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Engineering in KENYA

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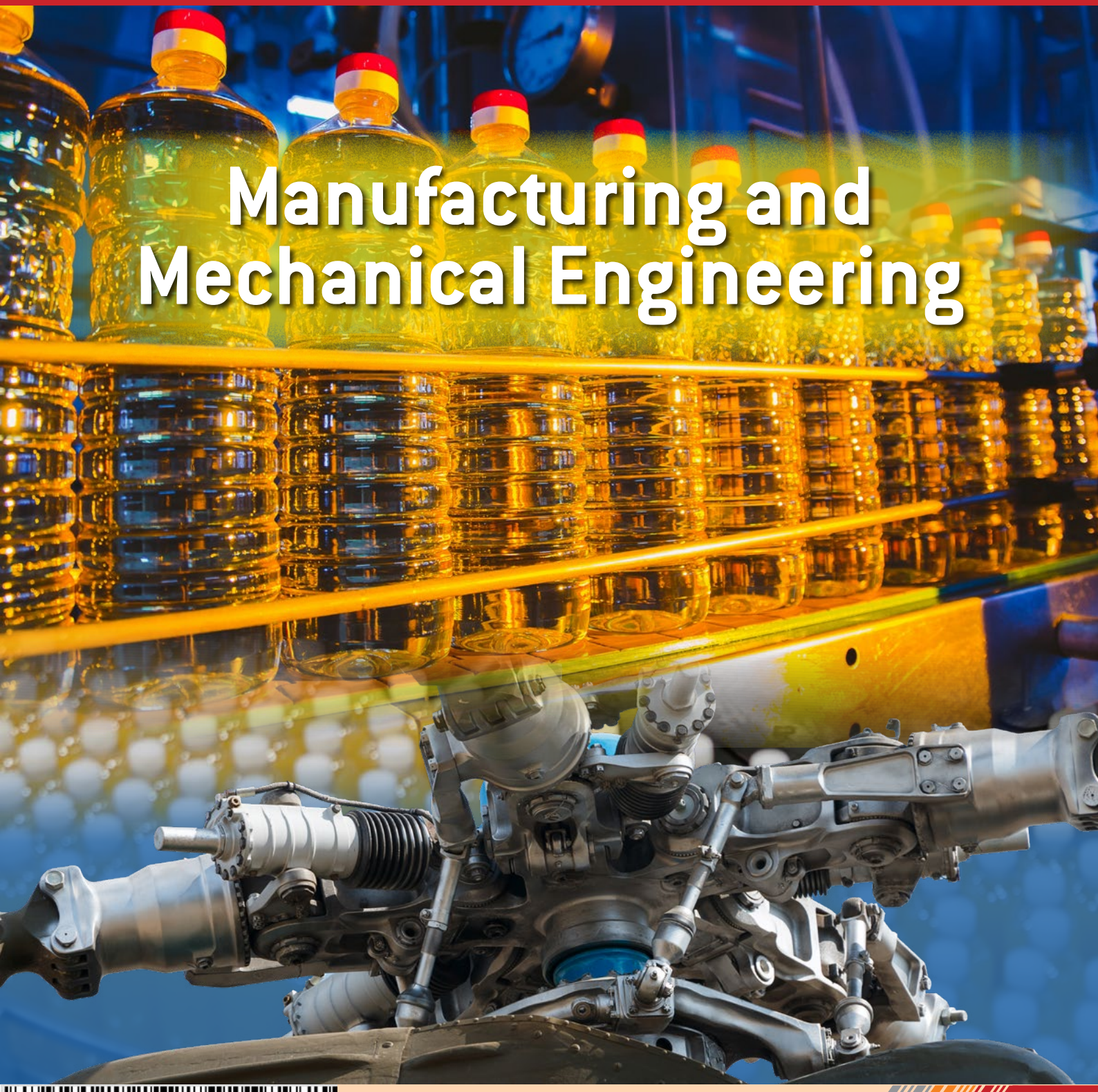

Manufacturing and Mechanical Engineering

ISSN : 2710-3951

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Call for Papers

Engineering in Kenya Magazine - Issue 013

The Institution of Engineers of Kenya (IEK) publishes Engineering in Kenya magazine, whose target audience includes engineering professionals, practitioners, policymakers, researchers, educators and other stakeholders in engineering and related fields. The publication is distributed to its target readers free of charge through hard and soft copies.

IEK invites you to contribute articles for our next and future editions. Articles should reach the Editor not later than **20th May, 2023** for our next issue, whose theme shall be "**Chemical and Process Engineering**" and related sub-themes, across all engineering disciplines. An article can range from engineering projects to processes, machinery, management, innovation, news and academic research.

The articles must be well researched and written to appeal to our high-end readers in Kenya and beyond. The IEK Editorial Board reserves the right to edit and publish all articles submitted, in line with standing editorial policy. All articles should be in Word document format, 500-700 words, font type Times New Roman and font size 12.

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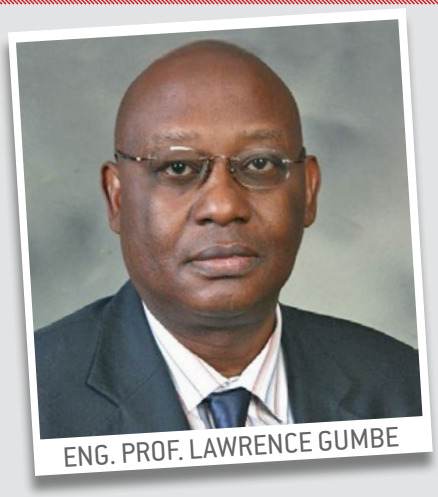


ENG. PROF. LAWRENCE GUMBE

Manufacturing and Mechanical Engineering

THE Kenyan government recognises that the manufacturing sector, in line with Vision 2030, is a key driver for economic growth and development. Industrial activities create jobs, increase GDP and contribute to wealth accumulation. As such, Kenya aims to have a robust, diversified, and competitive manufacturing sector. In addition, the sector is projected to support the country's social development. The manufacturing sector's contribution to the Gross Domestic Product (GDP) has stagnated at about 10 per cent in the last few decades. The growth of the sector has been below the annual target, and Kenya's exports have remained predominantly primary commodities with low value addition.

Manufacturing is the creation or production of goods with the help of equipment, labour, machines, tools, and chemical or biological processing or formulation. It is the essence of the secondary sector of the economy. The term may refer to a range of human activities, from cottage to hi-tech, but it is most commonly applied to modern industry, in which raw materials are transformed into finished goods on a large scale. Such goods may be sold to other manufacturers for the production of other more complex products, such as aircraft, household appliances, furniture, sports equipment or automobiles, or distributed via the tertiary industry to end users and consumers, usually through wholesalers, who in turn sell to retailers, who then sell them to individual customers.

Manufacturing engineering is the field of engineering that designs and optimises the manufacturing process, or the steps through which raw materials are transformed into a final product. The manufacturing process begins with the product design, and materials specification. These materials are then modified through manufacturing to become the desired product.

Modern manufacturing includes all intermediate processes involved in the production and integration of a product's components. Some industries, such as semiconductors and steel manufacturers, use the term fabrication instead.

Mechanical engineering is a diverse discipline that encompasses the teaching, practice and leadership of others in the development and application of scientific principles to mechanical systems. Mechanical engineering covers the ability to deliver and optimise safe, sustainable and ethical solutions for the design, production and operation of devices, machines, structures, processes and systems involving mechanical elements. Mechanical engineering frequently overlaps and/or combines with other engineering technologies to create multi-disciplinary projects/solutions.

Mechanical engineering careers centre on creating technologies to meet human needs. Virtually every product or service in modern life has been touched in some way by a mechanical engineer to help humankind. This includes solving today's problems and creating future solutions in healthcare, energy, transportation, world hunger, space exploration, climate change, built environment and more. Mechanical engineers are an integral part of manufacturing in a country.

The Industrial Revolution brought steam powered factories utilising mechanical engineering concepts. These advances allowed an incredible increase in production scale, numbers, and efficiency. During the 19th century, material science advances had begun to allow implementation of steam engines into steam locomotives and steam-powered ships, quickly increasing the speed at which people and goods could move across the world.

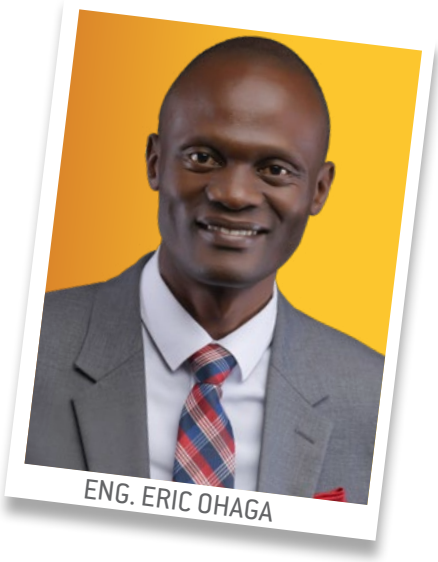
The reason for these advances were the machine tools developed in England, Germany, and Scotland. These allowed mechanical engineering to develop as a separate field within engineering. They brought with them manufacturing machines and the engines to power them.

At the near end of the Industrial Revolution, internal combustion engine technology brought with it the piston aeroplane and automobile. Aerospace Engineering would develop in the early 20th century as an offshoot of mechanical engineering, eventually incorporating rocketry. Coal was replaced by oil-based derivatives for many applications.

With the advent of computers in the 20th century, more precise design and manufacturing methods were available to engineers. The rise of CAD software has reduced design times and allowed for precision manufacturing. Engineers are able to simulate the forces and stresses of designs through computer programmes. Automated and computerised manufacturing allowed many new fields to emerge from Mechanical Engineering, such as Industrial Engineering. Although a majority of automobiles remain to be gas powered, electric vehicles have risen as a feasible alternative.

In modern history the USA and China have been the most dynamic and dominant world economies. Manufacturing and mechanical engineering have played key roles in the development of these economies. Kenya, and Africa in general, must prioritise manufacturing and mechanical engineering in its industrialisation and transformation endeavours in order to create employment, increase food security and improve affluence and human welfare.

This issue of Engineering in Kenya is dedicated to Manufacturing and Mechanical Engineering. We hope that you will enjoy reading the same.



ENG. ERIC OHAGA

Kenya Needs to Support Mechanical Engineering to Accelerate Growth of the Manufacturing Sector

> IT HAS BEEN ESTABLISHED THAT TO REVERSE THE DOWNWARD ECONOMIC TREND IN THE COUNTRY, KENYA NEEDS TO BE TRANSFORMED FROM A CONSUMER TO PRODUCTION ECONOMY. I URGE ALL STAKEHOLDERS TO RALLY BEHIND THIS CLARION CALL TO MAKE THIS POSITION A REALITY.

IN a policy paper presented between 16th and 18th March, 2022 during a "High-level Policy Dialogue on Fostering Productive Capacities in Kenya for Industrialisation, Export Diversification and Inclusive Growth" in Nairobi, Hezekiah B. Okeyo, the Industrialisation Secretary in the Ministry of Industrialisation, Trade and Enterprise Development, quotes UNCTAD TDR 2016 that "a broad and robust domestic manufacturing base is the key to successful economic development, since it helps generate virtuous and cumulative linkages with other sectors of the economy, drives technological progress (industrial revolution), and has the strongest potential for productivity gains."

The Secretary goes on to say that manufacturing is considered as the backbone of socio-economic transformation because it contributes to food security through provision of chemicals, machinery and equipment for mechanisation of agriculture and processing plants in agro-processing to reduce post-harvest losses and add value to agricultural produce. It also supports the housing sector through production of construction materials, innovations in building designs and construction; and enhancement of the use of local construction materials. It further supports the health sector through manufacture of medical equipment and pharmaceutical and hygiene products. Lastly, it creates direct and indirect employment, including in related services such as transport, logistics, financial sector, ICT.

In his conclusion, Mr. Okeyo stated, *"Economic Diversification and Structural Transformation has not been achieved!"* This conclusion presents a position that requires attention by all the stakeholders in Kenya. It has been established that to reverse the downward economic trend, Kenya needs to be transformed from a consumer to production economy. I urge all stakeholders to rally behind this clarion call to make this vision a reality.

The high cost of crude oil, electricity bills and a plethora of tax regimes continue to scare away investors, thus aggravating the situation. I similarly plead with our government to lower these costs so that ultimately, the cost of manufacturing can be reduced to benefit the common man and woman together with their families.

On the global scene, the Russia-Ukraine war has disrupted Africa's promising recovery from the COVID-19 pandemic by raising food and fuel prices, disrupting trade of goods and services, tightening the fiscal space, constraining green transitions and reducing the flow of development finance in the continent. This is according to United Nations Assistant Secretary-General Ahunna Eziakonwa at the US Institute of Peace on June 14, 2022. The war has also complicated the initiatives towards resuscitating the manufacturing sector.

Mechanical Engineering was among the first engineering programmes to be offered in our local

universities in the early 1970s. Out of this programme have sprouted other engineering disciplines such as electrical, civil and agricultural, among others. The Mechanical Engineering degree programme has continued to transform into other forms and styles, including Mechatronics Engineering, Production Engineering, Textile Engineering, Manufacturing Engineering, Marine and Maritime Engineering, Petroleum Engineering, Chemical Engineering and Mining and Mineral Processing Engineering. These more focused programmes have responded to the specialised needs of the different sectors to which they are applicable. It has avoided the employment of several original disciplines of engineering in one particular sector and moved to deliver specific human capital that gives an end-to-end wholesome and specific engineering solutions.

The number of graduates in Mechanical Engineering and affiliated programmes who are transitioning to Professional status continues to be low. However, the initiatives put in place by both our regulator, the Engineers Board of Kenya (EBK), and the Institution of Engineers of Kenya (IEK) aim at growing these numbers for the benefit of society. The Institution and EBK continue to sensitise the industry on the need to have graduate engineers transition to the professional level.

The 5th World Engineering Day was celebrated globally and locally on the March 4, 2023. The IEK, in addition to its activities at the national level, witnessed much more publicised celebrations at its branches. This publicity serves to create civic awareness to the societies that we serve at the national and county levels. We were privileged to have Principal Secretary, State Department for Roads, Eng. Joseph Mbugua, EBS, who is a Professional Engineer, grace the occasion as the Chief Guest and Speaker.

According to Lou Farrel, in his article, "Looking at Mechanical Engineering Trends in 2023" *(https://revolutionized.com/author/loufarrell/)* published in the *"Revolutionized"* of February 19, 2023, the mechanical engineering sector was already on track to undergo a digital transformation before the pandemic started in 2020. IBM's 2021 Digital Transformation Assessment found that 67% of surveyed manufacturers accelerated their digital timetable because of the pandemic.

Additive manufacturing, known colloquially as 3D printing, is reshaping manufacturing practices globally. This growth will continue to impact the mechanical engineering sector, especially with the push towards creating sustainable materials and flexible systems for on-demand 3D printing. Current mechanical engineers and those looking to work in the field in the future can all benefit from this growing trend by focusing on design for additive manufacturing (DfAM) skills.

Sustainability continues to be a buzzword on everyone's lips. Countries are looking for new and innovative ways to reduce their carbon dioxide emissions and carbon footprint. If they hope to avert a looming climate crisis, humanity must come together to reduce carbon dioxide emissions by 40% before 2030. They also need to reach the goal of net zero emissions before 2050. It's a lofty but achievable goal if companies and corporations start making the necessary changes.

One of the many ways the world works to achieve this goal is by leaning more heavily onto subjects like eco-engineering. Mechanical engineers looking for a change should consider shifting to this eco-friendlier field, Lou Farrel adds. Even without that career shift, there is a growing movement for engineers to create and embrace the kind of green engineering technologies that will reshape the industry in the coming decades.

(Photo Courtesy)


ENG. SHAMMAH KITEME

Let's Build Local Capacity in Manufacturing to Ensure Continued Economic Growth

IN this edition, we focus on Manufacturing and Mechanical Engineering. One of my university professors once told us that Civil Engineering is also "stationery engineering". The good professor was teaching us solid mechanics. He thus used the expression to differentiate the kind of solid mechanics that Civil Engineering deals with from solid mechanics that Mechanical Engineers consider. Many of the structures Mechanical Engineers consider are largely in motion. They weigh in aspects of friction, drag, thermodynamics, lubrication, etc.

This is precisely what manufacturing deals with. In manufacturing we look at processes that will convert raw materials to finished products and in the process, create value addition. This means a farmer producing milk, a miner producing iron ore or a petrochemical product will be taken through a process whose final product is more applicable to daily use than when it is in the raw state. This then creates value for the product.

We produce a lot of raw materials and export them cheaply to be processed in foreign countries, only to be sold back to us several times more expensively as a finished product. This begs the question, why would we not process the product ourselves and sell it in a far higher price than when we sell it in the raw form?

As Engineers, we must lead the conversation on emphasising local industries to be set up to focus on manufacturing and value addition. This is because the manufacturing industries would greatly create employment opportunities for our countrymen. Of course, Engineers would be really gaining a lot when the manufacturing sector grows.

COVID-19 taught us that building local capacity to produce the essentials we require to survive is important. When the global supply chain was disrupted, we realised that we can no longer rely on India as a world pharmacy, we need to set up our own pharmacies locally to produce what we need and sell the surplus.

We have also witnessed a global shortfall in production of micro chip that has also affected a lot of production of machinery, plant and equipment globally. This should also trigger the need for us to set up the local industries to produce these kinds of products. Generally, every problem is also an opportunity in disguise.

The question of capital always comes up when we look at manufacturing and setting up industries. But where there is a will there will always be found a way.

Granted, there are several factors of production, including land, labour, capital power, and incentives such as available market. It is however important to note that Kenya has a very well-educated populace, which is largely jobless. This is therefore an indication that there is a relatively well-educated workforce available for recruitment.

It should not be hard for the government to provide land as an incentive to investors who want to set up manufacturing industries in Kenya. The Institution of Engineers of Kenya (IEK) will be at the forefront in encouraging the national and county governments to provide these kinds of incentives as well as market Kenya aggressively. The one-county-one-product idea is a great initiative that would ensure every county pursues the effort to set up industries.

The Africa Continental Free Trade Area (AfCFTA) should create one big market for all those willing to set up a manufacturing plant in Kenya. They should easily be able to reach a population of 1.4 billion. This would easily solve the question of market for the products that are manufactured in Kenya.

A stable political environment is also important to ensure business thrives. We urge authorities to provide this kind of environment as well as ensure that the judicial system is capable of resolving any commercial disputes. This will build the reputation of the country as being a preferred investment destination for investors.

Electricity is also a very key component of production. Reliability and cost of power are key in ensuring that industries are able to produce and sell at a reasonable price. All costs of production are passed on to the buyer through the product cost. It is for this reason that Engineers are working hard to provide power solutions that guarantee reliability. This should be our goal as a country to support an aggressive manufacturing industry.

In its half yearly report on power for July – December 2022, the Energy and Petroleum Regulatory Authority (EPRA) confirmed that we reached a peak demand of 2,149MW in December 2022. Our installed capacity is 3,601.76MW and of this over 76% is from renewable sources. This clearly indicates that there is a room for lowering the cost of power and this should be pursued by the government as a matter of policy. IEK is engaging the government in these matters in order to spur the manufacturing potential for this country. We note with gratitude the stated goal of the government to grow the percentage share of industrialisation on our GDP from the current 7% to 20% by 2030. This presents a great opportunity for Engineers to lead in this process of industrialisation.

I now invite you to read this issue and learn the opportunities available in the manufacturing space.

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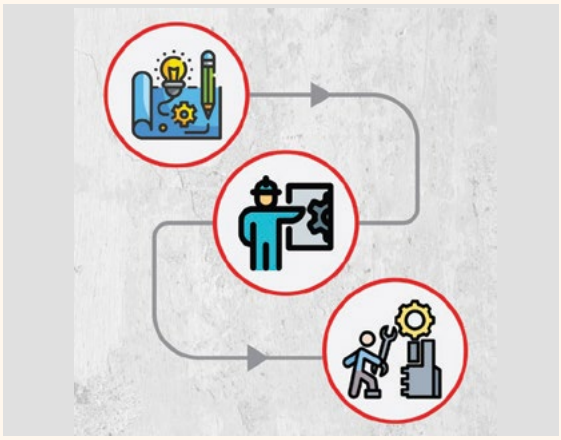

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- Building Engineering Technical Capacity in National and County Governments
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Government's Role in Boosting the Local Manufacturing Industry

Industrialisation PS Dr. Juma Mukhwana in his office at the NSSF Building, Nairobi.

