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Engineering in KENYA

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Aerospace and Aviation Engineering

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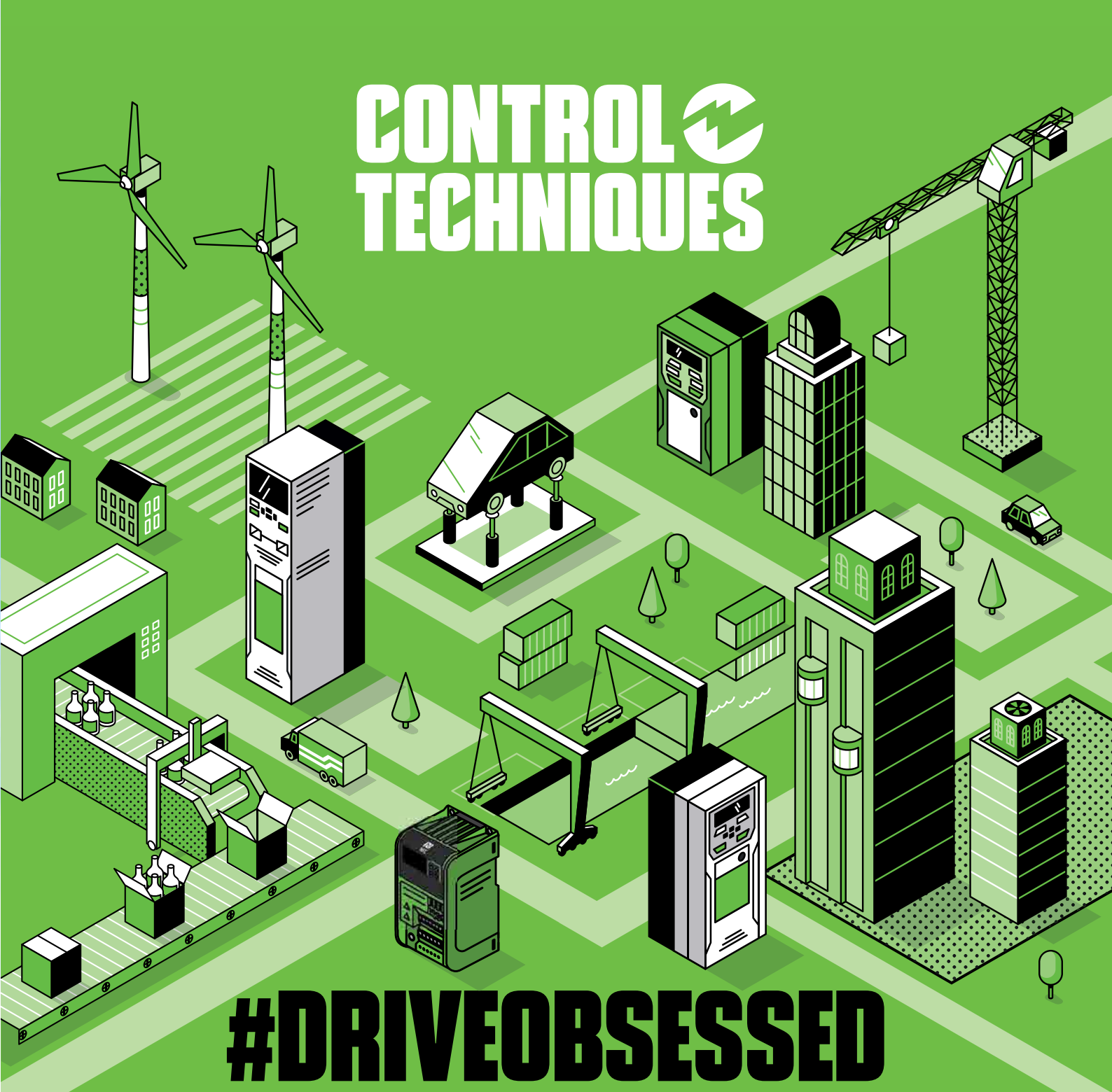

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Call for Papers

Engineering in Kenya Magazine - Issue 011

The Institution of Engineers of Kenya (IEK) publishes Engineering in Kenya magazine, whose target audience includes engineering professionals, practitioners, policy makers, 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 January, 2023 for our next issue, whose theme shall be "Telecommunications 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.

