products all around us. 'Industrial Design' impacts life.

Industrial design is global, it's about you, and it's about me. It's about everyday products all around us. 'Industrial Design' impacts life.

The use of drawing was first developed by architects and shipwrights. It helped them to reduce the possible errors and to plan the order of product development. The

"Industrial design is global, it's about you, and it's about me. It's about everyday products all around us. 'Industrial Design' impacts life."

emergence of industrial design is specifically linked to the growth of industrialization and mechanization that began with the industrial revolution. Industrial revolution brought significant changes in industrial sector. Industrial revolution changed the way objects were designed, manufactured, changed patterns of consumption, broadened tastes and created varied markets.

To fulfill the increased demand and different preferences for a much larger and more heterogeneous population, the product should be widely acceptable and requires large scale production. Responding to unprecedented public and industry demands for innovation in products of new styles, craftsmen and

machine designers started to focus on the product design. Distinctive design and styling gives companies across almost all industries a significant competitive advantage in the market. The popular designs by those craftsmen and machine designers increased sales and profits dramatically for manufacturers, which boosted the economy; established a new profession - industrial design. Later on, along with the advancement in the field of modern technology, industrial design elevated to a new horizon. At present industrial design is not just about giving different fashionable styles and attractive packaging to a product. In addition to aesthetics, industrial design also encompasses engineering, ergonomics, usefulness, market placement, and other concerns—such as psychology, desire, culture and expectations of the users.

Although the process of design is considered as an innovative process, many analytical tools are into practice. In fact, many industrial designers often use various design methodologies in their creative process. Some of the processes that are commonly used are user research, sketching, comparative product research, model making, prototyping and testing. Industrial designers often utilize 3D software, Computer-Aided Industrial Design and CAD programs to move from concept to production. The inclusion of industrial designers for product design in a product development

INDUSTRIAL VISION

process may lead to added value by improving usability, lowering production costs and development of appealing products. An industrial designer has the responsibility to do the same in the industries.

Industrial design involves various steps depending upon the field of application and the type of industry. Behind every industrial design there is an idea that solves the design problems, manufacturing and technical problems to fit the strategy called concept design. For the development of the products, the concept design is the replication of the idea in form of normal sketch or a digital sketch using the platforms like Dassault Systèmes 3D experience platform for more efficient and flexible designs. An industrial designer can offer the flexibility in designs of a product working closely with the engineers to determine how to manage costs through the use of different manufacturing techniques, materials or functions. The concept design is then evaluated and discussed and forwarded for 3D evaluation. For 3D evaluation, the sketch is developed into a 3D model also called virtual prototyping by adding all the necessary details. Virtual prototyping is done by creating (usually 3D) computer generated geometrical shapes (parts) and either combining them into an assembly and testing different mechanical motions, fit and

function. The assembly or individual parts could be opened in computer aided engineering (CAE) software to simulate the behavior of the product in the real world. By utilizing tools such as Finite Element Analysis (FEA) and Computational Fluid Dynamics (CFD), the prospective design can be put through different tests that it would be expected to experience within the service life. By utilizing the analysis and simulation software engineers and designers can adapt the design to ensure the desired performance. Then a physical prototype is developed either using 3D printers or different machine tools. Designers usually had to redesign the initial concept multiple times to address weaknesses that were revealed in physical testing. After lots of tests and modification a concept design is finalized as a product that an industry can manufacture to change the way of life.

Industrial design is the creation of things, the product of human creativity, and the expression of our existence. It's the production, development and manufacturing of objects, processes, and even services. From an idea comes reality. It is about colors, textures and shapes. It's about the culture, tradition and experience. It meets needs, improves stands of living, and finds solutions to everyday problems. It makes life easier. It changes how we interact

with the environment, and the world around us. It seeks to create or improve objects- making them more functional attractive, more efficient, accessible and responsible. It uses technologies and materials. It involves research and requires inspiration, thus evokes changes. Industrial design is global, it's about you, and it's about me. It's about everyday products all around us. 'Industrial Design' impacts life.

In Nepal, industries still rely upon those traditional methods and skills for product design and development. Inclusion of industrial designers during the early stages of a product's development ensures the anticipated utility, reduces the possible defects and delivers the desired performance. An industrial engineer is regarded to be proficient in industrial design to bring innovation in the Nepalese industrial sector.