> We have identified 24 counties in Kenya mostly in Western, Eastern and Coastal regions to revive cotton growing. We will partner with private stakeholders to set up ginneries in these regions to grow the textile industry.

An interview with Dr Juma Mukhwana, Principal Secretary in the State Department for Industrialisation

By Maureen Mwangi

Like many other developing countries around the globe, Kenya's traditional mode of industrialisation is agriculture. Therefore, Kenya has vested a lot in manufacturing agricultural products since independence through government-owned firms. These firms were highly protected against unfair competition from imports in a bid to grow the sector and create employment for Kenyans.

In 1990, the country adjusted its structure to create a competitive market for the private sector and the global market. However, the lack of a strong private sector led to emergence of many intermediaries and cartels between the farmer and the market. This dwindled the growth of the manufacturing sector and encouraged exploitation of farmers.

Mismanagement has led to the collapse of most government-owned manufacturing firms, says Principal Secretary in the State Department for Industrialisation, Dr Juma Mukhwana.

The textile industry in Kenya has been wiped out of the market due to the importation of 'mitumba' clothes.

"I grew up as a young man growing cotton and supplying to ginneries. In the current market, textile industry has collapsed and cotton has lost its local market," said Dr Mukhwana during an interview with Engineering in Kenya magazine in his office in Nairobi.

"We have identified 24 counties in Kenya mostly in Western, Eastern and Coastal regions to revive cotton growing. We will partner with private stakeholders to set up ginneries in these regions to grow the textile industry."

The PS says the pyrethrum market, East African Portland Cement Company and sugar factories have as well collapsed, giving room for the private sector to invade the sectors.

"Our work as the government is now to make rules and regulate the sector to make sure it runs fairly, openly and in a transparent way," he says.

The PS now calls for the revision of liberalisation and other government laws on importation to revive and protect local manufacturing firms.

Dr Mukhwana is concerned that the manufacturing sector in Kenya is skewed towards benefiting only a few large-scale manufacturers, with Small and Medium Enterprises experiencing slow growth rate due to inadequate capital and unfavourable economic environment.

Kenya's manufacturing industry faces a myriad of challenges, including use of outdated technology, returns taking long to be realised, Kenyans' preference for imported goods over locally manufactured products, unstructured payment systems that discourage foreign investors, unhealthy business competition as well as the boom of counterfeit trade.

Future of manufacturing

Dr Mukhwana says the future of manufacturing in Kenya is in the development of Small and Medium Enterprises (SMEs).

He says the ministry is focused on growing SMEs through the

development of industrial parks and increased incentives for Kenyans to venture into manufacturing. The industrial parks will be set up in each county for the common use by the local entrepreneurs, and the government will allocate Ksh100 million to each county for works.

The PS says the ministry is currently conducting a feasibility study to determine what is viable to be manufactured in the identified areas. The industrial parks will be co-financed by individual county governments. Additionally, he said, the ministry will develop specialised industrial parks for all construction materials; for instance, a textile park in Eldoret, automotive park through Numerical Machining Complex and Furniture Park at Jamhuri Grounds along Ngong Road.

"For factories to grow there is a need for mentorship of SMEs by large-scale factories to develop value chains. Our industrialisation is stuck because we have a few elephants on the road that are not mentoring the small-scale factories. Instead, the large-scale factories are fighting small-scale ones, hindering growth and causing unhealthy business competition," says Dr Mukhwana.

To solve the problem of delayed payments, which has been one of the biggest obstacles to the growth of SMEs, the ministry presented the Prompt Payment Bill to Parliament that, if passed, will compel the buyers to pay the manufacturers within 14 days of procurement.

"The payment system in Kenya is discouraging local manufacturers from growing their firms as most retailers and government agencies take products on credit. This has led to the collapse of many business firms in Kenya. Nakumatt, for example, collapsed with nearly Ksh13 billion worth of Kenyan," says Dr Mukhwana.

He says the counterfeit market is now outgrowing the manufacturing sector and the country has not done enough to protect the economy from sub-standard products. Therefore, there is a need to create policies to protect the local market from low quality goods.

The ministry is working with relevant industry players such as Kenya Association of Manufacturers to create a directory for manufacturing firms in Kenya with the products that they produce. This will make it easier for the ministry to identify and arrest counterfeit products before they get to the consumer.

The PS asserts that another challenge stifling the growth of local manufacturing industry is the high cost of electricity. To address this challenge, he said, the government is working towards establishing special power rates for industrial use.

He says manufacturing firms should be set up near the primary source of raw materials to cut on transport cost, even as the government deals with the high cost of electricity.

Besides, the technology being used by manufacturing firms is outdated, leading to high cost of production. This means that the government firms cannot compete with the private and international firms in the country.

"It is cheaper to import maize from South Africa, about 3,000km away, and land it in Nairobi compared to buying from a farmer in Kitale," says the PS.

Dr Mukhwana says the ministry is working towards revising the 2009 industrialisation policy and enactment of the Industrialisation Bill for effective regulation of the sector. The Industrialisation Act will set a base for the creation of an Industrialisation Commission that will work with the ministry to grow the sector.

Industrialization Commission will be charged with imposing import levy for goods that can be locally produced. The funds collected from the import levy kitty will then be advanced as loans to local manufacturers to enable them expand their firms.

Reduction of importation of goods and increased exportation will improve the value of the Kenyan shilling against the dollar and other major foreign currencies and grow local manufacturing.

Buy Kenya Build Kenya initiative was implemented during President Mwai Kibaki's era and it advocates for government agencies to procure 30% from Kenyan made goods. Dr Mukhwana says the ministry is working towards promoting the initiative by encouraging the development of local content in every sector.

Kenya remains the manufacturing hub for East and Central Africa, and the African Continental Free Trade Area (AfCFTA) will be a game changer for manufacturing in Kenya. The PS says the ministry is working closely with other African countries to ensure the agreement is signed and ratified.


(Photo Courtesy)

IEK President, Eng Eric Ohaga (centre) hands a copy of Engineering In Kenya to KETRACO Ag. Managing Director Eng Isaac Kiva (right) as EBK's Eng Okere Makokha looks on.

A team from IEK, led by President Eric Ohaga, with their counterparts from KETRACO, led by Ag. Managing Director Isaac Kiva.

Editorial Board Chairman, Eng Prof Lawrence Gumbe, Roads PS Eng Joseph Mbugua, IEK first VP Eng Grace Kagondu, EBK Chairman Eng Erastus Mwongera and IEK Hon. Sec. Shammah Kiteme during the launch of Ajeri publication.

IEK team and Principal Secretary, State Department for Roads, Eng. Joseph Mbugua, (fifth right) display the inaugural issue of Ajeri during the launch of the publication.

EBK Chairman Eng Erastus Mwongera presents a certificate to young innovators for their innovation dubbed 'Eco-Fluido' on World Engineering Day 2023.

IEK First Vice President, Eng Grace Kagondu, presents a certificate to George Otieno for his innovation dubbed, 'Magic Camera'.

The young innovators pose for a photo with their trophies on World Engineering Day 2023.

IEK Acting Chief Executive Grace Wanjihia (left) meets a team from Rural Electrification and Renewable Energy Corporation (REREC).

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Financing Industrialisation in Africa: Challenges and Winning Strategies in the Manufacturing Sector

By Bheki Bhembe

THROUGH numerous policy pronouncements, such as SDGs, Agenda 2063 and African Union's 2011 Action Plan for accelerated industrialisation of Africa, African Development Bank (AfDB) 10-year strategy (2013 – 2022) has recognised industrialisation as a solution to the development deficit of the continent. Industrialisation carries a great potential to support economic growth, diversification and also reduce exposure to external shocks. This will substantially contribute to poverty eradication through employment and wealth creation. The AfDB Africa's resource base as well as market size presents an opportunity to providing the missing middle – value addition or industrialisation.

By advancing actions to achieve Sustainable Development Goal 9, African countries can adopt sustainable industrialisation, innovation and infrastructure to generate employment and income, promote new technologies, facilitate international trade and enable efficient use of resources. Specifically, agro-based industrialisation can support the continent's poverty reduction efforts by helping African countries to grow jobs along the food value chain, raise incomes and close rural-urban inequality gaps, ensuring that 'no one is left behind' by 2030. Doing so calls for embracing advances in digitalisation, skills training, and infrastructure development to leapfrog the continent's industrialisation agenda.

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30%	US$ 1.6 TRILLION	64%	US$ 83 BILLION
FDI GROWTH		FDI GROWTH	

What are the sources of finance for industrialisation?

> The African Development Bank has developed an African Industrialisation Index (AII), inaugurated in 2022, that covers three dimensions and 19 indicators. The dimensions are performance, direct determinants and indirect determinants. Among the direct determinants two sources of finance are identified, namely Foreign Direct Investment (FDI) and domestic credit to the private sector.

FDI flows

FDI flows in 2021 increased by 64%, the highest growth rate in the past decade, partly associated with recovery from COVID-19 that saw FDI plummeting to a low of around US$1 billion. Both developed and developing countries recorded an increase in FDI growth, with the former recording more than a 100% growth and developing countries recording a 30% growth in 2021. Notably in both 2020 and 2021, developing countries' FDI inflows were higher compared to developed countries.

The 2021 US$1.6 trillion FDI flows were largely influenced by recovery from the COVID-19 pandemic that led to a collapse of the economic value chains due to lock-downs and social distancing. Over 80% of the total FDI came from record reinvested earnings of the multi-national corporations (MNCs) that supported mergers and acquisitions. Africa's share grew by

64% to US$83 billion in 2022. While this growth is impressive, it is only 5% of the total Global FDI. Within Sub-Saharan Africa, different regions had different flows. South Africa, being the most industrialised economy, attracted almost half of Africa's FDI flows, US$41 billion, and was the only African country in the top 20 hosts for FDI. Africa has continued to attract investment around renewable energy projects that have become an alternative source of energy for both exports and regional needs. East Africa attracted US$8 billion worth of FDI in 2021, up from US $6 billion in 2020.

Domestic credit to the private sector

The end of COVID-19 has put an end to the low inflation rate period as countries reversed the policy stance implemented during the pandemic period. This was done in response to increasing inflation across the globe as reopening of economies brought about an increase in demand for products. The Russia-Ukraine war also added to the mix by disrupting energy prices. As a result a systematic tightening of the monetary policy across the globe, led by the US, saw other countries following suit to meet the multiple monetary objectives, which include inflation control, financial stability and deflation. This generally made monetary policy complicated post COVID-19 period.

Challenges for financing industrialisation

Pending COVID-19 and Russia-Ukraine war recovery: Despite the impressive 2021 growth, there is a risk that this may not be sustained into the future as investors remain cautious on greenfield investments, given the instability brought about by COVID-19 recovery and the ongoing Russia-Ukraine war. With the prevailing attitude of caution towards greenfield investments by MNCs, this means countries that are better positioned to receive FDI inflows are those that are hosting MNCs within their jurisdictions.

Banking crisis threat: The ongoing threat of a banking crisis in the US may also contribute to the slowdown in FDI inflows. In 2021, the United States was a source of 25% of the global FDI flows. Generally there is tendency for MNCs to support their operations outside of source jurisdictions through inter-company credit facilities, as opposed to borrowing within host countries. This practice is reinforced by higher lending rates outside the United States market. The prevailing concerns around an imminent banking crisis are likely to reduce credit to MNCs for on-lending to sister companies in other countries, which may slow down flows for 2023.

Opportunities

Geopolitical risks: Kenya had successful elections in 2022 that reinforced investor confidence within the economy that long-term investment is welcome in the country. Maintaining this record would be critical not only for the country but for the entire East African Community (EAC) region. Linked to this fact is the prevailing Russia-Ukraine war, which may bring about a repeat of the 2014 Russia economic sanctions. As anticipated reduction in FDI inflows to one country is most likely to lead to an increase elsewhere, which could be the African region.

Trade diversion: From the above analysis it is clear that with the ongoing risks around COVID-19 recovery as well as the implications of the Russia-Ukraine war, new investments would continue to be limited. Countries that are better positioned to receive FDI are those that host MNCs. This factor has worked to the advantage of South Africa, the only African country in the top-20 FDI host economies. Similarly, repositioning of some African countries with capacity to produce some of the products traditionally produced by either Russia or Ukraine, such as gas, has provided an opportunity for those countries to receive FDI.

Deepening of economic integration: MNCs by their nature are poised to service regional markets than country markets. The signing of the AfCFTA agreement has led to African countries reorganising themselves more in alignment with this initiative. In 2022, Kenya launched her National AfCFTA Implementation Strategy that would see deepening of economic integration within the region and Africa-wide. Secondly, the revival of the 2016 Kenya-South Africa Memorandum on Trade and Investment through the Kenya-South Africa Trade Forum promises to better position Kenya and the East African Community to benefit from the leading African FDI host economy.

Conclusion

For African countries to meet most of her SDG and other development targets and reap the demographic dividend at her disposal, industrialisation would be one of the most critical tools to leverage on. This, however, requires balanced navigation and positioning through domestic and regional policy to benefit from FDI inflows as well as protect the organically growing industry within our borders.

Mr Bheki Bhembe is UNDP Kenya Economic Advisor. He is a development economist with over 20 years' experience in economic policy management.

(Photo Courtesy)

We Aim to Have Manufacturing Contribute up to 20% to the GDP this Year, says KAM

KAM CEO Anthony Mwangi

The Kenya Association of Manufacturers (KAM) recently unveiled its 2023 Manufacturing Priority Agenda (MPA). In an interview with Engineering in Kenya magazine, KAM Chief Executive Officer ANTHONY MWANGI delves into the agenda dubbed 20BY30, what ails the local manufacturing industry and how best to make it work.

What is the role of Kenya Association of Manufacturers (KAM) in Kenya's industrialisation efforts?

Kenya Association of Manufacturers (KAM) is the representative organisation for manufacturing value-add industries in Kenya. KAM provides an essential link for co-operation, dialogue and understanding with the government by representing the views and concerns of its members to the relevant authorities.

The Association promotes trade and investment, upholds standards, encourages the formulation, enactment and administration of sound policies that facilitate a competitive business environment and reduce the cost of doing business.

KAM recently launched the Manufacturing Priority Agenda. How will this boost the manufacturing sector?

Kenya Association of Manufacturers develops the Manufacturing Priority Agenda (MPA) at the beginning of each year to guide its advocacy geared towards manufacturing sector competitiveness.

> This year's Priority Agenda, themed Resetting Manufacturing to achieve Agenda 20BY30, presents proposals that will transform the manufacturing sector, if implemented. The aim is to contribute 20% to the GDP from the current 7.2% as outlined in the Kenya Manufacturing 20BY30 agenda, with a potential of increasing direct jobs from the current circa 348,000 to circa 980,000 jobs.

The MPA is clustered into four pillars; namely, Global Competitiveness, Export-led Industrialisation, SME Development, and Industrialising Agriculture.

How is the Association working with the government to ensure this agenda is achieved? Are there any other stakeholders you are working with to ensure the agenda is achieved within its stipulated timelines?

The Association is committed to achieving the goals set out in our MPA, and we will work closely with both national and county governments and development partners towards the industrialisation vision for Kenya. We look forward to working together for manufacturing competitiveness.

We have outlined our Agenda under each pillar of the MPA 2023, as follows:

- **Global competitiveness:** Some of the actions that can enhance Kenya's industrial competitiveness include reducing regulatory burden, promoting access to quality, affordable and reliable energy, reducing transport and logistics costs, sustaining the fight against illicit trade, creating manufacturing-centric counties, ensuring certainty and predictability of tax policies, lowering the cost of industrial inputs, incentivising prompt payment culture and providing long-term financing for manufacturers. These measures will increase the capacity of local industries to compete globally.
- **Export-led industrialisation:** Export-led industrialisation is based on the production of manufactured products for sale in the international market. This calls on Kenya to

leverage on products that have a comparative advantage to grow our exports while increasing export basket of high technology goods. However, we cannot speak of growing our export potential without addressing access to local markets. Not only does it lead to increased market shared by local industries, but it is also a useful platform for manufacturers to develop their export capacities. As such, the challenges inhibiting local consumption need to be addressed. Fast-tracking and conclusion of all pending issues under trade agreements such as the African Continental Free Trade Area (AfCFTA), and Free Trade Area (FTA) between Kenya and USA are important on this front.

- **SME Development:** The government is keen on SME development to uplift incomes of "hustlers" through the "bottom-up economic model". SMEs at KAM constitute about 52% of members and through the Manufacturing SME Hub can benefit, especially in targeting main challenges they face in the pulled effort created to complement government efforts. Some of the intervention areas to promote SMEs include access to finance, implementation of Preferential Procurement Master Roll, enactment and implementation of the Local Content Bill, 2018 and passage of pending SME enabling legislation/bills.
- **Industrialised Agriculture:** A focus on agro-industry value chain will lift incomes of more than 8.6 million farmers, a majority of whom are small-scale. Value addition of agricultural products will not only increase the income of farmers, but also earn more foreign exchange through exports. Some of the actions that the government can pursue include prioritising food security, reducing the cost of farmers' inputs, improving technical services and enhancing agricultural productivity.

From where you sit, do you believe there is over-taxation by the government, and how do you think this is affecting the local manufacturing industry?

Taxation should drive global competitiveness for locally produced goods and services, which, in turn, boost economic growth. However, in Kenya, our tax policies stifle growth, as the business community grapples with over taxation and an unpredictable tax regime.

The tax system should be designed to promote social, political, and economic development. Tax policies and laws on investments should be long-term, focused and tenured to enable investors to plan with reasonable certainty. In particular, the National Tax Policy should:

- Enhance the competitiveness of the manufacturing sector.
- Ensure stable and predictable tax policies that support the long-term planning of businesses.
- Promote exports.

Kenya has been enacting tax laws that disincentivise manufacturing despite the low capital investment in the country. These tax laws include introduction of 16% VAT on imported plant and machinery, reversal of investment deductions allowance (IDA), and limiting interest deductibility to 30% of earnings before interest, taxes, depreciation (EBITDA). This has major unintended consequences such as raising income tax on capital intensive businesses to over 60% and bankrupting businesses.

The following actions should ensure certainty and predictability of tax policies to encourage industrial investments:

- Finalise and implement a pro-industry National Tax Policy.
- Revert investment deduction allowance to 150% or 75%, in the first year, and 37.5% in the second and third year or 50% in the first, second and third year.
- VAT exemption on plant and machinery of Chapter 84 and 85 used for the manufacture of goods.
- Revert to pre-Finance Act 2021 basis for interest restriction under thin capitalisation rules to the ratio of debt to equity of 3:1.

How is the Kenya Association of Manufacturers working with stakeholders to create a competitive and sustainable manufacturing industry in Kenya?

The manufacturing sector requires a conducive business environment to thrive. This is only possible through a multi-stakeholder approach.

KAM works with the government, development partners and our members to promote competitive and sustainable manufacturing in Kenya.

We advocate for the government to create an enabling environment for manufacturers in Kenya, and subsequently enhance local industry's competitiveness.

Our development partners continue to support various initiatives such as the TVET programme, SME Hub, and Women in Manufacturing (WIM) as well as green growth, climate change and energy efficiency and conservation services.

What challenges need to be addressed by the government and other stakeholders in the manufacturing sector to enhance healthy business competition?

As mentioned earlier, our MPA 2023 launched earlier this year outlines different challenges facing manufacturers and their solutions, under every pillar. These include:

- Global competitiveness
  - Reducing regulatory burden
  - Promote access to quality, affordable and reliable energy for manufacturing
  - Reduce transport and logistics costs
  - Sustain the fight against illicit trade
  - Manufacturing-centric counties
  - Ensure certainty and predictability of tax policies to encourage industrial investments
  - Lower the cost of industrial inputs
  - Incentivise prompt payment culture
  - Avail long-term financing to manufacturers
- Export-led industrialisation
  - Enhance domestic market access
  - Enhance EAC market access
  - Diversify international market access
- SME Development
  - Access to finance
  - Market access
  - Governance
- Industrialising agriculture
  - Value chain integration
  - Competitive industrial inputs
  - Mechanization of agriculture

We continue to work with all stakeholders to resolve these challenges and transform Kenya into and industrial-led economy.