Send your article today, and get a chance to feature in the magazine!

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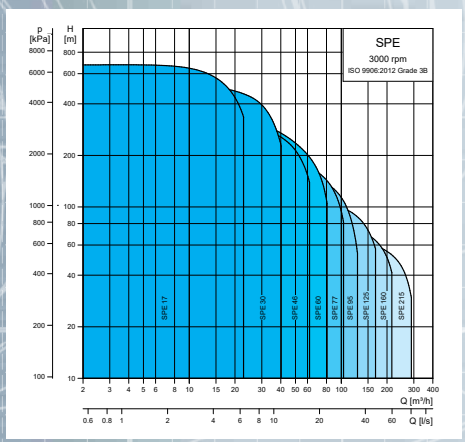
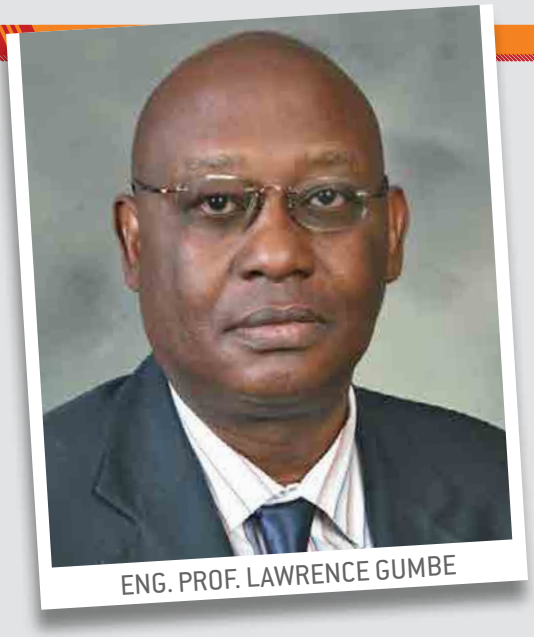


GRUNDFOS

In this **Issue**

Cover photo: Courtesy Kenya Civil Aviation Authority (KCAA).



ENG. PROF. LAWRENCE GUMBE

Aerospace and Aviation Engineering

AIR transport generates benefits to consumers and the wider economy by providing speedy connections between cities. These virtual bridges in the air enable the economic flows of goods, investments, people and ideas that are the fundamental drivers of economic growth. It is estimated that aviation enables US $3.5 trillion in global GDP. If aviation were a country, it would be the 17th largest economy in the world, supporting 87.7 million jobs and nearly 3.5 trillion dollars in economic impact.

Air transport creates connections between towns and cities, enabling the flows of goods, people, investment and ideas that stimulate economic development.

> Aerospace engineering is the primary field of engineering concerned with the development of aircraft and spacecraft. It has two major and overlapping branches: Aeronautical engineering and astronautical engineering.

Aeronautical Engineering is concerned with development, design, production, maintenance and operation of flight vehicles which are subjected to demanding conditions such as those caused by changes in atmospheric pressure and temperature, with structural loads applied upon vehicle components. Consequently, they are usually the products of various technological and engineering disciplines including aerodynamics, propulsion, avionics, materials science, structural analysis and manufacturing.

Astronautical engineering includes the design, develop and manufacture spacecraft, the same vehicles astronauts use to journey past the skies and into what in many ways remains the great unknown. Space vehicles have come a long way in a relatively short period of time. Thanks to state-of-the-art technology, unmanned devices can travel greater distances and remain there for longer periods through intelligent navigational systems and remote sensing. These capabilities are largely attributable to the work and technical know-how that astronautically engineers provide to aerospace systems, in particular, and the science and engineering field overall.