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CONSERVATION AND DIVERSIFICATION

-Bipin Karki

Key to Energy Security in Nepal

Energy plays a vital role in developing economic activities and natural security. So energy management must ensure that the supply, demand and consumption of energy be carried out in a sensible, continued, rational and optimized manner. It plays important role in the national security of any given country as a fuel to power the economic engine.

There are threats to energy security such as political instability and economic sanctions. Fossil fuel is essential to basic functioning of global economy from production of goods in factories and for their delivery to local markets across country. To minimize such vulnerabilities and security dilemmas they create, we must end the mad pursuits of fossil fuel.

Energy diversification is a great source of strength to reviving our economy, strengthening growth rate and increasing employment. Diversification of energy sources will help to ensure that the economy remains productive and viable even in the event of adversity or conflict with other nations. The past and present scenario of Nepal is an evident example of how a country can be choked off by energy crisis when it is overly dependent upon other countries.

Hydroelectric power is perceived to be the backbone of our energy, but since we are able to trap only few percentages of immense potentialities it is highly unlikely that current blackouts will be resolved with hydroelectric power alone in near future. It is not with single approach that Nepal can aim to be self reliant on energy production. The focus should be to increase energy security reducing dependence on any source of imported energy, increasing suppliers, exploiting native renewable energy resources and reducing overall demands through energy conservation.

As a matter of civic responsibility and obligation people should

press their election representatives to accelerate for clean sustainable energy economy. The longer our officials remain beholden to powerful private interest, the more our families and communities will suffer. There must be policy level changes so as to increase transparency, predictability and stability of energy markets improving investment climate in energy sector.

By strengthening the value of rule of law and the state machinery, people's participation, transparency, accountability, and a corruption-free environment, the access of all Nepalese including those excluded in economic and social service delivery has to be increased. For this, the

"Thus, instead of unilaterally focusing on only one sector, the focus on adoption of more equitable and diversified sources shall assure energy security."

private sector and civil society (including NGOs and community organizations) have to be accepted as partners in development.

Necessary laws, policies and programs has to be revised, formulated and implemented in addition to an

gy infrastructure, strategy has to be adopted to construct mega, medium and small-scale projects with the help of identification and participation of local people.

Enhancing energy efficiency and energy saving

The current way of energy use in Nepal is economically not cost effective, environmentally not friendly, and principally not sustainable. Because of country's large gap between the supply and demand of electricity, greater focus has been given on generating more electricity (supply side), though it is not happening as per expectation. No serious attention has been paid into demand side management and energy efficiency. No comprehensive energy efficiency strategy as well as integrated energy policy is in place so far.

Energy efficiency is the most effective energy resource for reducing the supply gap, carbon emissions, and reliance on expensive imports of petroleum products. The Energy efficiency increases the energy security and reduces the level of per capita energy consumption and overall power system peak demand.

Ensuring physical security of critical infrastructure

The energy infrastructure should be provided with special security and priority. Small and medium hydroelectric projects currently being constructed have to be completed. Initiatives should also be taken to make mega hydroelectric projects started.

Information and communication technology has to be extensively expanded among stakeholders and public. Even special task force can be formulated and implemented. So there is smooth operation, procurement and establishment of energy technology and infrastructure.



Figure: Energy Security for Development of Nation

emphasis on decentralization, institutional strengthening and capacity development. In addition to putting special emphasis on reconstruction and development of social and physical infrastructures related to energy generation, new concepts have to be utilized. In the context of ener-

INDUSTRIAL VISION

Strengthening regional and international co-operation and sustainable use of energy

Sandwiched between two burgeoning and economically strong nation with immense energy need and shifting energy, Nepal has immense potentialities to lead Asian market for energy export. Nepal's excess generation of hydroelectric will get right market and reward, if we are able to trap this opportunity.

Excluding sales in the domestic market, there are also prospects of exporting power to Tibet and neighboring Indian states of Bihar and Uttar Pradesh. Power demanded in Bihar is about 2,300 MW, but just 1,550 MW is met from installed capacity. Analogously, while the power demand of Uttar Pradesh is about 9,330 MW, only 5,080 MW is met from installed capacity. Thus, there are good prospects for power exports from Nepal to these areas.

Addressing climate change and sustainable development

Indoor air pollution is the fourth largest health risk in the world's poorest countries, and every year an estimated 2 million people die from illnesses linked to the air pollution caused by household cooking and heating practices. Nepal does not have any known reserve of fossil fuel in the country. In such an environment, the developments of non-conventional renewable resources like solar, wind, biogas, biomass and geothermal technology provide an immediate solution.