Mechanical Engineering Solutions for Agricultural Challenges in Kenya: Addressing Drought and Pest Management through Mechanisation, Automation, and GM Crops

By Bruce Oyugi Nyainda

Introduction

KENYA'S agricultural sector is facing a slew of challenges, including drought and pest infestations, which are lowering crop yields and jeopardising food security. The incorporation of advanced technologies such as mechanisation, automation, and genetically modified (GM) crops can play a critical role in addressing these challenges and improving the agricultural sector's productivity and sustainability.

Mechanisation and Automation: Overcoming the Challenge of Drought

Mechanisation and automation can assist in addressing the drought challenge by improving water management and reducing water waste. Automated irrigation systems, for example, can be programmed to deliver the exact amount of water required by crops, reducing water waste and increasing crop yields. Furthermore, the use of farm machinery can aid in water conservation by reducing the need for manual labour and allowing farmers to cultivate more land with less water.

The Rise of GM Crops: A Response to Pest Management Challenges

The use of genetically modified (GM) crops is another important area of opportunity at the intersection of engineering and agriculture. These crops are engineered to be pest and disease resistant, reducing the need for pesticides and herbicides while increasing crop yields. Furthermore, GM crops can be enriched with essential vitamins and minerals that are frequently lacking in Kenyan diets, improving food security and nutrition.

Barriers to Adoption

Despite the benefits of these engineering solutions, there are several challenges that must be overcome to promote their widespread adoption in Kenya. These include:

- High Costs: The high cost of equipment and technologies is a major barrier to their adoption, particularly for small-scale farmers and rural communities.
- Skilled Labour Shortage: The lack of trained personnel to effectively operate and maintain equipment and technologies is also a challenge.
- Public opposition: There is often public opposition to GM crops due to concerns about their health and environmental risks.
- Regulatory Limitations: The lack of regulation and oversight for the development and use of GM crops in Kenya can limit their adoption and use.

Facilitating Adoption

To address these challenges and facilitate the adoption of these engineering solutions in Kenya, the following steps are essential:

- Investment in R&D: Investment is required in research and development to improve equipment and technologies, as well as to develop new GM crops that are suitable for Kenya.
- Capacity Building: Farmers and agricultural workers must be equipped with the skills and knowledge necessary to effectively operate and maintain equipment and technologies.
- Strengthening Regulation: The Kenyan government and international organisations must establish clear policies and guidelines for the development, testing, and deployment of GM crops in Kenya to ensure their safe and responsible use.
- Public Education: Comprehensive public education campaigns are necessary to dispel misconceptions about GM crops and promote their benefits.

Conclusion

Finally, the incorporation of advanced engineering solutions in Kenya's agricultural sector represents a promising path forward in addressing the complex challenges posed by drought and pest infestations. We can improve the sector's efficiency, sustainability, and food security by deploying mechanisation, automation, and GM crops, while also supporting economic development, reducing poverty, and raising the standard of living for farmers and rural communities. To fully realise this potential, however, we must overcome adoption barriers through investment, capacity building, public education, and strengthened regulation.

Bruce Oyugi Nyainda,
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National Housing Corporation

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What it Takes to Become a Manufacturing and Mechanical Engineer and the Hierarchy in Practice

Authors:

Eng. Christopher Tuluba (B.Tech.Hons. MSC. MIEK, PE)

Eng. Boniface Karobia (B.Tech. Hons. MIEK, PE)

MECHANICAL Engineering is the study, design, construction and maintenance of mechanical systems. It is basically the branch of engineering associated with the construction of machines. It involves advanced application of physics, chemistry, mathematics and physical sciences in the design of mechanical systems. Mechanical engineering has a number of specialisations at higher levels of study. These include; production, manufacturing, automotive and mechanical building services. Other close affiliated branches of mechanical engineering include aeronautical, agricultural & biosystems, mining, petroleum and energy.

The learning and training of Mechanical Engineers is highly regulated. The university degree programmes are accredited by the Engineers Board of Kenya (EBK). The universities offering the degree programme in mechanical engineering have increased many folds. Initially only the University of Nairobi was offering the programme but over time other colleges have started. They include Moi University, Jomo Kenyatta University of Agriculture and Technology, Kenyatta University, Technical University of Kenya, Dedan Kimathi University, among others. The universities are also required to have practising engineers as part of teaching staff.

The Mechanical Engineering degree programmes usually take five years in most of the local universities. The time under study is distributed into machine theory study, experimentation and prototyping in the workshops, industrial visits and attachments. The machine theory is meant to equip the student with all the principles of science and mathematics needed in design, construction and maintenance of mechanical systems. The prototyping is meant to equip the student with hands-on skills to convert theory blueprint designs into products. The industrial attachments are meant to equip the learner with technologies in practice, production planning, quality management and other industrial management practices. The student is also involved in machine maintenance routines, system installations, machine diagnostics procedures, and undertakes production duties such as fabrication, machining, welding, cutting, bending, joinery and other holistic plant management practices.

> The student on graduation is faced with various employment opportunities where he/she applies the training acquired in design, construction and maintenance of mechanical systems. These employment opportunities for Mechanical Engineering graduates are in the following areas:

Public sector

- Energy – engaged in exploration, generation, production, transmission, distribution, fuel pipeline works, among other duties.
- Construction – engaged in mechanical building services, industrial mechanical services.
- Transport – involved in automotive, earth moving machinery, railways, ports, airlines and airports.
- Agriculture – involved in agricultural machinery.
- Maritime – involved in ships logistics, construction and maintenance of ships and management of ports.
- Defence and security – involved in combat engineering, policing works and intelligence roles.
- Quality assurance – involved in managing standards.

Private sector

- Energy – engaged in exploration, generation, production, transmission, distribution, oil distribution works, among others.
- Construction – engaged in mechanical building services and industrial mechanical services.
- Transport – automotive, earth moving plant machinery, railways, airlines and airports
- Agriculture – involved in agricultural machinery.
- Maritime – involved in ships logistics, construction and maintenance of ships.
- Quality assurance – involved in managing standards.

Research sector

- Engaged in teaching and training of student engineers and technicians.

The Student Engineer on graduation joins any of the sectors mentioned previously and is designated as an assistant engineer. The Assistant Engineer is supposed to understudy a senior engineer in the field and is guided on the design procedures,

design calculations and building or construction of the mechanical systems. This may take a minimum of three years or more. The Assistant Engineer is expected to document a project he has undertaken from inception to completion stage and submit it to the EBK for consideration in the interview for a Professional Engineer. The Assistant Engineer upon successfully passing the interview is transitioned into a Professional Engineer (PE). As a Professional Engineer he/she is given the authority to design and supervise construction without direct supervision. The PE is expected to consult widely and apply self-knowledge rigorously in coming up with the mechanical systems designs. The Mechanical Engineer spends most of their practice as PE until they transition to a Consulting Engineer, the highest level one can attain. The Mechanical Engineer must improve continuously by attending seminars, workshops, studying and researching fervently, mentoring upcoming engineers, playing advisory roles to government and other organisations on policy issues.

The progress of Mechanical Engineers has not been very swift to match the speed at which the learning institutions have been churning out graduates. This is partly due to the fact that the Kenyan economy is basically agricultural and operates at extractive stage. This means there are limited value addition chains (industries) to our agricultural produce and minerals. Secondly, the influx of cheap inputs lowers the appetite to set up factories to produce these items. Thirdly, limited incentives to individuals willing to set up industries, which are usually capital intensive ventures.

Despite the many challenges the future is not bleak as a result of the following initiatives being spear headed by the government. First, there is aggressive promotion of manufacturing sector by setting up special economic zones for investors willing to set up industries. Secondly, the setting up of Konza Technopolis and other hubs to attract industrialists. Thirdly, the rebasing of our economy to a middle-income country means the country has to industrialise to remain in this level.

The mechanical engineering field has also had emerging advancements over the years. The interface between mechanical, electrical/electronics and climate consciousness implies the mechanical engineering graduate must progressively be acquainted with the following fields.

- 3D printing – process in which a digital file is used to create a three dimensional solid object.
- Robotics and automation – the interface between machines and electronics.
- Green technologies – the paradigms shift to cleaner energies.
- Climate change compliance – the shift to climate adaptive mechanical designs.

In conclusion, mechanical engineering is a branch of engineering that deals with study, design, construction and maintenance of mechanical systems, which is the core of industrialisation. The five-year university training entails acquisition of advanced knowledge and rigorous study of the science and mathematics subjects, workshops prototyping and industrial attachments, making the student well acquainted with skills needed in practice. Kenya requires to transition to middle-income economy (industrialised) as matter of priority; thus, there is bound to be demand for these skills. The opportunities this paradigm shift portends are enormous for the Mechanical Engineering graduates. The graduates have a chance to practise and reach the highest level as consulting mechanical engineers. The future of Mechanical Engineering is bright in the country as a result of the government's sharp focus on setting up the appropriate policy and providing incentives to the investors willing to set up the industries. Finally, the advancement in Mechanical Engineering in 3D printing, advanced robotics development and automation provides practitioners with interesting fields to explore and major in.

Eng. Boniface Karobia is the Acting Chief Engineer, Mechanical (Building Services), at the State Department for Public Works.

Eng. Christopher Tuluba is a Consultant in Building and Energy Services

(Photo Courtesy)

AJERI: First African Journal of Engineering Research and Innovation Launched

By EiK Correspondent

> The African Journal of Engineering Research and Innovation is a peer-reviewed academic journal that focuses on publishing research articles in the field of engineering, particularly on topics that are relevant to Africa. The journal aims to promote innovative research and solutions that can contribute to the development and progress of the continent.

THE World Engineering Day for Sustainable Development (WED) was proclaimed by UNESCO at its 40th General Conference in 2019 and is celebrated worldwide on 4th March of each year. The day offers an opportunity to highlight engineers' and engineering's achievements in the modern world and improve public understanding of how engineering and technology are central to modern life and for sustainable development. The Institution of Engineers of Kenya (IEK) in collaboration with the Engineers Board of Kenya (EBK) on 4th March, 2023 joined the global engineering community in observing World Engineering Day. The theme for this year's celebrations was, 'Engineering innovation for a more resilient world'.

The WED celebrations were held in Nairobi and at the IEK branches countrywide. In Nairobi the institution held a procession from the University of Nairobi to Kenyatta Avenue and back to the University of Nairobi.

The climax of the celebrations was the launch of the 1st African Journal of Engineering Research and Innovation (AJERI) at the University of Nairobi's Chandaria Hall.

The journal is expected to encourage more research and development in the field of engineering, as well as promote collaboration among researchers and practitioners in Africa and beyond.

By providing a platform for researchers to share their findings and ideas, the African Journal of Engineering Research and Innovation can contribute to the advancement of engineering in Africa, which in turn can have a positive impact on various aspects of society, such as infrastructure development, energy, healthcare, and environmental protection.

Speaking during the launch, the IEK Editorial Board Chairman, Eng Prof Lawrence Gumbe said AJERI presented an opportunity for students pursuing engineering studies at universities in Africa for a short turnaround for publication, hence a shorter study period.

The launch was presided over by the Permanent Secretary for Roads, Eng Joseph Mungai Mbugua, who commended the IEK for the great milestone achieved. He termed the launch of AJERI as a landmark publication that had placed Kenya in the global scene. Eng Mbugua added that the launch of the journal was a promising development that can help support the growth and progress of the engineering industry in Africa.

Editorial Board Chairman Eng Prof Lawrence Gumbe, Roads PS Eng Joseph Mbugua, EBK Chairman Eng Erastus Mwongera and IEK first VP Eng Grace Kagondu lead the launch of Ajeri.

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Industry 4.0 Smart Factory:

Transforming the Manufacturing Sector through the use of Technology to Improve Efficiency, Production Management and Quality

By Eng. Pius Churu Githu

INDUSTRY 4.0 Smart Factory: Transforming the manufacturing sector through the use of technology to improve efficiency, production management and quality.

Industry 4.0 (Fourth Industrial Revolution) is the arguably the most contemporary issue in manufacturing and an important phase in the digitization of the manufacturing sector. Driven by disruptive trends including the rise of data and connectivity, analytics, human-machine interaction, and improvements in robotics, this new and disruptive revolution has come a long way through cycles of industrial metamorphosis from Industry 1.0, that was only referred as industrial revolution and made the first significant footprint in human history, even as some say 'causing significant collapse of slave trade'.

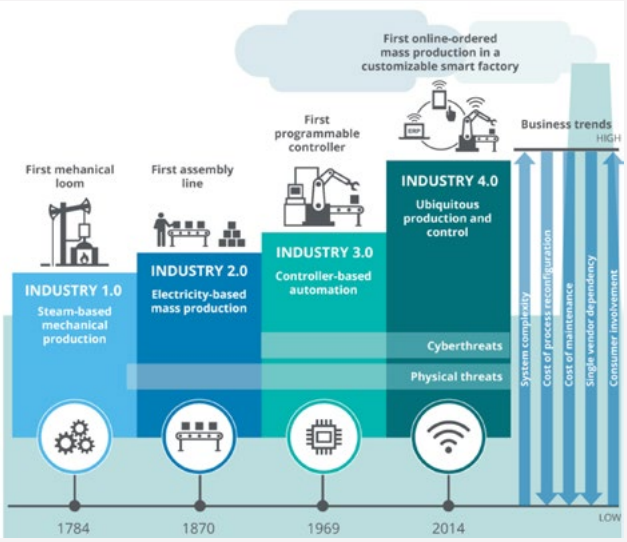

Figure 1: Evolution of Industry 4.0 (Source: Deloitte, 2021)

Evolution of Industry 4.0

The First industrial revolution, starting in the late 18th century, allowed mass production by using water and steam power instead of purely human and animal power. Finished goods were built with machines as opposed to being painstakingly produced by hand.

Second industrial revolution which happened a century later and introduced assembly lines and the use of oil, gas and electric power. These new power sources, along with better advanced communications via telephone and telegraph, brought mass production and some degree of automation to manufacturing processes.

The third industrial revolution began in the middle of the 20th century and added computers, advanced telecommunications and data analysis to manufacturing processes. The digitization of factories began by applying programmable logic controllers (PLCs) into machinery to help automate some processes, collect and share data. *(Source: IBM, 2023)*

Fourth industrial revolution is characterized by increasing automation and the employment of smart machines and smart factories, informed data helps to produce goods more efficiently and productively across the value chain. Ubiquitous production and control refer to versatile and smart access to production monitoring and control. Manufacturers are integrating new technologies, including Internet of Things (IoT), cloud computing and analytics, and Artificial Intelligence (AI) and machine learning into their production facilities and throughout their operations. By amassing more data from the factory floor and combining that with other enterprise operational data, a smart factory has more information transparency and better decisions. Industry 4.0 is revolutionizing the way companies manufacture, improve and distribute their products.

Key focus areas under industry 4.0 include:

- Embedded systems
- Cyber security
- Cloud Computing
- IoT (Internet of Things)
- 3D Printing and Additive manufacturing
- Big Data
- Smart Manufacturing/Smart Factories
- Autonomous Robots
- Augmented Reality

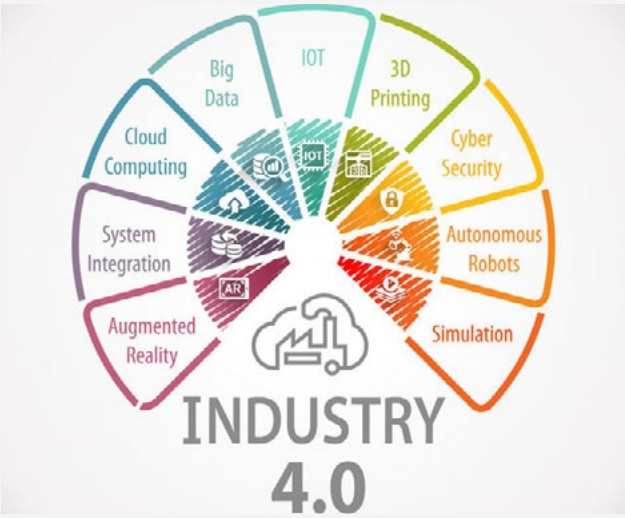

Figure 2: The Nine Pillars of Industry 4.0 (Source: Circuit Digest, 2019)

Role of Smart Factories/Smart Manufacturing in enhancing industrial efficiency

> Developing smart factories provides an incredible opportunity for the manufacturing industry to enter the fourth industrial revolution. These smart factories are equipped with advanced sensors, embedded software and robotics that collect and analyse data and allow for better decision making. Even higher value is created when data from production operations is combined with operational data from Enterprise Resource Planning (ERP), supply chain, customer service and other enterprise systems to create whole new levels of visibility and insight from previously 'siloed' information.

Analyzing the large amounts of data collected from sensors on the factory floor ensures real-time visibility of manufacturing assets and can provide tools for performing predictive maintenance in order to minimize equipment downtime.

These digital technologies lead to increased automation, predictive maintenance, self-optimization of process improvements and, above all, a new level of efficiencies and responsiveness to customers not previously possible.

Using IoT devices in smart factories leads to higher productivity and improved quality. Replacing manual inspection business models with AI-powered visual insights reduces manufacturing errors and saves money and time. With minimal investment, quality control personnel can set up a smartphone connected to the cloud to monitor manufacturing processes from virtually anywhere. By applying machine learning algorithms, manufacturers can build on Big Data technology and leverage on autonomous capacity to predict and detect errors, plan better and make real-time interventions in manufacturing systems

Industrial control systems (ICS) are systems used as critical infrastructures in smart factories for supervisory control, data acquisition, and industrial automation. Vital systems and services of modern society controlled by ICS processes include electrical energy generation and delivery; petroleum and gas refining and pipelines; water distribution and treatment; chemical processing and production; pharmaceutical, food and beverage production; and even support critical national infrastructure like railway transportation, port operation and air traffic control

Enhancing worker safety and operations continuity with secure operator controls

Technological development has allowed development of real-time remote control of a smart factory even from kilometers away. Engineers are able to remotely and safely operate machinery in an industrial center run primarily by robots and automation rather than human employees. This concept has especially useful application such as hazardous environment and application where human being safety would be ordinarily compromised where use of smart manufacturing and advanced robotics becomes extremely convenient. Some technologies being used to make manufacturing safer and efficient include:

- **Digital Twin:** By creating virtual models of a factory, machine, or product, users can better test and optimize their assets, test out new workflows, or even revise products to improve functionality in a risk-free environment.
- **Machine Learning Based Visual Inspection:** Remove the human element from simple monitoring and inspection tasks by utilizing high-res cameras and machine learning algorithms to perform these menial tasks.
- **Autonomous Mobile Robots:** Utilizing Complex AI, these robots can work independently of human operators to perform mission-critical tasks, maintenance, or simply automate production on the factory floor.

Emerging vulnerabilities:

Most Smart Factories that connect to the internet are required to put cybersecurity at the forefront.

Manufacturing is one of the most commonly targeted industries for hackers, with malware attacks in particular devastating several organizations in recent years.

In December 2015, more than 230,000 Ukrainians in three different regions suddenly found themselves without electricity on a cold winter evening. A single, coordinated attack had taken down 30 public power substations. The attack may have seemed sudden to the utility company, but it was the result of careful plotting over the course of six months on the part of the cybercriminals. They used a combination of phishing, keylogging, VPN hijacking, denial of service and even firmware modification. This was among the major cyberattacks on industrial systems and caused the entire world to rethink cyber security in smart factories.

There are many rational solutions that engineers can employ in order to improve their security efforts. For instance, making sure that every device within the factory is up-to-date on all software updates and security patches eliminates one of the most common risk factors for IoT devices.

This can go a stage further by designing solutions to avoid the public internet. By utilizing private networks to avoid public IP addresses, eliminating the easiest entry point for compromising factors of the smart factory. Cyber security training for any staff that may interact with connected devices within manufacturing can also tighten up security efforts considerably.