The International Air Transport Association, IATA, estimates that in Kenya, airlines airport operators, airport on-site enterprises (restaurants and retail), aircraft manufacturers, and air navigation service providers employ 15,000 people. In addition, by buying goods and services from local suppliers the sector supports another 96,000 jobs. On top of this, the sector is estimated to support a further 43,000 jobs through the wages it pays its employees, some or all of which are subsequently spent on consumer goods and services. Foreign tourists arriving by air to Kenya, who spend their money in the local economy, are estimated to support an additional 257,000 jobs. In total 410,000 jobs are supported by air transport and tourists arriving by air.

IATA further estimates that for Kenya, the air transport industry (including airlines and its supply chain) are estimated to support US $1.6 billion of GDP. Spending by foreign tourists supports a further US $1.6 billion of the country's GDP, totalling to US $3.2 billion. In total, 4.6 percent of the country's GDP is supported by inputs to the air transport sector and foreign tourists arriving by air.

The Ministry of Roads and Transport is responsible for policy in the aerospace and aviation sectors. The Kenya Civil Aviation Authority (KCAA) is the state corporation responsible for regulating the aviation industry in Kenya and for providing air navigation services in the Kenya flight region. The Kenya Airports Authority (KAA) provides facilitative infrastructure for aviation services between Kenya and the outside world.

The main airports in Kenya are: International Airports: Jomo Kenyatta International Airport; Moi International Airport; Eldoret International Airport; and Kisumu Airport. Domestic Airports are: Wilson Airport; Malindi Airport; Lokichoggio Airport; Wajir Airport; and Isiolo Airport. There are also many airstrips in Kenya.

The Kenya Space Agency is mandated to promote, coordinate and regulate space related activities in the country. This is effected through promotion of research and innovations in space science, technology and respective applications as well as enhancing the regulatory framework.

Vision 2030 states that the government aims at making Kenya the aviation hub in the African region through construction and modernisation of aviation facilities and targets annual capacity of 45 million passengers. Key projects includes: reconstruction of terminal two at JKIA; construction of Green Field Terminal, second runway and associated facilities at JKIA; improvement of terminal and airside capacity at Kisumu International Airport, improvement of safety and support operations at Moi International Airport; modernisation of Air Navigation Services Phase II & III and construction, rehabilitation and maintenance of Airstrips and Airports.

This issue of Engineering in Kenya present interesting articles in the broad areas of aerospace and aviation engineering. We are sure that you will be informed, educated and entertained!

The 29th Annual International Institution of Engineers of Kenya's Convention will be held on 21- 25 November at Diani Reef Hotel, South Coast. Please purpose to attend.

ENG. ERIC OHAGA

29th IEK International Convention: A Call to Reflect on Sustainable Engineering in Era of Climate Change

> WE ENGINEERS ALONGSIDE KEY STAKEHOLDERS IN INDUSTRY AND ENGINEERING PRACTICE HAVE INTENTIONALLY COME OUT TO SEEK AND INFLUENCE POLICY FORMULATION AND DECISION MAKING IN REGARDS TO CLIMATE ACTION AND CLIMATE CHANGE MITIGATION.

THE world is witnessing unprecedented times, coming post COVID-19 pandemic. The costs of food and energy are soaring, thus affecting millions of people. It is estimated that sky-rocketing food and energy prices have resulted in 71 million people in developing countries falling into poverty; according to the UN Development Programme (UNDP). The war in Ukraine has equally led to a rise in inflation due to further disruptions in the global supply chain. Of the cost of increase of natural gas over the period running May 2021 to May 2022, 166.8% is attributed to the war in Ukraine that begun in February 2022. The conflict has led to an estimated 40% increase in annual prices of wheat and for 60-75 % of the annual price increases of corn and sunflower seed oil, according to UNDP.