The demand and supply of energy generated from renewable resources such as solar, micro hydro and biogas is gaining momentum as over 15 percent of the total population in the country uses them for lighting and cooking purposes at present scenario. The installation of renewable and alternative energy sources could achieve energy equity where the poor and rural communities living in harsh topographical region will have access to clean energy source for lighting and cooking purposes.

Even dedicated small efforts on ground level can bring about massive changes. Replacement of diesel generator with solar power, furnishing banks, malls and commercial complexes with solar powered sta-

tion, introducing nano, micro and mini grid for rural electrification, and urban re-electrifying are some of the efforts that can initiate the change. Net-metering on solar powered homes can be brought into action where consumer will sale excess power to electrical grid and draw power in when less generation. This will be a win-win solution for both government and people. Government is guardian of country and they have resources as well as responsibility. Government should start evolving by supporting right initiative, policy, approach and ideas which are relevant.

Japan used to be heavily dependent on imported oil for fulfilling its energy demand in the past. Japanese Government steadily introduced the use of natural gas, nuclear power, high speed mass transit system, and implemented energy conservation measures to fulfill its energy demand.

The towers of cellular network, TVs, cable, fm station can be powered with appropriate alternative system. The areas with enough sunlight can be solar powered, and areas with constant airflow can be powered with the wind energy. A tower near Muglin in Prithivi Highway is being powered with the energy harnessed with wind turbine. Solar dryer, solar pump, solar cooker can be used to replace their traditional counterpart. Poultry waste can be use for bio-gasification which later can be used to harness power to make farms independent of central power system. The similar initiative has been started in Chitwan, a hub for poultry industry. The sugar wastages generated from sugar mills can be used for power generation within industry for its self reliance on energy, and can be further processed for ethanol generation as done in Brazil.

We should not stick to single solution as our problems are diverse. Instead of merely going for electrification of rural areas, pristine environment centralized on solar or micro-hydro can be establish to bolster local economy and resource utilization. Bio-briquetting would be a smart use of waste husk, a parasitic grass which doesn't have much other uses. In this was dependability for firewood for cooking purposes in rural areas can be reduced as well.

Simply training local people to make cheap and efficient briquette can also evolve as business enterprise reinforcing local economy.

Using less energy can save money and improve the quality of environment for future generation. Conservation measures can be introduced rapidly at lowest level with little cost for example lowering room temperature, turning off unnecessary lightening, and reducing leakage in transmission line. Energy reduction through energy efficiency measures like insulation of a building to reduce heat loss, purchasing a vehicle with an improved fuel economy, and replacing of incandescent bulbs with fluorescent or LED bulbs generally take more time and money to implement.

Thus, instead of unilaterally focusing on only one sector, the focus on adoption of more equitable and diversified sources shall assure energy security. The holistic approach of energy security in Nepal will only aggravate the right energy solution. Hence only through diversification and conservation of energy will bring energy security in Nepal.

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INDUSTRY 4.0

A paradigm shift in industry

— Ashrita Dhungel

The Industrial Revolution is a concept and a development that has fundamentally changed our society and economy. The term ‘development’ may seem to signify some tardiness in the context of a ‘revolution’, which really indicates a rapid and fundamental change, but there is no doubt that major alterations occurred within a relatively short period. Industries arose and replaced small-scale workshops and craft studios. Textile and pottery factories were the first to recognize the new dawn, and a new infrastructure of canals and railway lines enabled efficient distribution. It was the transition from *industrious* to *industrial*, and the start of a boom for both.

The first industrial revolution marked by mechanical production powered by water and steam engines and continued with mass production powered by electricity named as second industrial revolution and inventions of computer and internet named as third industrial revolution. This continued development in the industrial sector is now in its fourth series of revolution based on ideas of service oriented design called **Fourth Industrial Revolution** or **Industry 4.0**. It refers to a further development phase in the organization and management of the entire value chain process involved in manufacturing industry.

Industry 4.0 is the production side equivalent of the consumer-oriented ‘Internet of Things’ embracing a number of contemporary automation, data exchange and manufacturing technology. Industry 4.0, according to Germany

manufacturing industries, draws cyber physical system, internet of things and internet of services. It facilitates the vision and execution of smart factory. Of central importance for industry 4.0 is its interface with other smart infrastructures, such as those of smart mobility, the smart grid, smart logistics, and smart homes and buildings.