Smart factories thus present increasing challenges linked with advanced control failure risks and cyber-attacks. Industrial systems are increasingly demanding frequent upgrades, firewalls, online support and increased collaboration

Conclusion

With the increasing need for efficiency, autonomy of machines, data analytics and remote monitoring, smart factory concept is a disruptive technology that will require the manufacturing industry to rethink and adopt to the new normal. New set of skills and adaptability among the engineering workforce is required to successfully be globally competitive in manufacturing. It is therefore imperative that the players embrace the new development in order to remain competitive while also enlightening themselves of the new developing challenges and leveraging on the emerging opportunities.

Eng. Pius Churu Githu
Senior Superintending Engineer- Maintenance at Numerical Machining Complex Ltd.

(Photo Courtesy)

NuPEA
NUCLEAR POWER & ENERGY AGENCY

Mandate

Nuclear Power and Energy Agency (NuPEA, formerly the Kenya Nuclear Electricity Board (KNEB) is a State Corporation established in law through the Energy Act No.1 of 2019. The Agency's mandate as stipulated in Section 56(1) Act are to: a) be the nuclear energy programme implementing organization and promote the development of nuclear electricity generation in Kenya; and (b) carry out research, development and dissemination activities in the energy and nuclear power sector.

Vision

A premier hub for nuclear power development and sustainable energy solutions

Mission

To develop nuclear power, and undertake research and capacity building in the energy sector for socio-economic prosperity

Core Values

I-TEC:
Integrity
Teamwork
Excellence
Creativity
innovativeness

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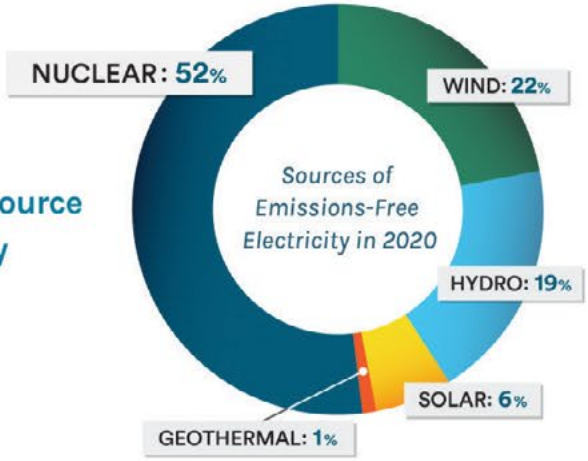
FACTS ON ENERGY

1

Nuclear power plants produced **790 billion kilowatt hours** of electricity in 2020.

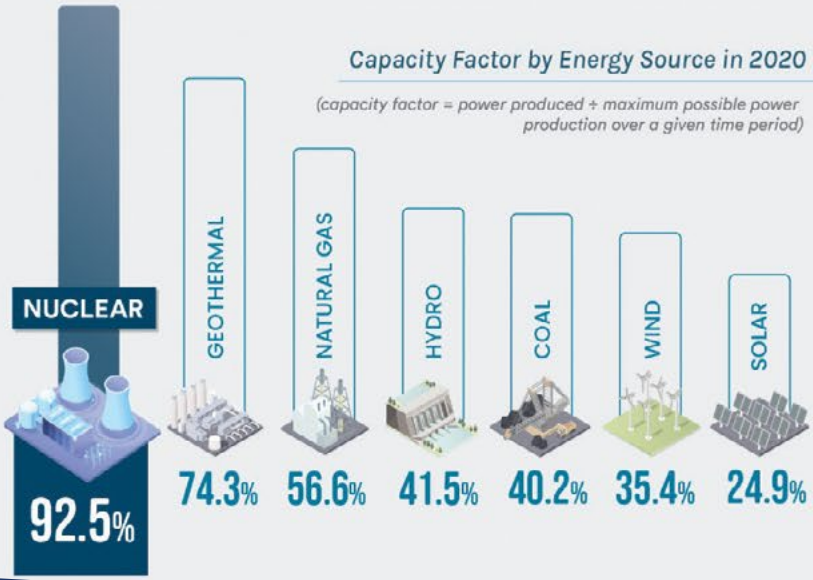
2

Nuclear power is the **largest source of clean energy**



3

Nuclear is one of the **most reliable energy sources.**



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Manufacturing and Mechanical Engineering Education at Kenyatta University

By Jackline Mwende

THE manufacturing sector is critical in sustaining economic growth and development globally. For developing countries such as Kenya, the sector is not fully established as the agricultural sector is considered the main economic booster (Kenya National Bureau of Statistics Survey 2022). Some of the factors hindering robust growth in the manufacturing sector include competition from imported goods, minimal automation of processes, and the high cost of capital financing. Engineers are vital in running the sector. A report on the manufacturing industry in Kenya highlighted the lack of adequate technical skills to fully support the growth in the sector as a major drawback to its growth. As a result, the local manufacturing sector cannot compete with developed countries that have advanced education and training systems (The Implementation of Technological Aids and ERP Solutions; In the Manufacturing Industry in Kenya, SYSPRO Proprietary Limited and Strathmore University, 2019). Training of individuals in the different specialisation areas within the sector is paramount.

The Department of Mechanical Engineering at Kenyatta University has been training students for more than 10 years. The programme, recognised by the Engineers Board of Kenya (EBK), prides itself in training students in the areas of design, manufacturing, thermal and dynamic systems. To ensure the continuous growth of the programme, Kenyatta university continues to engage well-trained lecturers and support staff, purchase of modern laboratory and workshop equipment, and enhance linkages with industry partners.

Periodic review of the curriculums, taking into key consideration inputs from the industry partners, is one of the strategies adopted by Kenyatta University to ensure that the engineering students are trained based on the industry requirements. The students undergo a compulsory four-month attachment in the industry prior to graduation. It is from this industry exposure that they are able to identify challenges experienced in the industry and propose projects in their final year of study addressing these shortcomings. Projects that have a potential for commercials are then incubated at the Chandaria Incubation Center.

> Recently, some of the final-year students pursuing a Bachelor's degree in Mechanical Engineering implemented a project aimed at designing, fabricating, and testing a low-energy automatic 440-egg capacity incubator using locally-sourced materials. The research project addressed some of the challenges faced in the poultry industry such as inadequate and unreliable energy for egg incubation, which translates to low productivity and profitability for smallholder farmers living in rural areas.

The novel humidification technology incorporated in this model aimed to significantly reduce energy consumption during the humidification process. Its low energy requirements allowed for easy integration with other energy sources apart from the main grid, such as solar photovoltaic systems. This is in line with one of the 'Big Four' agenda on enhanced manufacturing, an economic blueprint developed by the Kenyan government to foster economic development and provide a solution to the different socio-economic problems facing Kenyans (Ministry of Energy – Kenya, 'National Energy Policy,' 2018). In addition, the project supports the implementation of Sustainable Development Goal 13 on Climate Action, which aims at regulating emissions and promoting renewable energy (United Nations, Sustainable Development Goals Report, 2019).

Kenyatta University continues to support the Mechanical Engineering department activities such as the running of a production unit. This is a departmental initiative that seeks to use the engineering skills of both the staff and students to solve challenges within the university. Some of the projects that have been addressed include servicing the Kenyatta University mortuary and the production of drawing tables for students in the Architecture department.

While there is great room for growth in the manufacturing and mechanical engineering sector in Kenya, more resources should be deployed towards skill development, including

Kenyatta University Mechanical Engineering students during their workshop practical session.

Kenyatta University Mechanical Engineering students during their project presentation.

both education and training. Research-based knowledge transfer will not only encourage innovation but also entrepreneurship among graduate engineers. This will then translate to job creation and economic growth.

Jackline Mwende Mutunga is a registered graduate engineer with the Engineers Board of Kenya, and currently a Tutorial Fellow in the Department of Mechanical Engineering at Kenyatta University.

Ensuring Seamless Connectivity and Quality Built-up Environment in the Transport Sector: The Mandate of Mechanical and Transport Division

By Eng. Richard Thitai

Why Mechanical and Transport Division was established

THE Mechanical and Transport Division (MTD) is one of technical divisions in the State Department of Roads, under the Ministry of Roads and Transport. Its core mandate is to provide advisory services to government on all mechanical services and support the operation and maintenance of its fleet. It was established in 1949 as the Chief Technical Advisor to the Government on all matters related to Mechanical and Transport services with a mission of repairing and maintaining government vehicles and equipment used for construction and maintenance of roads and other infrastructure.

Core Mandate and Functions

MTD has the following functions:

- Co-ordination of procurement, standardization and maintenance of public service vehicles, plant and equipment;
- Provision of professional and technical services to the national government, public institutions, county governments and state corporations on procurement, repair, maintenance and disposal of vehicles, plant and equipment;
- Provision of equipment for development and maintenance of roads and other physical infrastructure on hire basis;
- Fabrication and repair of safes and cash boxes for the National Treasury;
- Conduct of suitability and occupational tests for drivers and plant operators for MDAs;
- Provision of all kinds of mechanical, plant, equipment and motor vehicle inspections.
- Implementation of Kenya Standard, KS 1515:2000 code of practice for inspection of road vehicles for roadworthiness; and,

i. Provision of Government transport services.

ii. Management of the Mechanical Transport Fund (MTF).

All the functions are fundamentally aimed at supporting the State Department of Road to fulfill its mandate. They are confined within the public service except equipment hire service, and are of a regulatory/advisory nature – activity notwithstanding.

Achieving seamless connectivity and quality built-up environment

Mechanical and Transport Division has been collaborating with all the stake holders to achieve seamless connectivity and quality built-up environment in the following ways;

It has helped in capacity building of local contactors through operation lease of vehicle plant and equipment since the year 2006 to a point where many of them have their fleet of equipment and can undertake major projects in the country. We are still supporting upcoming contractors especially Women, Youth and People with Disability through the same operation lease under Mechanical and Transport fund.

The vehicle plant and equipment inventory in mechanical and transport division is a strategic pool supported with very well-trained Operators, Mechanics, Technicians and Engineers that the government can deploy in disasters and can also be used to support the military in situations of adversity. This was well demonstrated during the construction of the security wall in the Kenya-Somali border.

Mechanical and Transport has been supporting all the roads agencies undertake projects that are of emergency in nature like response to disasters for example MTD collaborated with Kenya National Highways Authority (KeNHA) in responding to the crack that developed at a section of Mai Mahiu – Naivasha road due to underground river erosion.

Mechanical and Transport Division was instrumental in the setting up (National Transport and Highways Authority (NTSA) as most of its pioneer staff were seconded from mechanical and Transport.

Mechanical and Transport Division is well suited in supporting NTSA in carrying motor vehicle inspection and ensure a more safe national vehicle fleet in both private and public in that it has a country wide reach, It has very well trained and experienced inspectors, it is in the process of sourcing for funding for setting up inspection centres and is the only organization the government of Kenya can initiate an affirmative action to lower the cost of inspection and make it more accessible and ensure compliance even to motorcycle riders given the high cost of inspection infrastructure and the fact that MTD holds land in trust of the public throughout the country .

After the promulgation of the constitution, a political decision was made to devolve 80% of MTD vehicle and plant to the counties which was geared towards building in the counties, most of the counties had no experience in fleet management and most of it was run down. Mechanical and Transport Division has been bridging this gap through partnering with county government in undertaking their roads projects and ensure effective service delivery.

Capacity building of Mechanical Engineers

Mechanical engineers play an important role in the automotive and manufacturing industries. They design, develop, build and test all sorts of mechanical devices, tools, engines and machines.

They identify a problem, we analyse it to see how a mechanical device might solve it, design and develop a mechanical device to address this problem.

> MTD has a number of mechanical engineers. It is likely to be having the highest number of mechanical engineers than any other single institution with a pool of 63 engineers. It has 16 registered engineers, 32 awaiting registration while 15 are currently undergoing training.

Mechanical and Transport Division has been in the fore front of enhancing the capacity of Mechanical engineers in the country through several interventions including:

- Regular recruitment of fresh graduates from universities offering mechanical engineering.
- Provision of internships through public service commission.
- MTD has always ensured that all the engineers in the division are up to date with their subscriptions to both Engineers Board of Kenya (EBK) and the Institution of Engineers of Kenya (IEK) by paying their annual subscriptions.
- MTD has been encouraging its engineers to be active in dissemination of information relating to mechanical engineering in magazines supported by IEK such as the Engineering in Kenya and the preceding Kenya Engineer.
- In every financial year MTD set a budget for projects that will assist engineers serving in the division to transition from graduate engineers to professional engineers and from professional to consulting engineers.
- Through the public service and the ministry of roads, MTD ensures that most engineers serving in the division have opportunities to further their education locally and internationally.
- MTD provides attachments to students pursuing undergraduate courses in mechanical engineering from local universities.

Standardisation of vehicles, plant and equipment

All National Government departments and agencies, and County Governments when procuring vehicles, plant and equipment get technical specifications (specs) from MTD when procuring vehicles, plant and equipment. These specs constitute a critical part of the tender documents. This is accordance with Legal Notice 69 of 2020 for the Public Procurement & Disposal Act section 173. The specs provide a tender document that is fair to all bidders (level playing field hence fair price to client), ensures a final product with latest and modern technology and which does not infringe on the laws of the country.

In addition, MTD provides technical assistance during tender evaluations process and in pre-delivery inspection of procured vehicle, plant and equipment for compliance with tender specifications.

MTD ensures standardisation of vehicles plant and equipment in the public sector by ensuring government fleet is selected based on the extent it supports government service delivery goals while ensuring value for money ensuring safe, effective and efficient operation of government.

MTD being the government advisor on matters mechanical, achieves this through formulation of specifications used in procurement of government vehicles, plant and equipment including Ministries, Departments, Counties and Agencies (MDCAs).

MTD plays a role in the standardization of vehicle plant and equipment in the country. It is well represented in the Kenya Bureau of Standards (KBS) technical committees that touch on vehicle plant and equipment. It also carries out inspection of pre-owned vehicles imported into the country from origins with no KBS contracted companies for pre shipment inspection to ensure conformity with KS1515:2000 in Nairobi and Mombasa before they registered in Kenya.

From 1983, alternative direct funding through the Exchequer and periodical donor injection was inadequate to sustain MTD's operation and maintenance activities. The end result was the continued inadequate and unreliable vehicles and equipment hence poor maintenance of the physical infrastructure which affected economic activities country wide.

In their concerted effort to remain relevant, the division came up with an equipment hire proposal whose objective on the one hand was to support local contractors through an equipment hire initiative and on the other hand to provide additional funds for the MTD for its operations. The initiative was approved by government in 2003 and the Mechanical and Transport Fund (MTF) was established through Legal Notice No.140 under the Exchequer and Audit Act (CAP 412).

In 2006, with the blessings of the Ministry and Treasury the MTD proceeded with investments in the construction industry. They acquired a fleet of plant, vehicles and equipment that could be hired out to clients on a commercial basis. The fund was established to provide additional funds for the administration, planning, development, management, regulation, operation and maintenance of effective, economical and efficient Mechanical and Transport services in Kenya. The Fund was operationalized via the mechanical and Transport Fund Rules, Procedures and Guidelines, 2006. These rules and procedures were developed in line with section 7, 8 and 10 of the Mechanical and Transport Fund Regulations, 2003.

Although the MTD has not conducted an impact study on the construction industry, empirical evidence suggests reasonable success in capacity building amongst local contractors and public. The Division is set to undergo transformation in a Semi-Autonomous Government Agency (SAGA) in the process funded by the World Bank under the Horn of Africa Gateway Development Project. The transformation into a SAGA is envisaged to catapult the Division into modern operational status and unlock the division's potential in revenue generation and modern resource management. The division will achieve this by doing the following;

- Consolidate the equipment and form Construction Company that would compete with other players but most importantly help stabilise the cost of construction by adding value to contracting.
- Be primary advisor to local contractors on matters equipment.
- Team up with NTSA in policy and regulation and in the proposed bi-annual inspection of vehicles.
- Operate the workshops commercially including providing services to the public.
- Carry out vehicle inspections for MDAs and the public.
- Regulation of Automotive Repair Services.

Enhancing sustainability through Electric mobility

MTD have intensified the collection of any information related to electric mobility and have acquired a lot of knowledge in this area. We have theoretical knowledge on the following:

- The types of electric mobility, objectives and advantages.
- The finance bill 2019 on excise duty on electric vehicles.
- UNEP global electric program in Nairobi.
- Paris declaration on electric mobility and climate change.
- Leading countries in this area.

E-mobility will play a critical role towards achievement of net zero emission. MTD is actively involved in this conversation and is doing the following in promoting e-mobility:

- MTD was well represented through its technical section in the KEBS committee on e-mobility that developed standards for battery electric vehicles (BEVS).
- MTD is also actively involved in the conversation on how Fuel Cell Electric Vehicles (FCEV) can be rolled out in Kenya.
- MTD has also developed specifications that are available for use in procurement of battery electric vehicles (BEVs) i.e., for sedans SUVs and Pickups in Ministries Departments Counties and Agencies (MDCAs) and the public sector.
- Power generation and utility companies have been developing Level II charging infrastructure and have already imported Battery Electric Vehicles (BEVS). MTD envisions a holistic approach where all stakeholders are involved including financiers in the development of level II chargers in public spaces and some focus on Fuel Cell Electric Vehicles.
- MTD has been following the conversation on conversion of Internal Combustion Engines (ICE) vehicles to BEVs and has not been able to establish Original Equipment Manufacturers (OEM) authorisation for the conversions. MTD has not yet come across convincing data on thermal management of such conversions. Intercalation batteries with liquid electrolyte are susceptible to thermal runaway and thermal management is very critical. The peak torque of electric motor is a function of time and temperature and this determines the gradeability of an electric Vehicle. MTD has not yet come across convincing data on the protection of the battery pack compartment in this conversion and vehicle behaviour on worst case scenario of an accident in which an anode and cathode might be brought into contact followed by instantaneous release of energy.
- MTD will work with all stakeholders in the formulation of electric mobility policy that is spearheaded by the ministry.
- It has been the norm for franchise holders of vehicle brands to have them tested in MTD and obtain data on performance under local condition and we welcome local supplies introducing e-mobility products to have them tested as we are the advisor to the government on mechanical matters.
- MTD understands the determinant of success of e-mobility lies in batteries and fuel cell technologies and has its staff very well trained on these technologies and will be organising sensitisation in these technologies in the future.

Eng. Richard Thitai is the Chief Mechanical Engineer in the Mechanical and Transport Division (MTD).

Optimisation of Manufacturing and Supply Chains for Sustainable Project Delivery

By Eng. Francis Mwangi

STUDIES in project management have advanced in the 21st century. It was expected that project delivery would be more successful, but this is not the case (Zall, et al., 2013). This could be for many reasons, especially given the triple constraints of project management. Project managers have viewed the triple constraints as tradeoffs to the delivery of the project that would mean that one factor is either neglected or reduced to a level that it is a tradeoff. For different projects, cost, time or quality is taken as a tradeoff. It is estimated that the Cost of Quality could be as high as 25% of the sales turnover (Barber, et al., 2000). This in the real world would mean that the results that are derived from such considerations are not sustainable.

Recently, sustainability has taken a more significant role in project management, and as such projects that do not respect sustainable practices will receive less financing. The reporting tools in the new era are the Environmental, Social, and Governance tools (Nedopil et al., 2021). Green financing is the new frontier in the financing world (Legal Monitor Worldwide, 2020).

Construction projects are one of the biggest polluters, accounting for at least 67% of greenhouse gases through the construction of cities and utilisation of fossil fuels (Guo, et al. 2012). This is because of the environment in which the projects are undertaken; for example, huge infrastructure projects that require massive excavation, construction with materials that had already been polluted as well as the crucial process of delivery of the products for construction. The projects are implemented because they solve a crucial role in society and as such means of reducing pollution and emission in the implementation is critical. One of the activities identified that can reduce pollution and emission is the optimisation of manufacturing and supply chain. Manufacturing can be viewed as a subsection of supply chains.

Konza Technopolis Staff undertake a factory acceptance review in Italy. The factory is supplying vertical pumps to Konza Technopolis.