Locally, overall inflation remained high during the second quarter of the year 2022, driven by supply side factors that drove food and energy prices upwards (according to Central Bank of Kenya-Quarterly Economic Review publication of April-June 2022). Inflation increased to 7.2 percent from 5.3 percent in the previous quarter, according to this report. Food prices increased, on account of unfavorable weather conditions and global supply chain disruptions, further exacerbated by the Russia-Ukraine conflict. Despite continued government interventions to stabilize pump prices, fuel prices increased due to elevated international oil prices arising from higher demand and the Russia-Ukraine conflict.

The engineering practice does not happen in isolation. Engineering is core, functional and fundamental fulcrum for any functional economy. This is why, we engineers alongside key stakeholders in industry and engineering practice have intentionally come out to seek and influence policy formulation and decision making in regards to climate action and climate change mitigation.

Kenya's new administration has taken shape both at the national level and in the 47 counties. We highly recommend that policy formulation experts at all levels of administration consider engaging our highly qualified engineers in the development of resilient infrastructure that will support economies in their various jurisdictions. Involve Engineers closely in legislation, regulation and in every context of governance and place infrastructure development as a central priority in development of dams, roads, irrigation , energy, ICT, and other infrastructure.

Discussions and concerns around the negative impact of Climate Change continues to occupy global news headlines. A global Conference of Parties 27 (COP27) just ended in Sharm El-Sheikh, Egypt with more than 100 World leaders attending. Climate action is an ongoing process, not an event, and requires extraordinary collaboration. COP27 is a critical call to action for business and government leaders to double their climate goals, forge new collaborations, and achieve innovative solutions—together. This year, COP27 has focused particular attention on strengthening adaptation and resilience, mitigating emissions, facilitating a just transition, and increasing funding and collaboration for essential climate solutions.

The Institution of Engineers of Kenya's 29th IEK Annual International Convention is themed "Sustainable Engineering in the Era of Climate Change", addresses the bigger agenda of Climate Change. The convention, organized in collaboration with the Engineers Board of Kenya (EBK) is set for 21st to 25th November 2022 in Kwale County, in the Coastal area of Kenya. Expected attendees include engineers and policy makers from around the world as well as local experts, among other professionals who will benefit from the event. A total of 3,000 participants are expected to attend the 2022 IEK Annual International Convention.

The aviation industry which we highlight in this 10th Edition of Engineering in Kenya collaborates to deliver one specific mandate: driving the global economy in an interconnected society. I welcome you all to learn and gain insight into the various thematic areas that constitute the aerospace and aviation engineering.


ENG.SHAMMAH KITEME

Message from IEK Honorary Secretary

> AVIATION CAPTURES THE INGENUITY AND CREATIVITY OF ENGINEERING IN THE SENSE THAT A LOT OF ENGINEERING GOES INTO THE DESIGN OF THE PLANE (THE VEHICLE) WITH TURBOPROP PROPULSION.

DEAR Member,

I welcome you to read our 10th edition of Engineering in Kenya magazine. In this edition, we focus on aviation. Perhaps apart from Engineers roles in medicine and nuclear power, it is in aviation that the incredible power of Engineering is made into practical use. This is not to undermine the great innovations in underground tunneling or the tubes that have by far created engineering marvels in underground tunnels and sea tubes. But the sheer marvel of what the jet engine has done in creating ability of the human race to move from one end of the world to the other in a fraction of time of what it could take a century ago is a wonder in itself. Hitherto, these distances would only be covered by water in very treacherous sea voyages. Presently, you will hear that now you can take your breakfast in Tokyo and Dinner in New York to capture the spirit of these long-haul flights the longest currently being from New York to Singapore taking just about 19 hours non stop.

Another important aspect is how the air traffic in general has so advanced to be where it is and especially in terms of safety. The amazing thing about this feat is that a lot of Engineering has gone into this from the jet propulsion concept providing the thrust for lift, propulsion and effective control while airborne. By now the reader will have picked that I am an aviation enthusiast.