Industry 4.0 will be the biggest revolution ever since. It will completely be connecting each and

“Industry 4.0 will be the biggest revolution ever since. It will completely be connecting each and everyday activities and objects from cars to the thermostats to toasters to the internet.”

everyday activities and objects from cars to the thermostats to toasters to the internet. Simply, it will be making an individual’s life not only comfortable but sophisticated and technical. Smart factories for an instance will be manufacturing things best suited for an individual or let’s say, in accordance with the taste and desire of an individual. The monotonous routine of an individual from home to work and vice versa will be followed by the machines for convenience.

The industrial achievements are so monumental and numerous that their impact can hardly be overrated. Just think of the appliances we have in our homes, such as the washing machine and vacuum cleaner, the planes and cars to transport us wherever we desire, the advanced food industry, and the pharmaceutical industry. New opportunities are being revealed

with further advancements through Industry 4.0: airplane engines, locomotives, buses, building, toothbrushes, lighting, post-sorting machines, solar panels, and suchlike. Not only are they assigned an Internet connection with the digital world, they are also equipped with better capacities to distinguish and register situations and events.

It’s guaranteed that Industry 4.0 is going to change the life of an individual but we may be wondering how it will bring change in community or nation. In this modern age, a nation cannot make progress if it’s lagging behind in the field of industrial development as industries itself, in our country, is contributing 10% of the G.D.P. of our country and it can be increased in huge ratio if the nation can make necessary advancements to meet and execute the policies of industry 4.0. Industry 4.0 will not only be reimagining the assembly lines but it will also focus to create a network of machines that not only can produce more units but can produce more units with less errors. With the rising integration between small factories and machine to machine communication, energy wastage can be reduced which is not just advantageous for a company but for the globe.

But we must not forget that these innovations in revolution have its dark side as well. Industry 4.0 will bring change in our society but we can’t neglect the risks which it will be bringing. Though the industries will be running under remote control system through machine to machine communication, determining common platforms and languages

INDUSTRIAL VISION

to allow machines to speak across corporate boundaries stands as one of the foremost problems for the widespread adaptation of cyber physical system. Creating secure network is a tough task and integrating physical systems under the internet makes them easily vulnerable to cyber attacks. Foremost, artificial intelligence in machines and capability of machines to communicate each other will be replacing new jobs for people, something that will prove to be a problem as demographic shift and overall human population continues to grow, effectively pulling mat out from under developing nation which

are increasingly reliant on their manufacturing jobs.

To get the best out of 4th industrial revolution, the primary step will be to minimize all the risks. Conversation about the ethical standards should be broadened, merged and expedited to develop common ethical guidelines and embed them in society and culture. A forum for discussion and fostering joint action is necessary to regulate and negotiate agreements and create a serious and credible platform for multi-stakeholders to dialogue on all the issues raised.

To sum up, we are on the eve of a major turnaround. The world of

machines and appliances, and the corresponding processes is about to receive an enormous impulse that will have great impact on human-machine interaction. At last, it won't be wrong to say that Industry 4.0 is a revolution for an individual's comfort, nation's prosperity and we can regard this development as an extension of our ongoing revolutionary industrial past.

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Industrial Engineering Trivia

Frederick Taylor, the “Father of Scientific Management,” and an “efficiency expert,” is acknowledged to be the first true Industrial Engineer.

Timothy Donald “Tim” Cook, the CEO of Apple Inc. who succeeded Steve Jobs is an industrial engineer.

Did you know that one of today's operating room procedures was developed by Frank Gilbreth (one of the founders of Industrial Engineering), in an efficiency study of medical operations? The next time you see a surgeon extend an opened hand and a nurse place an instrument into it, think of Industrial Engineering. Prior to this change in method, doctors wasted much time (frequently while the patient bled) searching for the right tool.

Lillian Gilbreth, wife of Frank Gilberth and an industrial engineer, was one of the first working female engineers holding a Ph.D.

In the United States, the first department of industrial and manufacturing engineering was established at the Pennsylvania State University in 1909.

Industrial Engineers can get the highest pay in Alaska, where they earn an average job salary of about \$98790.

Roger Corman, reknowned producer, director and actor known for films like “The Silence of the Lambs”, “Grand Theft Auto”, “Godfather II (where he played the senator)” was an industrial engineer.

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