Manufacturing can follow tradition, and agile or lean production. The traditional method of manufacturing has received a lot of attention over the years. Its advantages and disadvantages are well understood, with the most infamous being the wastage of both energy and raw materials. Agile manufacturing is well suited to smaller manufacturing firms that have minimal volumes but huge varieties of finished products. There is minimal automation of processes, given the cost-intensive nature of automating for different projects. The firm also must hold huge levels of inventory.

The greatest cost of the manufacturing process is inventory as this holds onto critical capital that would have been used for other revenue-generating processes. A good example of this company is Novaractor; a firm that is involved in the manufacturing of vertical pumps for water treatment plants and sewer treatment plants. The plant specialises in attending to specialist work and works with clients to deliver the product as per client demands (Seliger, 2012).

As companies grow, there is a tendency to automate processes and reduce waste. The seven wastes are commonly referred to by the acronym TIMWOOD – Transport, Inventory, Motion, Waiting, Over-processing, Overproduction and Defects. A Gemba walk is a technique for identifying these wastes, translated from Japanese, which means 'the actual place'. Doing a Gemba walk means walking to the actual place where production is happening, such as the factory floor. Lean organisations


Konza Technopolis staff undertake a factory acceptance review in Italy.

seek to minimise waste through streamlined flow. This leads to lean manufacturing processes. They are highly optimised and aimed at producing the same product at minimal cost when demanded by the customer. This is theoretically possible but faces challenges in actual implementation as the satisfaction of clients is difficult due to the changing nature of needs or delays that may be incurred during production or transportation.

A more realistic manufacturing process is therefore the merger between Lean and Agile, commonly known as Leagile. The point of change from Agile to Lean processes is called the decoupling point and ensures that the firm specialises in its area of strength. Most of the other activities that are not the core competencies of the firm are outsourced. An example is the screws used in pumps of wastewater that would be outsourced to specialist firms whereas the firm only assembles those parts. This reduces wastage in terms of time and holding of inventory. It also reduces space requirements.

A lot of finished goods are imported into the country either because they are not being manufactured in the country or because of the contracts that require procurement of goods from the funding source country. The balance of trade is therefore negative, and this leads to a strain on the economy due to reliance on foreign capital to import as well as the opportunity cost of manufacturing. This trend has been in place since the 1970s. The resultant trade deficits have persistently expanded every year and have hindered the achievement of the country's growth targets. For example, the World Bank (2013) reported that trade deficits reduced Kenya's economic growth by 4.1 per cent in 2012. With a balanced trade account, Kenya's Gross Domestic Product growth rate would have reached 8% that year. The labour that would have been used and therefore reduced unemployment, which is at about 5.7 per cent of Kenya's labour force, was out of work in 2021 (Business Daily, 2022).

The government has doubled up the effort to undertake most of the manufacturing or value addition in the country. An example is the Konza Technopolis, which has an area dedicated to manufacturing or industrialisation. Konza Technopolis has among other things promoted competitive ground with special economic status, reliable and adequate power, water, and ICT (Information and Communications Technology). Industrialisation 4.0 is the future and present (Kim, Suresh, and Kocabasoglu-Hillmer, 2013). Mostly fuelled by the recent COVID-19 pandemic, companies had to rely on automation given the limited mobility, proximity at work, and reduction in the availability of raw materials. The country needs to borrow the best practices in the industry for it to be competitive (European Commission, 2017; Liao et al., 2017).

In recent years, there has been the expression of interest by companies to set bases in the developing world. At Konza Technopolis, a lot of effort is being undertaken in the screening of projects to ensure they align with the masterplan, environmental laws as well as the credibility of the source of funds. If this template is adopted by more agencies, the country will attract more sustainable projects and reduce the reliance on imports.

Eng. Francis Mwangi is a Civil Engineer at Konza Technopolis Development Authority (KoTDA). He is involved in the development of the first Smart City in East and Central Africa and the first one in Africa from a Greenfield. He is experienced in engineering turnkey projects.

Role of Policy in Accelerating Electric Mobility Adoption in Kenya

Robert Njuguna Njoroge

Introduction

THE transport sector is amongst the largest contributors of greenhouse gas (GHG) emissions globally. This is contributed from an increasing global population and the reliance on GHG emitting transportation driven by a rapid rate of economic growth, globally. Over the last decade, 14% of GHG emissions has been attributed to the transport sector, primarily through combustion of fuel from road transport [1]. To address the risks of climate change from emissions, in 2015, the global community adopted the Paris agreement as the international treaty on climate change. Member states submitted Nationally Determined Contributions (NDCs), in which 140 of the 194 submitted NDCs identified transport as a major GHG emitter and made pledges on electric mobility [2]. Electric mobility (E-Mobility) therefore offers a promising option for reduction of greenhouse gases across the world.

Kenya is at the nascent stage of electric mobility implementation with the number of electric vehicles (EVs) accounting for less than 1% of the total number of vehicles [3]. In part of promoting energy efficiency, conservation and improving energy security, the Kenyan Government intends to increase the use of electric mobility technologies. This is specifically through a 5% target of electric car adoption by 2025, captured in the Kenya National Energy Efficiency and Conservation Strategy (KNEECS), 2020. Globally, only 19 countries have achieved a 5% EV adoption according to a Bloomberg study [4]. The study indicates that several European countries, China, and USA have surpassed 5%, with Norway having the largest share of EVs per capita. This percentage is a critical EV tipping point for any country, as rapid growth commences immediately after due to mass adoption (see Fig. 1).

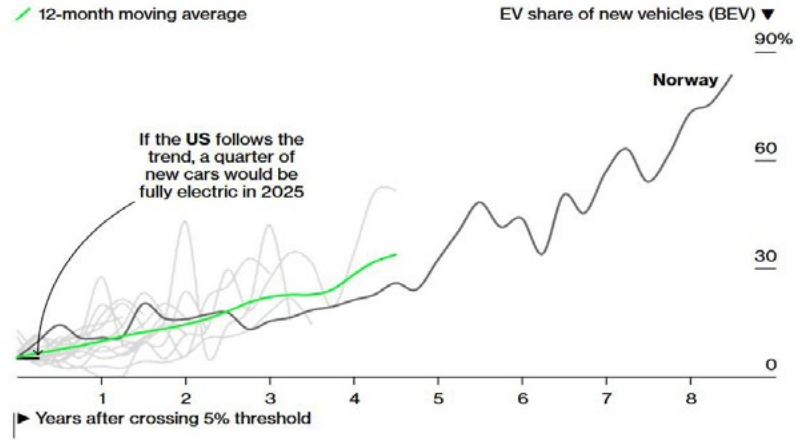

Fig. 1. Growth of EVs after passing 5% tipping point [4]

Therefore, it is critical for any country to surpass this point to have a rapid accelerated demand for EVs. From analysis, different policy measures have supported growth in the top EV countries. The measures cover both fiscal and non-fiscal actions and have contributed differently to the growth of the sector. As Kenya aims to increase its fleet of EVs and subsequently achieve the KNEECS target, there is need to develop similar policy measures.

Policy Measures

Policy acts as an essential tool that can be used by countries to boost the uptake of electric vehicles. Globally, different policy measures have contributed to increased uptake of EVs. Research analysis highlights three categories in which the policy measures are covered under [5]. First, fiscal policy measures such as tax exemptions and subsidies have been used in countries such as the UK, which offered a GBP 5000 EV grant until 2017 to boost adoption.

Secondly, traffic regulations such as free parking and use of bus lanes for EVs have also been adopted to attract the use of EVs. This policy measure is less capital consuming as it is dependent on existing infrastructure such as parking spaces and dedicated bus lanes.

Thirdly, charging infrastructure policy measures through establishment of public and private charging stations has also been adopted in several countries. As this is a capital-intensive approach, Governments usually take-up the development of public charging points along highways and public parking points. Additionally, to promote deployment of private charging stations, private companies intending to set up infrastructure are incentivized through tax subsidies.

Electric mobility policy measures in Kenya

Kenya has developed policy measures to boost the uptake of EVs. These measures have employed fiscal incentives and charging infrastructure initiatives. Presently, traffic infrastructure measures are yet to be adopted in the country to boost uptake of EVs. Some of the existing strategies include:

i. Kenya National Energy Efficiency and Conservation Strategy, 2020– This strategy targets a 5% increase in the number of electric/hybrid vehicles by 2025. The strategy employs fiscal policy measures such as import duty incentives for electric vehicles, bicycles, tuk-tuks and reduction of road taxes, as proposed in the document. In addition, it employs

the charging infrastructure strategy through proposing the revision of the building code to incorporate charging stations. The two strategies are aimed at providing a conducive environment for the growth of the sector.

ii. Finance Act 2019- The Act proposed a reduction of the excise duty for electric vehicles from 20% to 10%. As a fiscal policy measure, the Act encourages the uptake of electric vehicles in the country. This measure is a fundamental contribution towards overcoming unaffordability of EVs by the public through tax reduction.

iii. National Climate Change Action Plan (NCCAP) 2018-2022- The plan identifies transport emission reduction as a mitigation measure against climate change through pilot projects on electric vehicles. It further highlights domestic technology development for electric vehicles as an enabling measure for promoting e-mobility. It also encourages exploration of infrastructure needs required for electric mobility. The plan contributes to EV growth through the charging infrastructure measure, by promoting development of infrastructure. This is a key initiative as it creates an enabling environment for EV growth.

Other policies that are currently under development including the National Electric Mobility policy for Kenya which is an initiative by the State Department of Transport, and the Integrated National Transport Policy (2009) which is under review with a likelihood to incorporate electric mobility provisions.

Policy measures in the top EV adopted countries

A total of 19 (nineteen) countries have surpassed the 5% tipping point of EV share of new cars [4]. This percentage is critical as it signifies the point at which mass adoption occurs after the early adopter's phase. These countries are composed of a majority of European countries, China and USA. They are currently at the growth stage of EV adoption, having advanced from the introductory stage. In Europe, Norway has the largest EV ownership per capita in the world at 83.5% EV share of new cars [4]. The country was the first to surpass 5% EV uptake in Q3 of 2013. Similarly, Netherlands crossed the 5% mark in Q4 of 2018 with an EV share of 15.9% as at 2022. The country boasts of having the densest charging network in the world at 19.3 stations per kilometer. China is currently the largest EV market having 14% share of the total number of EVs in the world. It crossed the tipping point in Q4 of 2018 and currently has a 16.7% EV total share. USA follows as the second largest EV market in the world with a 4.5% share of total EVs in the world. Recently, USA crossed the 5% mark in Q4 of 2021 with a 5.3% EV share of new cars [4].

The following measures from different policies covering fiscal measures, traffic regulations and charging infrastructure, were adopted by the above-mentioned countries.

Table 1: Policy Measures in countries with the largest EV markets

Country	Fiscal measures	Traffic Regulations	Charging Infrastructure
Norway	• EVs are exempt from VAT and registration tax. • Financial stimulus package (2009-2010)- The package supports schemes on installation of public charging infrastructure.	• EVs are allowed to access designated bus lanes. • EVs are exempt from road tolls. • Free parking for EVs in public places.	• Incentives to cover cost of charging infrastructure, through Enova (state owned enterprise). • Enova Financial support scheme for fast chargers- aimed at installing fast chargers every 50kms. • Charging infrastructure regulations for new buildings (2019)-New buildings to have 50% parking space designated for EV charging. • Electric Vehicle Supply Equipment (EVSE) grant for housing associations- Accessible grants on EVSE purchase and allocation per housing association.
Netherlands	• Available grants on new and used EVs of €4000 and €2000 respectively, running till 2025. • EVs are exempt from motor vehicle tax till 2024. • Reduced registration fee for EVs to 4% compared to 25% charged for internal combustion engine vehicles.	• EVs have special access to parking in Amsterdam. • Free EV charging in public parking spaces.	• Environmental investment tax scheme for charging infrastructure- Tax incentives are offered for investment in charging infrastructure by companies. • Availability of Open charge point protocol- The protocol enables EV drivers to charge in different stations using one card. • Directive 2014/94/EU- EU member states are to ensure adequate public charging points for EVs. • Dutch guidelines- Charge station operators are mandated to accept any charging card from users.
China	• Subsidies of up-to RMB 20,000 for vehicle insurance and charging equipment installations. • Development Plan for Fuel-efficient and New Energy	• There are designated regions for demonstration of charging infrastructure development.	• 2015-2020 Guidelines on developing EV charging infrastructure- The guideline calls for 12,000 EV charging stations. • A requirement of 18% parking places to be equipped with EV charging installation in Guangzhou.

Country	Fiscal measures	Traffic Regulations	Charging Infrastructure
	Vehicles- The Government has invested 100 billion CNY (15 billion USD in the EV industry. • Central EV public charging and battery swapping is exempt from demand charge in the electricity tariff.		• New EV infrastructure incentive policies- All provinces are required to support charging infrastructure development. • All residential buildings after 2015 are required to have charging infrastructure.
USA	• Federal Tax Credits of up to US $7500 on new plug-in vehicles. • Federal loan guarantees- for development of charging infrastructure.	• Designated EV corridors to promote use of EVs with major highways having charging infrastructure.	• California Green Buildings Standards Code- mandatory requirements for EV charging infrastructure in new buildings. • Proposed infrastructure bill- Investment of $15billion for 500,000 public chargers by 2030.

Policy measures required to boost EV uptake in Kenya

From evaluating policies implemented in countries with high EV penetration, several measures can be vital in supporting Kenya's KNEECS target. These measures should set out clear objectives under three categories: charging infrastructure, traffic regulations and fiscal incentives. The categories are aimed at providing an enabling environment through charging infrastructure, traffic regulations and also reduction of market entry barriers through fiscal incentives.

Charging Infrastructure

Policies developed covering charging infrastructure will go a long way in addressing range anxiety with the availability of charging stations for EV users. Uncertainties brought about by long charging times can be solved with the availability of a dense charging network. Research indicates that investing in charging infrastructure is 4-7 times more cost effective than proving fiscal subsidies on EV purchase. Therefore, these measures can have a larger impact in increasing demand. The charging infrastructure policies should therefore include the following:

- Measures to necessitate investment in public charging infrastructure by the Government. The Government can deploy public charging stations along major highways and public parking spaces. Investment by the Government absorbs research & development risks, attracts investors and at the same time encourages the public to purchase EVs due to availability of charging stations.
- Guide on setting up charging stations. The guide will ease the licensing and approval requirements of charge stations. A streamlined process attracts investors through increased efficiency in the time taken in setting up a station.
- Measures to support tax reduction of charging stations installations aimed at boosting private investment. Installation tax incentives can appeal to the private sector companies to set up infrastructure from possibility of increased profit margins and assurance of Government support.
- Mandate new buildings to set up charging infrastructure through revision of the building code. This measure will aid in raising awareness of e-mobility as well as increase accessibility of charging networks attracting EV ownership.
- Development of policies to support allocation of public land for charging stations. Such a measure will also aid in increasing the charging network density in the country. In addition, the Government can initiate measures to lease land to investors at reduced rates, thereby attracting private investment.
- Development of policies on Open Charge Protocol to enable interoperability of charging network card payments. The protocol encourages EV use by the public through assurance of a simplified payment processes.
- In order to create demand for the public charging stations, the Government can institute measures to initiate a change of Government owned fleet of vehicles to be fully electric. The initiative would spur deployment of charging stations by both private and public sector with the aim of profiting from charging of state-owned electric vehicles.

Fiscal Incentives

One of the key hinderances of EV uptake is the high initial cost of purchase. In 2019, the excise duty for EVs was reduced to 10%. However, further fiscal incentives are required to create demand, a measure that has been extensively used by countries with the highest EV adoption. As such measures can be capital intensive there is need to institute time limits to such incentives. Financial subsidies can be time bound to allow early adoption before demand increase, at which point the incentive is ceased. The fiscal policies developed should focus on the following:

- Tax reduction/exemption policies on purchase of EVs. The Government can institute policies to exempt EVs from VAT, import tax or any other tax associated to its purchase. As the cost of the vehicles is high, instituting these tax reductions will encourage purchase and create public demand. Lessons can be learnt from Norway which has an aggressive purchase subsidy that propelled the country to have the largest ownership per capita worldwide.

- Reduced electricity tariff rates for EV charging. Reduced electricity tariffs for public charging can attract investors as it increases profit margins, whereas reduced electricity tariff rates in private/home charging, attracts ownership by private homeowners.
- The Government can institute tax breaks for any financial institution offering green car loans. This measure prompts allocation of funds by banks to the public for EV purchase.
- The Government can also provide state loans to support deployment of charging stations by County Governments, institutions, or the private sector.

Traffic Regulations

Policy measures through traffic regulations are attractive as they have no financial obligation. They tend to appeal to the EV consumer due to the preferential treatment provided during EV use. They also act as support to other measures in boosting uptake through awareness creation. These policy measures should focus on addressing the following:

- Designate EV parking spaces in public places, specifically in the central business district. This measure will aid in raising awareness as well as incentivizing EV usage.
- Free charging in specific public designated areas. In order to attract EV ownership, availability of areas with free charging can boost ownership by the public.

Conclusion

Electric Mobility uptake is increasing globally, as it presents countries with an opportunity to reduce carbon emissions. Developed countries are currently leading in innovative technologies as well as setting pace in policy developments. Such initiatives have propelled a number of these countries to have an EV penetration of over 5%. A Bloomberg study notes that this is a significant milestone for adoption of EVs as the percentage represents the threshold after which mass adoption occurs for any new technological development. European countries, notably Norway and Netherlands, and other countries such as China and USA deployed policies which enabled them to surpass the 5% point and lead in EV penetration.

Currently EV penetration in Kenya stands at less than 1%, attributed to high purchase cost and range anxiety for charging. These two concerns should be dealt with for there to be a substantial penetration of EVs in the country. Kenya has come up with an ambitious target of having a 5% EV adoption by 2025 captured in the Kenya National Energy Efficiency and Conservation strategy, 2020. To achieve this target different policy measures, need to be put in place to support the ecosystem. A 10% reduction of the excise duty on electric vehicles to spur the sector growth as a fiscal measure was instituted in 2019 by the Kenyan Government. Other non-fiscal measures such as encouraging development of supporting charging infrastructure have been proposed in different policy documents. As much as these current policy measures have enhanced EV uptake, they are less likely to enable the achievement of the target.

A series of raft aggressive measures are required, especially supporting fiscal incentives and charging infrastructure development. These two measures are key in addressing affordability of EVs and accessibility of charging which are fundamental issues affecting EV uptake.

Charging infrastructure development requires support through favorable Government policies to encourage both private and public investment. The policies will provide guidance, regulations and promotion of incentives for charging stations. Private investors will thus be assured of investment security through a supportive policy framework. Similarly, availability of the stations, will ensure that the public have access to charge points thereby reducing range anxiety, encouraging use of EVs. Furthermore, it also raises awareness on electric mobility to the public.

Fiscal incentives require substantial Government financial incentives so as to address the high EV cost. Aggressive tax incentives, purchase subsidies, loans or grants can be employed to the reduce the purchase price, as high costs hinder uptake. However, this method is capital incentive and may be deemed unattractive to the Government. Instituting timeframes to such measures can attract early adoption and can be ceased once critical mass is achieved. Lastly, traffic regulations can be instituted to promote growth of the sector. The measures provide a conducive environment for EV users but are less likely to promote a substantial adoption. This is because the measure relies on existing infrastructure such as dedicated bus lanes, which is not as common in Kenya. Therefore, for rapid EV growth in Kenya, focus should thus be placed on policy measures for charging infrastructure development and provision of fiscal incentives.

In conclusion, the use of Electric mobility goes a long way in reducing greenhouse gas emissions and achieving Nationally Determined Contributions. EVs can therefore provide a promising future to clean transportation in Kenya and other countries in the world.