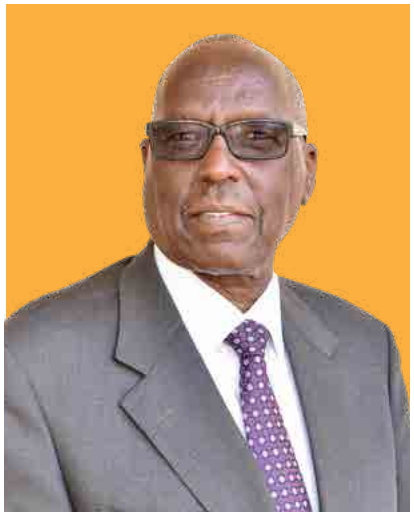
Aviation captures the ingenuity and creativity of engineering in the sense that a lot of Engineering goes into the design of the plane (the vehicle) with turboprop propulsion, but also GPS and satellite communication as a result of advanced instrumentation and control, composite material airframes from advanced material science, improved fuel efficiency in engines speak of incredible Engineering. It is therefore fitting that an edition of the premier publication of IEK would be dedicated to aviation.

But the design of airports and airstrips also involve a lot of Engineering as is the facilitation of all intermodal transportation to and from the airports. It is for this reason that aviation sector provides many jobs for Engineers both in civilian and military sectors. With over 400 flight take off every hour all over the world, over 100,000 daily flights the aviation sector must interest engineers by the sheer growth potential it has but also because as we look at the Sustainable Development Goals, the sector will become very key. It is expected that by 2050 two thirds of the world population will be living in cities. Here in Kenya, the cabinet secretary for Transport and Infrastructure has also indicated his desire for an airstrip in every county. This is basically an opportunity for Engineers to grab in implementing this vision if it is to be brought into fruition.

As we gather in this year's annual convention in Diani Reef on 21st to 25th November, I want to encourage members to engage with issues affecting our profession with view to contributing on the future of Engineering we desire for ourselves and posterity. This is particularly so because this year we also celebrate 50 years of IEK existence to serve the interest of Engineers.

The convention has a rich content from paper presentations, panel discussions and key note speeches that are worth the investment of your time as a member. You will not only earn 25 CPD points but you will also get updated on what is happening in your different areas of practices. We will also have poster presentations and exhibitions on the most current technologies of interest to us.

ENGINEERS BOARD OF KENYA CHAIRMAN'S REMARKS



Eng. Erastus K. Mwongera, RCE, FIEK, CBS - Chairman, EBK

I wish to join the Institution of Engineers of Kenya in warmly welcoming you for the 29th IEK Convention. I take note that the theme ***"Sustainable Engineering in the Era of Climate Change".*** Climate Change is a Global discussion which cannot be ignored. This is a global challenge that if not addressed could potentially impact the future, leading to an economic recession in many jurisdictions. I wish to quote António Guterres a fellow engineer and the Secretary-General of the United Nations, ***"The fight against climate change will only succeed if everyone comes together to promote more ambition, more cooperation and more credibility".***

The role of Engineers is pivotal in the function of the Kenyan economy cutting across government priorities of increasing productivity in agriculture, manufacturing, blue ocean and enabling infrastructure for transport, water, health, and communication. As we deliver on our role of providing engineering solutions to the problems facing our community, we must consider climate change as one of the major challenges facing the current and future generation and that if not addressed, will imperil the existence of humanity. We must therefore invest in solutions that lead to sustainable economic growth.

In the spirit of providing solutions to the community I urge all engineers to respond to climate change by exploring innovative solutions like renewable energy, next generation manufacturing, smart technologies and energy-efficient transport systems and further embrace engineering research that will spearhead innovations that will bring into balance our natural world, our built world and our societies. This is in the realization of Kenya's COP27 commitments and climates action plans.