Acknowledgement

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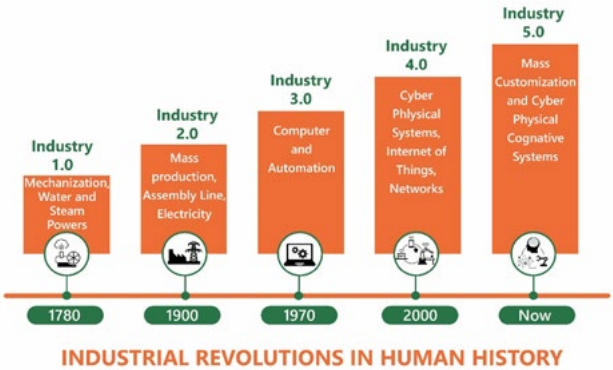
Renewable Energy: Rerec's Magic Bullet in Promoting Green Manufacturing

MANUFACTURING can easily be described as turning raw materials to products with the help of equipment, labor, machines, tools, and chemical or biological processing. This is an important part of the global economy. From the simple tools used in the pre-industrial age of the 16th century to the onset of the industrial revolution in the late 18th and early 19th centuries, appreciable progress has been made in speed, quality, impact and scope. This has been accompanied by an evolution in the production, transportation and use of power.

The development of steam engine was an important element of the first industrial revolution between 1760 to 1840. The second industrial revolution (1850 to 1970's) ushered in the era of mass-production and enhancement of petroleum refining and distribution. The third industrial revolution started in the late 1970's and was characterized by the onset of internet and shifting to renewable energy. The first, second and third industrial revolutions contended with energy access and security. **The fourth and fifth industrial revolutions (4IR/5IR)** have heralded the energy transition, putting pressure on all the three imperatives of energy access – equity, security and environmental sustainability.

Under the 4IR, major world economies are taking advantage of the speed, scope, and systems impact of the fusion of various emerging technologies to make breakthroughs in management, governance, and manufacturing processes. Particularly, outstanding progress has been made on the Internet of Things (IoT), Artificial Intelligence (AI), smart cities, electric mobility, high-speed internet, mobile communications, autonomous vehicles, nanotechnology, 3-D printing, blockchain technology, big data, augmented vision, virtual reality, Unmanned Aerial Vehicle (UAV) and biotechnology. To support its resource hungry applications, the 4IR ushered in Energy 4.0 whose key tenets are electrification, decarbonization, decentralization and digitalization of the global energy sector. Some of the enabling technologies for Energy 4.0 are renewable energy technologies, modern power electronics, bidirectional power flows, IoT, big data and cloud computing. In addition, the drive towards cheaper (or, affordable) energy, higher productivity and reduction of greenhouse gases assumed center stage, leading to greater innovations to support energy access and renewable energy technologies. The transition from traditional fossil fuels to renewable energy, on the other hand, has necessitated modernized and flexible power systems, dynamic system operations, innovative electricity markets designs and business models and greater use of technology in energy production, transmission, distribution, and end-use.

The Fifth Industrial Revolution (5IR), and its precursor – the Fourth Industrial Revolution (4IR) – is underpinned by significant technological advancements, innovations, human-centric approaches and global economic growth. With the increased focus on health and wellness of human capital, the 5IR, according to the European Commission, complements the 4IR by centering the worker's wellness in the sustainable production process and using new technologies to provide prosperity beyond jobs and growth.



INDUSTRIAL REVOLUTIONS IN HUMAN HISTORY

Manufacturing – and industry - then is defined beyond mere considerations of efficiency and productivity to its net impact and contributions to society. As a complement to the 4IR, the 5IR establishes research and innovation as inputs to the transition to a sustainable, human-centric and resilient industry. It favours a circular production model and lends its support to technologies that exploit natural resources more efficiently. Industry 5.0 – as the 5IR is also called – therefore focuses on people, green production and digitalization. So while the 4IR fuses technologies to harmonize the physical, biological and digital worlds, the 5IR balances the economic advancement with the resolution of societal problems by a system that highly integrates cyber and physical space. This vision involves energy security, economic efficiency, environment and safety.

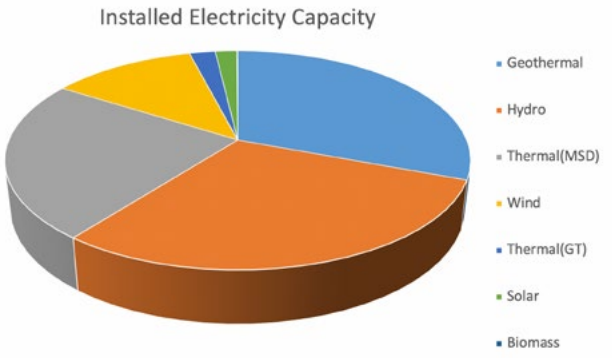
The 5IR, with its high processing speeds to support the digital transformation advancements and mental shifts in the energy sector, energy and storage demands and versatile applications, has, in turn, heralded Energy 5.0 – a more human centric, energy efficient and sustainable future for people and the planet.

While 4IR and 5IR will undoubtedly drive global energy demand, sustainability and climate change have redefined energy resources utilization. Green (or sustainable) manufacturing, for example, is the production of goods through environmentally friendly processes and materials with least negative impact on natural ecosystems. This includes waste reduction or elimination, use of renewable energy sources and optimal resource utilization. With the shift to Energy 5.0, economies and consumers are becoming more cognizant of the environmental burdens of their actions and are therefore shifting to cleaner production to reduce their carbon footprint and costs while gaining a competitive advantage. Green manufacturing is founded on designing for sustainability, resource efficiency, pollution prevention and life cycle assessment as an environmental accounting tool.

Kenya, through its long-term development plan, **Vision 2030**, aims to become an industrializing middle income country by 2030, providing high quality life to all its citizens in a clean and secure environment. The Vision 2030's economic pillar aims to achieve and sustain average economic growth of 10% per annum until 2030. To achieve these lofty targets, the government developed the **Big Four Agenda** – an economic blueprint focusing on food security, affordable housing, manufacturing and affordable healthcare for all. The Big Four Agenda's aim was to boost manufacturing's contribution to GDP from 8.4% in 2018 to 15% by 2022 through developing modern industrial parks, Special Economic Zones (SEZ) and operationalization of policies to support the processing of textile, leather, oil, gas, construction material, foods, fish, iron and steel. These efforts were in concert with SDG 9 which seeks to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. The manufacturing industry in Kenya has however been impacted by high cost of inputs such as electricity.

In 2015, the country ratified the Paris Agreement on Climate Change and set itself a target of reducing total national greenhouse gas (GHG) emissions by **32%** until 2030 through the United Nations Framework Convention on Climate Change (UNFCC). In 2016, the country joined the Sustainable Energy for All (SEforALL) initiative, adopting the objective to provide universal access to clean energy by 2030, in harmony **with Sustainable Development Goal (SDG) 7**. Following a development pathway that is fully aligned with the Paris Agreement and UNFCC commitments implies that, global emissions from the energy sector must reach net zero by 2050.

The energy sector in Kenya is dominated by petroleum and electricity. The country was ranked among the most improved nations in the three dimensions of energy – energy security, equity, and environmental sustainability (World Energy Council, 2021). With an estimated electricity access rate of 75% (ESMAP, 2021), Kenya's growing electricity demand is driven by urbanization, population growth and industrialization. The demand for electricity in the country has been increasing gradually over the past decade, catalyzing systemic and operational changes in the electricity sector. Peak demand rose from 1,354 MW in 2012/13 to 2,030 MW in 2021. The annual electricity consumption in 2021 was 12.82 TWh which is estimated to grow to 25.81 TWh by 2030.The generation mix in the country demonstrates the growing significance of renewable energy. The installed electricity capacity in 2021 was about 2.81 GW comprising geothermal, hydro, thermal (MSD), wind, thermal (GT), solar and biomass at 30.39%, 29.37%, 23.25%, 11.81%, 2.11%, 1.77% and 0.07%, respectively (EPRA, 2021).



Kenya is therefore faced with both a horizontal and vertical growth in energy consumption. While shifting to green energy and at the same time encouraging greater energy intensity in its manufacturing sector. The Rural Electrification and Renewable Energy Corporation is mandated to accelerate rural electrification and promote the development and use of renewable energy technologies. The Corporation, through a mix of initiatives, supports the countries global march towards universal access to energy through electricity and clean cooking solutions.

Promoting Local Textile Manufacturing in Kenya

By Dr. Eric Oyondi Nganyi, PhD and Enock Lagat

Rivatex Spinning Head of Department Mr.Charles Kipchoge (left) explains to visitors how the state-of-the-art machines work

Introduction

RIVATEX East Africa Limited (REAL) is a vertically integrated textile factory that converts cotton lint through various processes to finished fabrics. It was first established in 1976 as Rift Valley Textiles Limited (RIVATEX) by the Kenyan government through the Industrial & Commercial Development Corporation (ICDC) and a consortium of foreign investors. RIVATEX went into receivership in 1998 following adoption of Structural Adjustment Programmes (SAPs) instituted by the International Monetary Fund (IMF) and the World Bank. RIVATEX ceased operations in 2000 before being revived in 2007 as Rivatex East Africa Limited (REAL) by Moi University. REAL was inaugurated by President Mwai Kibaki on 4th October, 2007 and commissioned as a modernised factory by President Uhuru Kenyatta on 21st June, 2019.

Right from the time of acquisition in 2007, Rivatex East Africa Limited was envisioned as a world class manufacturing institution as well as to contribute in training and research, to be a leader in textile technology, innovation and production for development, and socio-economic well-being of its stakeholders. Its core mission is to satisfy customer needs through innovation development, design, manufacture and conversion of textile products. The rehabilitation and modernisation dream, which was in line with the Kenya Vision 2030 was realised by the year 2020. The company is at a stage where it is undertaking product diversification and expansion across the East African region and beyond. The constitutional dispensation and Vision 2030 blueprint offers many opportunities for the textile industry and by extension Rivatex East Africa Limited.

Promoting backward and forward integration

The potential for cotton farming in the country remains untapped, with over two million hectares of land suitable for cotton production in Nyanza, Rift Valley, Western, Coast, Eastern and Central. The company has been part of the cotton sensitisation programme team within communities in various counties, who will serve as a major source of cotton. The company recognises that for it to have sustainable growth and profitability it must have a reliable source of raw materials. The programme has also become a research and extension opportunity where several researchers and potential farmers have been able to gain vital insights on cotton farming. The good opportunities for research and development on cotton seeds, fibres, production technologies among other factors to improve the technologies and productivity in the entire cotton value chain has been ongoing.

> The company has done a lot in the promotion of cotton growing in the country together with other stakeholders and government agencies through field days, farm and factory visits and other forms of technical assistance.

A case in point is the ongoing sensitisation on cotton farming in various county governments, including Busia, Siaya, Baringo, Elgeyo Marakwet, Bungoma, Kericho, Bomet, Homa Bay, Kisumu, Migori, West Pokot, Meru, Tharaka-Nithi,

A cotton plantation in Baringo County, one of the cotton growing regions in Kenya.

Rivatex and other stakeholders distribute non-Bt cotton hybrid seeds to farmers.

Rivatex Managing Director (seated right) signs an MoU with former West Pokot Governor John Lonyangapuo (left).

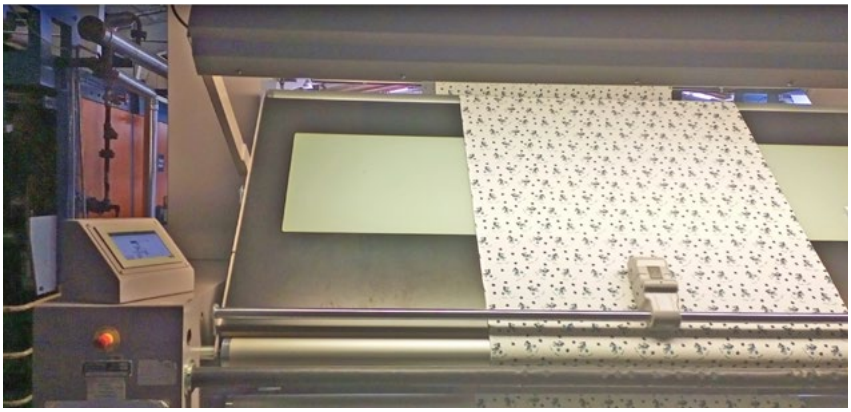
Kirinyaga, Embu, Machakos, Makueni, Kitui, Lamu, Kwale and Tana River. Rivatex recognises the critical role played by research and development (R&D) in accelerating economic development of the nation. Also, the company is working with other stakeholders to increase the current cotton production in Kenya through adoption and commercialisation of quality and certified insect protected biotech cotton (Bt. cotton) seed in Kenya. By integrating backwards the company will complement the government's efforts by increasing employment opportunities, enabling economic growth, reducing poverty and reducing insecurity in arid and semi-arid parts of the country.

Enhancing and promoting skills required in the manufacturing sector

Over the years since commencement of its operations, Rivatex has taken the role of enhancing skills required in the manufacturing sector by progressively expanding its attachment and internship enrolment for students in fields of engineering, business, social sciences, among others. The company has continued to encourage schools and other learning institutions to visit the factory. This enables students and pupils from all over the country to get first-hand experience, achieve a greater awareness of careers and opportunities in a particular subject area and observe integrated textile

State-of-the-art weaving machines at the Rivatex factory.

Modern washing machine at Rivatex factory.



Modern fabric inspection machine at Rivatex factory.

production.

The collaborations between the industry and learning institutions has provided the universities and colleges and the country the potential to produce highly skilled experts, especially for the manufacturing sector in various fields such as industrial, manufacturing, textile, mechanical, production, electrical and electronics, chemical engineering, industrial safety and marketing, among others. Furthermore, the facility supports the desired practical teaching and industrial research by students and teaching staff. This will consequently improve the quality of the human capital and their ability to undertake quality research, including derivation of research agenda. The net effect is that, owing to the modern facilities and technology available at Rivatex East Africa Limited, the Moi University academic staff is be able to optimally allocate their time between teaching and research.

The forerunner in the manufacturing sector and significance to Kenya's development

The textile industry has been identified by the government through the Vision 2030 blueprint as the sector that has political, economic and social development significance to Kenya through; creation of employment opportunities for youth and women; enhancement of the implementation of the long-term Arid and Semi-Arid Lands (ASAL) development initiatives that includes revival of cotton farming; playing a significant role in poverty alleviation; growth in the apparels sector and expansion of the cotton-textile-apparels value chain; and skills development.

The company has established ultramodern apparels and garments making unit that is well equipped with state-of-the-art machinery that make all kinds of outfits from cotton to cotton-blend fibres. Through the Kenyan Government's support, the facility has been able to invest in new and ultra-modern machinery in textiles, which are of their own kind in East and Central Africa. The company has established several factory outlets in major cities and towns in Kenya and the major clientele includes independent retailers, schools, universities and manufacturers. The company also exports products to Rwanda, Burundi, Uganda, South Sudan, among others. The revamped facility is a big boost to farmers' fortunes, especially cotton growers in 24 counties; an epicentre of job creation for the youth and a driver of manufacturing, which will further the realisation of the Kenya Kwanza government agenda. The facility has leveraged on technology to revitalise the textile industry and this will engineer demand for local products; stabilise prices of cotton lint and promote sustainable livelihoods.

Modern Dyeing machine at our facility at Rivatex factory

Rivatex Managing Director Prof. Thomas Kipkurgat (centre) with visitors at the garment section.

Dr. Eric Oyondi Nganyi, PhD, is a lecturer at Moi University, Department of Manufacturing, Industrial and Textile Engineering.

Enock Lagat is the Research Manager, REAL.

Enterprise Resource Planning and Technology Trends that will Shape 2023

By Mark Wilson

FOLLOWING a year of disruption caused by Russia's invasion of Ukraine, supply chain disruptions and record-breaking inflation, we look forward to what 2023 might have in store for manufactures and distributors.

Even with COVID -19 restrictions now a thing of the past, many reopened enterprises have quickly realised the market is not what it used to be. New technology and the latest enterprise resource planning (ERP) trends have enabled swift changes in ERP that will need companies to update quickly. Manufacturers and distributors will be looking at their ERP software systems and trying to maximise the benefits they can receive. So, what can these organisations expect to see in 2023 and what technology trends will define the year? Let's take a closer look.

Managing the supply chain

It would be difficult to discuss any future trends around ERP solutions without looking at the current global supply chain situation. While there has been some pressure removed from manufacturers and distributors, there are still major shortages of key materials, causing delays in production as well as increase to costs.

Due to these shortages, these organisations are finding it difficult to keep enough inventory in stock as well as numerous challenges around procurement. Almost every manufacturing organisation experienced raw material shortages, with supply chain management technologies within ERP systems becoming significantly more popular as a result. These solutions help organisations integrate with suppliers and customers more effectively and give leaders a better outlook into the health of their supply chain.

ERP solutions get smarter

ERP rollouts of the last decades focused on collecting transactional data. Now, finance organisations are burdened by the quantity of information collected and don't know how to analyse or use it. This has led to more intelligent ERP solutions, augmented with artificial intelligence (AI) and connected data, from transaction and external sources, to generate a system that provides contextualised features, experiences, and processes, and can continually learn, improve and adapt.

Effective implementation of an intelligence solution can help reduce human error, save costs, and free up time for your employees to focus on value-generating areas of your business. This domain will be supported by adjacent advancements in AI, the interconnectivity of Internet of Things smart devices, edge computing, digital twins, remote operation, satellite and 5G communications, and advanced materials.

Sustainable practices become the norm

After COP27 that took place in November 2022, there has been a renewed focus on finding sustainable solutions and fighting climate change from both the public and private sectors of all industries. Thanks to developments in power, energy, and battery technologies, new solutions can make organisations more efficient and lessen the impact of climate change.

For example, advancements in nanotechnology and materials are helping to improve battery life for vehicles and phones and to reduce dependence on infamously scarce and hard-to-obtain materials such as cobalt and lithium. Energy storage solutions such as pumped storage hydropower and flywheel energy storage can help stabilise energy grids, make them more efficient, and ensure that energy isn't wasted. We will see more manufacturers and distributors adopting sustainable solutions across their operations to not only reduce their energy costs but their carbon footprint as well.

Remote work and mobile ERP

Thanks to the COVID-19 pandemic, cloud adoption has increased globally, with ERPs moving away from on-premise and migrating their applications to the cloud.

Having remote access just isn't enough. ERP systems have to meet the needs of a more mobile and remote workforce. Accessing business insights, customer & stock information and processing alerts on the go from a mobile device are part of a mobile-friendly ERP, making your workers more productive beyond their place of work.

As a result, several features of ERP solutions are extending to mobile devices. Mobile ERP systems can support powerful functionalities beyond office or warehouse environments, adding considerable value to your business.

Rising into the clouds

At the start of 2022 IDC Corporation predicted that by 2026, Cloud-Native architecture and its ability for continuous innovation will be the main selection criteria in over 80% of IT-led enterprise application deployments.

These cloud models offer many benefits, including the ability for smaller companies to ramp up their IT investment. This has resulted in a variety of solutions available on the market, with today's cloud-based ERP systems becoming well-suited for even small-to-midsized companies. These companies can choose between implementing a system fully located in the cloud or implementing a hybrid model that still offers a degree of in-house IT control.

ERP technologies are constantly evolving and becoming more sophisticated. In the future, ERP systems will become more intelligent, more user-friendly, and more integrated. As a result, they will become an even more essential tool for businesses of all sizes.

Mark Wilson is the Chief Executive Officer of SYSPRO EMEA

How Technology is a Double Edged Sword in the Fight against Counterfeit Products

Dr. Robi Njoroge Mbugua, Anti-Counterfeit Authority Executive Director

In its efforts to stop illicit trade in the country, Kenya's Anti-Counterfeit Authority (ACA) faces various challenges, including rapid technological advancement, lack of international support and uninformed consumers. Despite these challenges, the Authority has seized counterfeit products worth over KES3 billion in the last seven years, as narrates ACA Executive Director, Dr. Robi Mbugua.

By Maureen Mwangi

Illicit trade has jeopardised the economy, hindering the growth of manufacturing sector in Kenya. What measures has the Anti-Counterfeit Authority put in place to combat illicit trade and ensure a counterfeit-free country?

The Authority employs a multifaceted approach that includes enforcement, awareness campaigns, research and policy advocacy on matters against counterfeiting. The approaches are drawn from its mandate as prescribed in the Anti-Counterfeit Act 2008.

The Act that has both civil and criminal sanctions against acts of counterfeiting. We have inspectors with police powers who investigate and enforce the law, leading to arrests of perpetrators and seizures of counterfeit goods. The Authority further recommends the prosecution of the perpetrators to the Office of the Director of Public Prosecutions (ODPP) for decision to charge.

Besides enforcement measures we undertake training and public awareness through anti-counterfeiting campaigns to address the demand side of counterfeiting. We undertake capacity building to local manufacturers and other stakeholders on how to protect their trademarks and brands by registering their intellectual property rights (IPR) with Kenya Industrial Property Institute and other regulatory bodies. This will give them the legal beef over their trademarks.

These efforts are geared towards changing consumer and public attitudes against counterfeit issues. We also liaise with the regional, national and international organisations on matters relating to this vice.

The development of e-commerce shows a need for the authority to invest in digital tools. What technological measures has the authority invested in to detect counterfeits across the entire supply chain?

While technological advancement is good for humanity, it has led to both positive and negative externalities, with IT gone to the wrong hands. In response, the Authority has taken both legal and technological measures towards protecting intellectual property rights (IPR).

The Anti-Counterfeit Act and its regulations have undergone several amendments to include the requirement for IPR recordation to deter entry of counterfeit imports. This process involves collecting and digitising information from IPR owners about their registered rights for all imported goods into Kenya. Failure to record IPRs for imported goods or to declare them during importation is a violation of the law.

The Anti-Counterfeit Authority has held engagement forums aimed at partnering with Kenya's digital market players to ensure that the e-commerce platforms are not used as conduits of counterfeiting.

As a self-regulatory measure by the players, plans are at an advanced stage to have online platform owners evaluate their vendor base to ensure that they meet certain requirements to weed out rogue sellers who trade in counterfeits.

What are the major factors frustrating the Authority's efforts to curtail counterfeit trade?

Pervasive consumer attitude towards counterfeits: Counterfeit markets continue to thrive partly because of inadequate awareness but majorly because of a reluctance to purchase the more expensive original goods. This is especially the case in instances where the dangers do not outweigh the perceived benefits of purchasing a counterfeit good. The problem can be seen across the income spectrum and is not unique to low-income earners as commonly assumed.

Rising e-commerce trade: The growth of online trade has further complicated

tracking the sale and distribution of counterfeit goods within the country. The use of such sites as Jumia, Olx and Masoko is growing, especially as internet access becomes more ubiquitous, and these sites expand their geographical coverage.

Rapid technological advancement: Counterfeiters continue to work hard to remain ahead of ACA and continue their trading activities. They are increasingly leveraging technology in various ways, including to replicate the marks of quality or to make not easily detectable changes to products' chemical composition. This makes it difficult to distinguish counterfeits from original products, especially among consumers.

Inadequate collaboration by all stakeholders in government and the private sector in the fight against illicit trade.

Lack of support by global intellectual property rights owners who do not find it economical to support our investigations due to the low quantities of counterfeit goods seized.

The Authority developed three strategic priorities to curtail counterfeit trade. How has this seized counterfeit goods as well as the successful prosecution of perpetrators?

On enforcement the ACA has conducted raids on markets and stores to seize counterfeit products, including imitation apparel, gadgets, and medications. We have seized counterfeit products worth over KES3 billion in the last seven years.

In terms of prosecutions, we have filed lawsuits against individuals, businesses and companies that have been found dealing in counterfeit goods through manufacturing, producing, making, selling and labelling counterfeit goods, which has resulted in convictions, fines and jail time for some offenders.

ACA under the muilt-agency spirit and whole government approach against illicit trade has collaborated with other law enforcement agencies, such as the National Police Service and the Kenya Revenue Authority, to take joint enforcement actions against counterfeiters. The Authority also collaborates and works very closely with the ODPP to ensure successful prosecution of counterfeiting cases.

One of the mandates of the Authority is to sensitise the public on dangers of purchasing counterfeit products. How has the Authority achieved this?

Our public awareness efforts have been carried out by ACA to inform customers about the hazards of counterfeit goods and the significance of purchasing authentic items. This is done through public forums and exhibitions, capacity building forums to government agencies on IPR enforcement as well as public outreach through traditional media and online assets.

Counterfeit imports have promoted unfair competition amongst local manufacturers. How is the Authority fighting this?

Our analysis shows that the majority (80%) of counterfeit goods in Kenya originate from outside the country. Instead of relying solely on traditional enforcement methods, we are adopting a more proactive approach by use of technology by implementing the IPR recordation process. It aims at protecting local manufacturers by dealing with counterfeiting at its source, preventing the goods from entering the country in the first place and reducing the cost and effort required to conduct enforcement intervention on traders of counterfeit goods within the country.

How is the Authority coordinating with various international conventions, agreements and treaties that are advocating for protection and enforcement of intellectual property rights.

Counterfeit trade has taken the international dimension. It misuses modern logistical solutions like shipping lines and airfreight as well as legitimate trade facilities like ports and railway transport. It thus needs international coordination to cut the networks that are planted within legitimate channels.

Kenya has ratified international treaties, conventions and agreements that form part of its laws as under Article 2 of the Constitution. Kenya is a member of the World Trade Organization (WTO) and has ratified the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS). TRIPS treaty sets the minimum standards for intellectual property protection for all WTO members. Kenya has also ratified the Paris Convention and the Berne Convention. The Authority in its enforcement and protection of intellectual property rights employs the standards set in the international laws on protection of international property to ensure proper enforcement and prosecution of counterfeiting cases. The international law provisions have seen the Authority enhance its operations and enforcement mechanisms in protecting intellectual property rights.

The Anti-Counterfeit Authority in Kenya partners with various key players in the government and private sectors to effectively enforce IPR laws and safeguard registered IPRs. This includes trade organisations, industry associations, and international organisations like the World Intellectual Property Organisation (WIPO), African Regional Intellectual Property Organisation (ARIPO), the Africa Intellectual Property Rights and Innovation Project (AfriPI) and Japan External Trade Organisation (JETRO). Additionally, the ACA collaborates with the Kenya Revenue Authority and the National Police Service to seize counterfeit goods. By working with these partners, the ACA aims to raise awareness about the importance of IPR protection and to promote compliance with IPR laws.

ACA is underway planning to hold the first International Conference on Intellectual Property Protection and Enforcement on 13th to 15th June, 2023. The Conference is meant to bring together policymakers, judicial officers, enforcers, leading academic scientists, research scholars and practitioners to exchange and share their experiences and research results on all aspects of intellectual property rights. It will also provide a premier interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of intellectual property rights.

Additive Manufacturing: The Missing Link Towards Successful Manufacturing Economy in Kenya

By Dr. James Mutua

Introduction

WITH the near end of industry 4.0 and the start of industry 5.0 characterised by mass customisation and cyber physical cognitive systems, concerted effort from all stakeholders to attract right skilled workforce to the industry is inevitable. Indeed, the training institutions should endeavour to churn-out fully baked graduates and offer on-job training while the industry must strive to attract young people with the skills needed for modern manufacturing. Jointly, training institutions and companies need to benchmark and promote their technology in the 21st century as exciting, innovative, clean, safe, and fun. Additive manufacturing (AM) will be the cornerstone of modern manufacturing in developed and developing countries. However, lack of specialty of AM has been recognized as critical to economic hindrance on competitiveness of African nations to lead from the front as the world matches towards industry 5.0. Further, African manufacturing powerhouses and the continent at large are devoid to the critical mass of AM experts who should generate the required knowledge and associated intellectual property necessary for technological exploitation.

Additive Manufacturing, applications, and opportunities

Additive manufacturing (AM) is a manufacturing process in which 3D objects are built layer-by-layer through the deposition of materials with the help of 3D CAD data as the digital blue print and heated energy source to fuse the material together. Complex prototypes and end-use parts can be produced with reduced cycle times and minimal material waste as material is deposited where it is necessarily needed. This is unlike in the conventional manufacturing where materials are removed in form of chips leading to waste, high cost, and associated environmental pollution. This state-of-the-art manufacturing technology produce not only functional research prototypes in order to enhance product quality, process parameters, and material universalization during design process but also full scale components for actual applications.

A new dawn fronted by reverse engineering (RE) has made additive manufacturing a quick fix to the long and costly cradle-to-product lifecycle. With RE, the process of taking something apart and analyzing its workings in detail, usually with the intention to construct a new device or program that does the same thing without actually copying anything from the original. New products derived from "diligently copied products" are realized in a short timeframe. Many developed/developing countries including the US, Japan, Germany, China, and South Korea just to mention a few, have embraced the art of reverse engineering to save on resources, time, and expedite their manufacturing capability.

The demand for mass customized and time depended products is overwhelming and this puts AM techniques in the pole position in meeting this need. Currently, several industrial sectors such as aerospace, automotive, medical, energy, and tool and die making have tapped into the imminent potential in AM technologies to produce geometrically complex parts.

> The Kenyan manufacturing fraternity is not an exception, as it must strive to exploit the opportunities posed by Additive manufacturing. With the global AM markets exponentially growing with projections of in excess of $26 billion by 2025 as reported by SmarTech Analysis, 2022. Kenya must throw in her weight around additive manufacturing to reap from the technological, economical, and environmental benefits associated with this technology.

In order benefit from additive manufacturing, human capital development by training institutions is indispensable. In addition, the government should invest heavily in machines and incentives to support the adoption of this manufacturing technology.

Any efforts by stakeholders toward adoption of Additive manufacturing technology in Kenya?

Jomo Kenyatta University of Agriculture and Technology

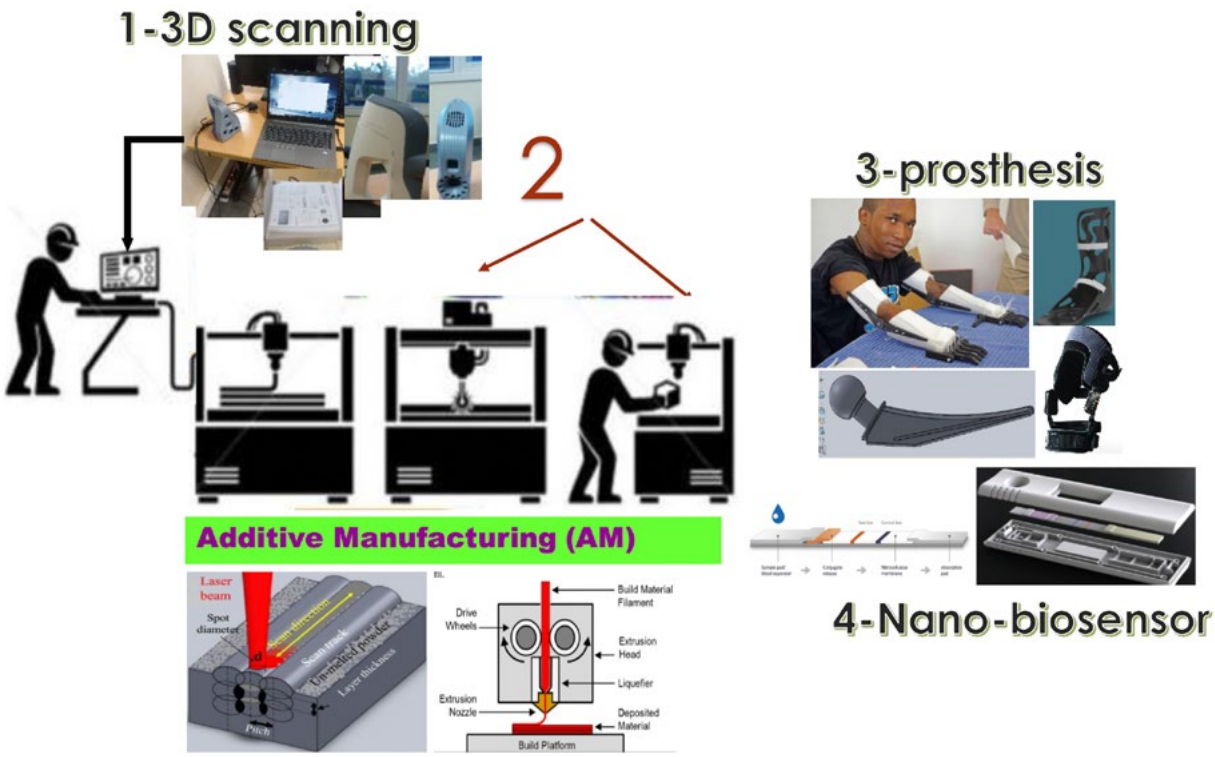


Figure 1: Principle of additive manufacturing processes and select applications in ongoing activities at JKUAT

(JKUAT) is spearheading the critical mass training in additive manufacturing. At the Rapid Prototyping 2 Laboratory, located at iPIC building in the Engineering Workshops, undergraduate and post graduate students are trained on 3D CAD model development, 3D printing, Data capture through 3D scanning, and actual additive manufacturing of select automobile/ machine spare parts and medical devices.

Figure 1: Additive manufacturing process, 3D scanning activities, and some applications in product development.

The university through the College of Engineering has been running seminars/workshops on additive manufacturing to enlighten the Local manufacturers and design engineers on the opportunities therein this technology. Further, recycling of plastic waste into 3D printing filament is ongoing as a means of sustainable supply of raw material for the 3D printing activities in the university, See Figure 2. This has a potential for mass production of the materials presenting Kenya as a 3D printing filament manufacturer and supplier in the African market.

The efforts put by JKUAT in demystifying additive manufacturing will go a long way in enhancing the levels of understanding and implementation of the technology to revitalize the quest towards a manufacturing economy in the country and the region at large.

In conclusion

No country has fully developed without embracing manufacturing backed by research. As such, Kenya must strive to rigorously train, nurture, and support agile manufacturing for it to realise some of its milestones featured in the vision 2030 manifesto. Visionary leaders who support research and rally to marshal resources towards the heavy investments associated with additive manufacturing is inevitable. JKUAT being at the forefront of building human capital in the said area should also endeavor to develop strong collaborations with the manufacturing industry for timely knowledge transfer.

Dr. James M. Mutua (PhD) is a lecturer in the Department of Mechanical Engineering at Jomo Kenyatta University of Agriculture and Technology (JKUAT), Nairobi-Kenya. He is a promising early career researcher (ECR) who attained his PhD in Mechanical Engineering from Tottori University-Japan in 2018.

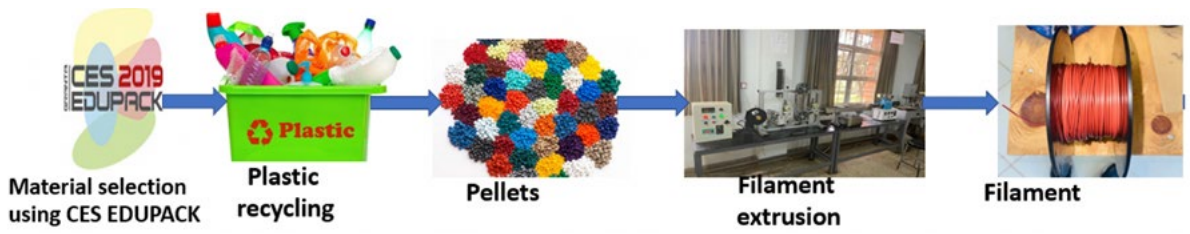
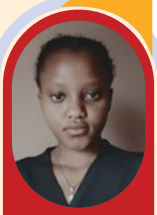


Figure 2: R&D towards transforming waste plastic into 3D printing filament through

Students Voices

University of Nairobi Prepares All-round Professionals Ready for the Industry



Betty Njeri Mbugua

The University of Nairobi offers a versatile and flexible syllabus that prepares students for the future in the industry. One of the most impressive aspects of the Mechanical Engineering programme is its focus on the practical application of the theories taught in class. Through collaboration with external organisations, the university offers platforms where students can innovate new products and prototypes relevant to the market by providing themes for innovation.

The students develop a well-grounded skill-set that includes theoretical knowledge and practical experience, critical thinking skills, and the ability to innovate and think creatively. Through clubs such as Engineering Students Association, mechanical engineering students are able to interact with other engineering students from different faculties and ultimately work on projects as a team, hence improving their teamwork skills and how to associate with fellow engineers.

The university also provides several opportunities for students to interact with industry professionals through industry visits and attachment. Students can interact with professionals on a one-on-one basis through industrial visits fully funded by the university. The students, therefore, gain insights into the various aspects of engineering in the field and have a strong foundation for their careers.

The department also offers several opportunities for mentorship through seminars, talks, and workshops, where the student engineers can interact comfortably with senior and professional engineers and are enlightened on what is needed in the industry. Apart from the technical skills, the programme has helped me to develop soft skills such as teamwork, communication, and leadership, which are essential in any profession, and will enable me to be a valuable asset in any organisation I choose to join. As a student, I am confident that the skills and knowledge gained from this programme will enable me to be a competent professional and a valuable asset to the industry.

Betty Njeri Mbugua is a 3rd year Mechanical Engineering student at the University of Nairobi

Kenyan Manufacturing, a Regional Approach

Emmanuel Ogweno

While the concept of free trade initially promised economic growth for all, it has become apparent over time that it may not be equally beneficial to all. Developing nations often experience significant trade deficits, prompting many countries to adopt regional protectionist policies. With manufacturing being one of the biggest contributors of economic growth, developing nations are striving to develop this sector to push back on the trade imbalance.

Kenya aims to increase manufacturing's contribution to the GDP by 10% annually, as envisioned in Vision 2030. To develop a manufacturing sector strong enough to stand on its own, Kenya needs to aim at serving the East African Community (EAC) regional market. With a population of over 300 million, this region provides the necessary market that can support an industrial base. Thus, efforts by the government to increase its manufacturing output should target the greater EAC with regional integration at the forefront.

By recognising key manufacturing areas that are crucial to the region's future and working to develop them not only locally but also regionally, Kenya stands a chance at realising its manufacturing dream. To achieve this, the government needs to promote collaboration among stakeholders, including manufacturers and support institutions. The government needs to work on joint trainings on industrial processes and developments as well as collaboration among its researchers and academics, including students and the informal sector. Another key factor is harmonising policies, strategies and the business climate regarding manufacturing.

Should Kenya adopt a regional outlook in addition to its local plan for manufacturing, the country, and by extension the whole region, stands a much better chance at building a profitable manufacturing sector.

Emmanuel Ogweno is a 3rd Year Mechanical Engineering Student at JKUAT

University Engineering Education Enables Us to Solve Real-world Problems

Stephen Odhiambo

Mechanical and Manufacturing Engineering studies equip the student with vast knowledge of various aspects of engineering, ranging from engineering design, to material science, thermodynamics, control systems, manufacturing, and fluids. The units covered throughout the course prepare the student to come up with solutions to problems facing society.

The practical bit of the course provides an exciting learning environment as the students gain skills through laboratory tests, workshop practice, and industrial attachments. Multimedia University of Kenya has well-equipped workshops with adequate modern machines, where students are guided on the operation and maintenance of machines by experienced technicians. The practical training provides valuable skills and enables the students to apply theoretical concepts in solving real-world problems.

As part of the course, we handle Engineering projects assigned to the design, development, and manufacture of mechanical systems and machines, providing us with the opportunity to understand the principles of engineering. The projects are normally done in groups and require valuable skills like communication and leadership, thus encouraging teamwork. Through the projects, we sharpen our skills in computer-aided drawing, simulation and analysis.

As an engineering student, I have had access to networking events, mentorship programmes, career fairs, and industry engagement opportunities that have played a pivotal role in bridging the gap between academia and the industry. The mentorship programmes enable the students to be well-informed about the current technological advancements in the engineering field such as electric mobility, 3D printing, and automation. We appreciate the continuous support of the Institution of Engineers of Kenya (IEK) and the Engineers Board of Kenya (EBK) in nurturing student Engineers.

The diverse knowledge provides various opportunities to the students as they can apply their skills in a range of companies/industries. As we prepare for the industry, we are confident that we have adequate skills that when given the opportunity, we shall contribute immensely towards the economic growth of this country.

Stephen Odhiambo is a 4th Year Mechanical and Manufacturing Engineering student at Multimedia University of Kenya

The Link Between Manufacturing and Mechanical Engineering

Chepngenoh Purity

Manufacturing Engineering deals with the improving of manufacturing processes through research of the most efficient methods while Mechanical Engineering deals with the design and development of machines.