Engineers Board of Kenya is committed to continuously provide an enabling environment for regulation and the development of the engineers and the engineering services. To achieve the UNESCO ratio of engineers to population in developing nations, the Board has prioritized having 10,000 professional engineers in the Register by the year 2027. There are several collective efforts to ensure this huge task is achieved and they include

1. *Independent Reviews for engineering programs being taught in local universities which will ensure graduates are registrable as Graduate engineers by the Board.*
2. *Graduate Engineers Internship Program (GEIP) by EBK.*
3. *Increased mentorship programmes with the industry.*

The Board has further strengthened Compliance and Enforcement functions to minimize non-compliance to the Engineers Act. The Board has completed the report on Country-Wide Structural Assessment of Ongoing Buildings and has submitted to the Ministry for adoption and will thereafter disseminate the report for policy action.

The Board has also appointed various Ad hoc committees which are investigating various cases of professional misconduct report by the public and the sector regulators. Their findings will further strengthen the profession. I urge stakeholders and employers to engage registered Professional Engineers for engineering services. I urge the County Government to strengthen technical capacity to deliver engineering programs by engaging professional engineers to head engineering dockets including energy, water, and roads. Let me take this opportunity to congratulate Uasin Gishu County which has nominated three engineers as CECMs.

The Board is continuously improving service delivery through digitalization of registration processes, integrated payment, compliance and enforcement and will therefore be having enhanced products to be launched in January 2023.

The Board is participating in Trade-in-Service talks at the East African Community (EAC), and African Continental Free Trade Area (AfCFTA). This will enhance export of engineering services seamless outside our borders and will open more opportunities for the engineers. The Board is pursuing the Washington Accord for global recognition of local engineering programmes to enhance mobility of our graduates. The Board aims to achieve provisional status in year 2023.

Let me seize this opportunity to also announce that the Engineers Board of Kenya has been admitted as an affiliate member of the World Federation of Engineering Organizations (WFEO). The acceptance was granted following Executive Council Meeting held on 27th October 2022 held at UNESCO Headquarters in Paris, France. The affiliate membership will enable the Engineers Board of Kenya to promote Kenya engineering practice at the global level and in the UN System, nominate our local engineers for WFEO Committees, and support Engineers Board of Kenya to join the International Engineering Alliance (IEA) through mentorship. This will further enable the global mobility of our local engineers and attract students to study our local engineering programs. I wish to thank everyone who has worked to make this journey a success.

Finally, I wish to remind all engineers to pay their annual subscription fees for the year 2023 and to update your CPD portal (remember that you require 50 points min); this will ensure you get your practicing license come January 2023.

KEY MILESTONES ACHIEVED BY THE ENGINEERS BOARD OF KENYA

1. Approval to join as an Affiliate Member of the World Federation Of Engineering Organizations (WFEO).

Engineers Board of Kenya has been admitted as an affiliate member of the World Federation of Engineering Organizations (WFEO). The acceptance was granted following Executive Council Meeting held on 27th October 2022 during WFEO-UNESCO Joint Meeting for Member States held at UNESCO Headquarters in Paris, France. The affiliate membership will enable the Engineers Board of Kenya to promote its work and its agenda at the global level and in the UN System, nominate our local engineers for WFEO Awards, and support Engineers to join the International Engineering Alliance (IEA) through mentorship. This will further enable the global mobility of our local engineers and attract students to study our local engineering programs.

2. The Engineers (Scale of Fees for Professional Engineering Services) Rules, 2022.

The Engineers (Scale of Fees for Professional Engineering Services) Rules, 2022 has been gazetted and commissioned for implementation starting 15th August 2022. Consumers of professional engineering services, approving Authorities, Ministries, Departments including Heads of State Corporations, Semi-autonomous Government Agencies (SAGAS) and other institutions are required to comply.

Visit the Engineers Board of Kenya website to view the Engineers Rules 2022 and the implementation circular by the Principal Secretary, State Department of Infrastructure.

3. Registration of engineers and Engineering Consulting Firms.

In the Financial Year 2021/2022 the Board registered 2,089No. engineers in various categories. This includes 354No. Professional Engineers, recording the highest number ever in a Financial Year. The Board is on course to achieve 10,000No. Professional Engineers in the next 5 years and this year targets to register 500 No. professional engineers.