Manufacturing Engineering is a branch of engineering that shares concepts and ideas with other fields of engineering such as mechanical, chemical, electrical, and industrial. Manufacturing Engineering requires one to be able to plan the processes of manufacturing, use machine tools, materials and human resources in the most efficient ways to produce quality goods with optimum expenditure of capital.

Manufacturing Engineering personnel are key in organisations. They plan and schedule the manufacturing of products; programme machines needed such as CNC machines and are also responsible for quality and inventory control. Some of the manufactured products range from gears, pumps, turbine blades, aeroplanes to integrated circuits and robotic equipment.

It is notable that Mechanical Engineering is one of the broadest engineering disciplines. Mechanical Engineers design, test and build. They do that by the use of principles and problem-solving skills. Mechanical engineers analyse their work using the principles of motion, energy, and force, ensuring that designs function safely, efficiently, and reliably. As technology becomes the norm in our society mechanical engineers also incorporate the use of computer systems to test, design and run simulations to determine how machines work and can be integrated with other systems and also use computer aided designs and manufacturing programmes.

Mechanical engineering offers a wide range of places of work from offices, industrial areas, construction areas, teaching institutions, research areas and airports. Mechanical and manufacturing engineering is a vital part in our world.

Chepngenoh Purity is a 3rd year Mechanical engineering student studying at JKUAT

Unlocking Kenya's Manufacturing Potential: Lessons from China's Success Story

By Khadija Omar

CHINA'S rise as a manufacturing powerhouse has been nothing short of remarkable.

Accounting for nearly 30% of global manufacturing output in 2019, compared to just 3% in 1990, the country has now become the world's largest exporter of goods.

Within just three decades, China has evolved from an agrarian society to a manufacturing giant. The industry has become the backbone of China's economy, totalling over 27% of the country's GDP and employing more than 200 million people.

> In order to change China from a big manufacturing nation to a strong manufacturing nation, we need to move from the low end to high end production. Beijing Automotive Group Chairman.

Given Kenya's strategic location in Africa, abundant natural resources, and dynamic population, the potential for the country's manufacturing sector is enormous. It is imperative that action is taken to foster an innovative and productive manufacturing environment. In this regard, China provides an excellent case study for Kenya to learn from.

While there are many initiatives being pursued by China, several stand out as particularly impressive. The "Made in China 2025" initiative prioritises high-tech industries and invests in innovation, research and development, talent training, and technology to transform China into a high-end manufacturer and increase its brand value. Additionally, the country's Mass Entrepreneurship and Innovation Programme supports start-ups and small and medium-sized enterprises with policies such as tax breaks, access to financing, and mentorship programmes. China has also made significant investments in research and development, with a total of $320 billion spent on R&D in 2019, making it the second-largest investor globally after the United States. Finally, the "One Belt, One Road" initiative promotes economic development and regional cooperation through strategic infrastructure investments that contribute to a more efficient supply chain.

Kenya, like China, has great potential in the manufacturing industry, yet it has encountered significant challenges due to lack of funding, skilled labour, energy, and supportive policies, especially in the face of rapidly advancing technology.

While Vision 2030 anticipated the manufacturing sector to contribute 15% to the country's GDP, the current administration has championed the "20 by 2030" initiative, aiming for an ambitious 20% contribution. In reality, the share of the manufacturing sector has been steadily declining in recent years, from 9.3% in 2016 to 7.6% in 2020.

To achieve these goals, Kenya needs to focus on the pillars that have driven China's global success. This includes the development of expertise, policy, infrastructure, and R&D. By investing in these areas, Kenya can unlock the full potential of its manufacturing sector and become a leading producer of high-value goods for the global market.

Kenya has a young population, which presents a valuable opportunity to develop a skilled workforce by improving coordination between education and industry and providing incentives for the private sector to invest in high-tech industries that require engineering talent.

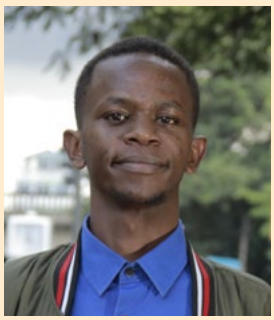
Special Economic Zones (SEZs) can also be a game-changer in Kenya's manufacturing sector, but the government needs to go beyond offering incentives and formulate strategic policy. To ensure their success, heavy investment in infrastructure such as energy, telecommunications, transport, water supply, and sanitation is crucial to establish seamless connections in the supply chain.

Investment in research and development (R&D) is a proven tactic to inform policy, enabling high-value manufacturing to thrive. By building a supportive framework for the private sector, Kenya can create an ecosystem that encourages innovation, entrepreneurship and sustainable growth.

As we look to diversify our economy, a transition from an agrarian-based economy to a manufacturing hub is a promising opportunity. Kenya has the opportunity to leverage its value-add agricultural resources to manufacture and export high-value products in growing industries such as nutraceuticals, bio-tech and pharmaceuticals.

It is important to recognise that the road ahead for Kenya is not without its challenges. However, in today's interconnected world, we have access to a wealth of knowledge and examples of best practices that can be adapted and customised to fit Kenya's unique circumstances. By harnessing the power of global innovation and local ingenuity, we can create a brighter and more prosperous future for all Kenyans. Let us look forward with hope, determination, and a willingness to learn from the world around us.

Khadija Omar, a Civil Engineer dedicated to finding innovative and eco-friendly solutions to engineering challenges. She is also a board member of the ALIVE Foundation.



Technologies in Manufacturing Sector

By Denis Musembi

MANUFACTURING and mechanical engineering have always been interrelated, with mechanical engineers playing a crucial role in designing and developing the machines and processes that power modern factories. However, in recent years, the manufacturing sector has experienced a wave of emerging technologies that are transforming the way things are made, and mechanical engineers are at the forefront of these innovations.

> One of the most significant emerging technologies in manufacturing is 3D printing, also known as additive manufacturing, which enables engineers to design and print complex parts and components with a high degree of precision and accuracy. This technology has revolutionised the manufacturing process, making it faster, more flexible, and more cost-effective than traditional manufacturing methods. It has also opened up new possibilities for mass customisation, where products can be tailored to meet the specific needs of individual customers.

Another emerging technology in manufacturing is the use of automation and robotics. Advances in artificial intelligence, machine learning, and robotics have made it possible to automate many manufacturing processes, from assembly line tasks to complex processes. This has led to significant increases in productivity and efficiency, as well as improved quality control and reduced costs. Moreover, the use of collaborative robots or cobots is becoming more common, where they work together with human workers to enhance productivity and safety.

In addition to 3D printing and automation, other emerging technologies in manufacturing include the Internet of Things (IoT), blockchain, and augmented reality. The IoT enables manufacturers to connect their machines and equipment, allowing them to collect and analyse data in real-time, leading to improved efficiency and productivity. Blockchain technology is being used to increase transparency and traceability in supply chains, while augmented reality is being used to improve worker training and enhance product design and development.

Mechanical engineers are playing a crucial role in developing and implementing these emerging technologies in manufacturing. They are responsible for designing and developing the machines and processes that enable 3D printing, automation, and other technologies to work seamlessly together. They are also responsible for ensuring that these technologies are safe, reliable, and cost-effective, while also meeting the needs of manufacturers and consumers alike.

In conclusion, the manufacturing sector is undergoing a period of rapid technological change, with the emerging technologies transforming the way things are made. Mechanical engineers are at the forefront of these innovations, designing and developing the machines and processes that make these technologies possible. As the manufacturing sector continues to evolve, it is clear that mechanical engineers will play an increasingly important role in shaping the future of manufacturing.

As a Mechanical Engineering student, I can't wait to join the industry and interact with these and many technologies.

Denis Musembi
BSc. Mechanical Engineering is a 5th Year student at the University of Nairobi

Innovators Recognised During the World Engineering Day on March 4, 2023

By Maria Monayo

The ***World Engineering Day*** for Sustainable Development was proclaimed by UNESCO at its 40th General Conference in 2019 and is celebrated worldwide on 4th March of each year. The day offers an opportunity to highlight engineers' and engineering's achievements in the modern world and improve public understanding of how engineering and technology are central to modern life and for sustainable development. In light of this importance, we collaborated with the Engineers Board of Kenya (EBK) to organise WED 2023 themed *"Engineering innovation for a more resilient world"*. This year we recognised the following young and women engineer innovators:

YOUNG ENGINEERS INNOVATORS

S/ NO.	NAME	TITLE OF THE INNOVATION
1.	George Ouma Otieno	MAGIC CAMERA
2.	Joan Wambui Kabura Stephen Mwangi Maina Mark Tanui Ruth Njoki Kamau	TRAFFI-AI
3.	Belinda Chuma Ywaya	BREAST CANCER DETECTION USING NEURAL NETWORKS
4.	Leonard Kibuthu Maina	A SEMI-AUTONOMOUS WHEEL-CLAMPING ROBOT.
5.	Joseph Nguthiru Yvonne Thuo Sam Okemwa Millie Cheptoo Charles Kinyua	ECO-FLUIDO
6.	Mergery Wanjiru Mukoma Nickson Kiprotich Ryan Kiprotich Cheruiyot	CAi
7.	Jill Amondi Onyango Khamis Muniru Gideon Kenyatta	NISHATI SAFI
8.	Kelvin Mutunga Kiiti	CBC INTERACTIVE LEARNING AID
9.	Dolphine Teyo	MULTI CRETERIA APPROACH TO ASSESS GROUND WATERPOTENTIAL CASE STUDY: CASE STUDY BARINGO COUNTY
10.	Kipkoech Ian Bett	SETTING UP ORGANIC FERTILIZER PLANTS IN MITIGATION OF SOLID WASTE IN POULTRY AND DAIRY FARMS
11.	Benard Kipngeno Koskei	3D PRINTING CONCRETE INK
12.	Miriam Wanjiku	DAKTARI
13.	Susan Muchira	DEVELOPMENT OF A SOFTWARE FOR THE DESIGN OF THE SLOPE FOR OPEN CHANNELS
14.	Yvone Robert	LEEDS VONNE INTERNATIONAL LIMITED
15.	Vigil Suerin	DESIGN AND CONSTRUCTION OF A GROUND-BASED ELECTROMAGNETIC SPACE LAUNCH SYSTEM
16.	Phillip Amani	BRIQUETTES MAKING MACHINE
17.	Shane Kwalanda Shitanda	INCORPORATING A PRESSURE GAUGE ONTO DOMESTIC GAS BURNERS AND REGULATORS
18.	Carolyne Kinya	MAKING OF TILES FROM MIX OF SAND AND MOLTEN PLASTICS
19.	Alex Katuso Kilwaya	GLOBAL WARMING PICOSATTELITE MAPPER
20.	Joykelly Makena	MAKING TILES OUT OF SAND AND BURNT PLASTICS
21.	John Mwiti	MAKING PLASTIC TILES
22.	Caleb Akwesera Ndiwa	PROTOTYPE OF A PYROLYSIS SYSTEM
23.	Jeff Machanda	ECO-VALUE
24.	Brian Ngumi Mundia	APPRENTICESHIP REALIZATION
25.	Omondi Onyango Vincent	INTERGRATED PHOTOVOLTAIC PEROVSKITE BASED SOLAR ROOFING SHEETS
26.	Abigael Nzembi Mutinda	KINERGY
27.	Japheth Kimutai Kiplagat	A SYNGAS GENERATION PROJECT

WOMEN ENGINEERS INNOVATORS

S/ NO.	NAME	TITLE OF THE INNOVATION
1.	Norah Magero	VACCIBOX
2.	Dorcas Jeptoo Aliaka Olyvia Gatwiri Shikhule	DRONELAB
3.	Faith Bochere Maera	WIND TURBINE DIGITAL TWIN
4.	Carol Chepkemoi	INTELLIGENT TRAFFIC MANAGEMENT SYSTEM AT TRAFFIC JUNCTIONS
5.	Merlyne Florah	CASE CONVEYOR CONTROLLER: ERGONOMICS AND SAFETY, A POWERFUL PAIRING
6.	Janet Jepkosgei Kangogo	EMECHANIQ AND MATHARECYCLE

IEK Membership Report

The IEK membership committee meets every month to consider applications for membership of the various classes received at the secretariat. The IEK Council at its 505th, 507th ,508th and 509th meetings accepted the following members under various membership categories as shown below;

MEMBERSHIP CLASS	NUMBER ACCEPTED- 505TH COUNCIL	NUMBER ACCEPTED- 507TH COUNCIL	NUMBER ACCEPTED- 508TH COUNCIL	NUMBER ACCEPTED- 509TH COUNCIL
Fellow	-	2	-	4
Corporate	6	10	-	88
Graduate	108	110	136	140
Graduate Engineering Technologist	6	5	6	3
Graduate Engineering Technician	6	-	3	4
Student	21	34	17	71
TOTAL	**147**	**161**	**162**	**310**

During the period, six members transferred from the class of Corporate to Fellow members and 104 from Graduate to Corporate members. In addition, 494 graduates, 20 graduate engineering technologists, 13 graduate engineering technicians and 143 students were accepted as members.

Gender Data

Class	Male	Female	Percentage (Male)	Percentage (Female)
Fellow	5	1	83.3%	16.7%
Corporate	84	20	80.8%	19.2%
Graduate	421	73	85.2%	14.8%
Graduate Engineering Technologist	17	3	85%	15%
Graduate Engineering Technician	11	2	84.6%	15.4%
Student	99	44	69.2%	30.8%
TOTAL	**637**	**143**	**81.7%**	**18.3%**

Summary

Gender	No	Percentage
Male	637	81.7%
Female	143	18.3%
	780	**100%**

505TH APPROVAL

CORPORATE

S/NO	NAME	MEMBER NUMBER
1.	David Kiptoo Lelei	M.6431
2.	Zipporah Chemutai Rotich	M.11785
3.	Kilonzo James Muia	M.8279
4.	Muthomi Munyua	M.6326
5.	Moses W. Warugongo	M.6644
6.	Clinton M. Rosana	M.10152

507TH APPROVAL

FELLOW

S/NO	NAME	MEMBER NUMBER
1.	Wilfred Omari Nyakundi	F.1946
2.	Mwaka Mungatana	F.3161

CORPORATE

S/NO	NAME	MEMBER NUMBER
1.	Antony Ochieng Onim	M.4663
2.	Beatrice Muthoni Maina	M.5916
3.	Ruth Achieng Kasera	M.7009
4.	Daniel Kilenge	M.9995
5.	John Kariuki Karanja	M.8805
6.	Evance Lusi	M.9022
7.	Hillary Cheruiyot Kemei	M.8247
8.	Mellese Yimam Emeru	M.11951
9.	Joshua Kyalo Mutunga	M.10656
10.	John Kirui Torongei	M.8074

509TH APPROVAL

FELLOW

S/NO	NAME	MEMBER NUMBER
1.	Maurice Sande Odera	F.768
2.	Orege Okwiri Carey	F.1444
3.	Benjamin Syengo Kiema	F.2945
4.	Jennifer Atieno Gache	F.1966

CORPORATE

S/NO	NAME	MEMBER NUMBER
1.	Abdifatah Edin Maalim	M.6781
2.	Abdullahi Mohamed Ahmed	M.8140
3.	Albert Isaac Omondi	M.9568
4.	Anthony Mbogo Njagi	M.8935
5.	Athanus Wanjala Opwora	M.9452
6.	Auru Daniel	M.8936
7.	Barnabas Muli Munyao	M.5325
8.	Benson Mwangi Kamau	M.9056
9.	Brian Donald Omindo Otieno	M.7798
10.	Caren Jerono Kipchumba	M.7421
11.	Charles Okoth Odhiambo	M.8766
12.	Cheruiyot Kiprono Leonard	M.10080
13.	Cheruiyot Nicholas Rotich	M.10085
14.	Clement Murimi Njue	M.9550
15.	Cyrus Kibet Ng'eno	M.7702
16.	David Kariuki Kirigo	M.9378
17.	Denis Mhuri Omari	M.7871
18.	Denis Mwangi Kabuga	M.8954
19.	Dickson Ng'unga Mutula	M.8188
20.	Duncan Amol Ochieng	M.7345
21.	Edwin Kipleting Kirarei	M.6949
22.	Edwin Moikoyo Orondo	M.8069
23.	Eliud Gachago Kaithaka	M.9312
24.	Ernest Mumela Machasio	M.10004
25.	Eunice Wangari Kamau	M.9837
26.	Faridah Akoth Odhiambo	M.11195
27.	Francis Benedict Ondiek	M.8541
28.	Francis Mogere Kimaiga	M.8542
29.	Franklin Mutuma Ngutiku	M.8067
30.	George Bernard Omondi	M.9463
31.	Gideon Opati Okaka	M.7282
32.	Halkano Mohamed Halkano	M.5401
33.	Innocent Xavier Gitonga	M.8071
34.	James Indika Saya	M.6835
35.	Jim Walter Githinji Makune	M.8072
36.	Job Onyango Ochieng	M.10597
37.	Joseph Agingu Sweta	M.8688
38.	Joseph Mutunga Kimuyu	M.8808
39.	Judy Cherono Rotich	M.10027
40.	Juliette Murugi Mburu	M.8982
41.	Ken Kilungu Mwanzia	M.9853
42.	Kennedy Saroni Melau	M.5659
43.	Kennedy Wafula Sichangi	M.9150
44.	Kenneth Gitahi Kariuki	M.3824
45.	Khamis Abdallah Mbarak	M.6806
46.	Kibush Daniel	M.9401
47.	Koskei Sammy	M.6705
48.	Lawrence Wanjala Musito	M.9429
49.	Lenah Kinya Mithika	M.8555
50.	Leonard Kipchumba Kiprono	M.9858
51.	Levi Mukubu Kulundu	M.9941
52.	Lydiah Waithira Thuo	M.6804
53.	Mark Omondi Ogol	M.8660
54.	Mathew Aringo Njoga	M.8026
55.	Mercyberly Akinyi	M.6773
56.	Michael Odiwuor Abande	M.8827
57.	Milton Muthomi M'arimi	M.5699
58.	Moses Gatune Kimani	M.8482
59.	Moses Muiruri Nderi	M.8293
60.	Muiru Martin Kinuthia	M.7659
61.	Naftaly Kihumba Ndiritu	M.9193
62.	Nicholas Ojune Parapara	M.6849
63.	Pauline Muthoni Wainaina	M.8484
64.	Peter Otieno Odhiambo	M.8723
65.	Radiance Rabillo Mungu	M.7937
66.	Raphael Kang'eri Karingithi	M.7080
67.	Reagan Omondi Onyango	M.9096
68.	Richard Odhiambo Otieno	M.7186
69.	Rinah Munyelele Chikamai	M.5981
70.	Salim Zimbu	M.8843
71.	Sella Jebitok	M.9287
72.	Sharon Atieno Omollo	M.9375
73.	Sibhora Simion Nyamwinara	M.9334
74.	Simon Omenda Afanda	M.6930
75.	Stanley Kanyua Kamau	M.6350
76.	Stephen Okuku Ogelo	M.7876
77.	Sylvia Wanjiku Wacharia	M.6658
78.	Tauseef Mohamed Kasman	M.5530
79.	Teresia Ipara Tangara	M.4751
80.	Teresia Wanjiru Njoki	M.10091
81.	Timoty Anyambu Asava	M.9553
82.	Veronicah Mwende Mualuko	M.6517
83.	Vincent Boi Paul	M.10614
84.	William Maina Njakai	M.7627
85.	Yvone Robert	M.7226
86.	Philip Aura Otieno	M.9163
87.	Michele Angila Ombima	M.8644
88.	Grace Gathoni Kamunge	M.8708

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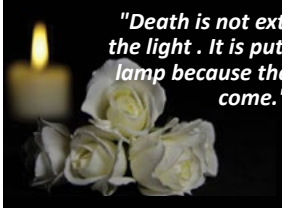
Graduate and Corporate members are encouraged to apply for transfer of class to Corporate and Fellow classes, respectively. Members can check eligibility and how to apply on our website using the following link: **https://iekenya.org/web/register_as_member**

The IEK condoles with family and friends of our members who have passed away in the recent past.

May their souls rest in peace.

1. Eng. Bernard Ngesu Kilundo
2. Kevin Steven Odongo



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