Prospective candidates are invited to attend the discipline-based Pre-Submission Conferences.

Visit the Engineers Board of Kenya website to access the list of persons duly registered by the Board in the different categories.

- Graduate Engineers.
- Professional and Consulting Engineers.
- Engineering Consulting Firms.

4. Countrywide Structural Assessment of ongoing Buildings.

The Board undertook a Countrywide Structural Assessment of Ongoing Buildings in March 2022 following the increased cases of infrastructural collapse. Ten (10) Counties were assessed to investigate the collapse of buildings in the Country. The Board has since developed a comprehensive report with findings and policy recommendations to address gaps to prevent further collapses and loss of lives. The Report has been submitted to the Ministry for adoption and implementation of the recommendations. Upon adoption, the report will be published and disseminated to members of the public.

5. Disciplinary Cases.

The Board has received various complaints from members of the public regarding professional engineering services offered by Engineers or alleging a breach of the standard of conduct of registered or licensed engineers. The Board set up Ad Hoc Inquiry Committees to investigate the complaints; to date, 2 cases have been concluded. In order to fast-track the pending disciplinary cases, the Board during 187th OBM established five (5) ad hoc Inquiry Committees and a Taskforce.

6. Recognition of engineering programs.

The Board is committed to ensuring engineering programs undertaken in various universities meet the strict standards of excellence and professionalism of chosen discipline. This enhances employment opportunities for our Engineers at a global level. The Board has conducted 8 Independent Reviews on engineering programmes this Financial Year at Kenyatta University, Muranga University, Multimedia University and Machakos University. The Board has received over 15 Programs for consideration from different local universities;

Visit the Engineers Board of Kenya website to view the programs (both local and foreign) recognized by the Board to date.

7. Acceding to Washington Accord.

Washington Accord is a multi-lateral agreement between bodies responsible for accreditation or recognition of tertiary-level engineering qualifications within their jurisdictions who have chosen to work collectively to assist the mobility of professional engineers. The Engineers Board of Kenya is aspiring to accede to Washington Accord as a provisional member by 2023 for global recognition of local engineering programs and engineers. During the last OBM, the Board established a Task Force with industry experts to spearhead the process.

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"Setting our sights high"

Shift Focus to Local Design to Grow Kenya's Aerospace Engineering Sector – Eng. Prof. Hameer Sameer

*Eng. **Prof. Hameer Sameer** is the Director, School of Aerospace and Vehicle Engineering at Technical University of Kenya. He dwells on the need to strengthen industrial linkages as a pathway to scaling up uptake of Aerospace engineering in Kenya, in an interview with **Engineering in Kenya** magazine.*

Aerospace and aviation engineering remains underexplored in Kenya. How can this discipline be strengthened?

Currently, only two public universities offer aerospace engineering in Kenya, Technical University of Kenya (TUK) and Kenyatta University. Jomo Kenyatta University of Agriculture and Technology is also incubating an upcoming program focusing on aerospace engineering. JKUAT & Japan International Cooperation Agency (JICA) have been building small rockets together, an initiative meant to train the next generation of professionals on the foundation of aerospace engineering. There is potential to explore great opportunities for this sector in the country. Aerospace engineering is a highly regulated field, and there is a need for more entrepreneurship in aircraft designs and airworthiness. This will grow and escalate the current status of aerospace engineering in Kenya.

The nature of the field needs us to design our own aircrafts. Right now the country is focusing only on inspection. Recently, Marsabit County was selected as a spaceport for Kenya to revive rocket operations which had been put on a lull in 1998.

What level of training is requisite to ensure graduate aerospace and aviation engineers acquire quality skills that prepare them to solve pertinent problems in the market?

The solidity of our aerospace training programs is sound, evidenced by the number of our students ending up being employed by big aviation companies in Kenya, with others getting scholarships to advance their studies abroad. Our engineers have also been competing internationally to show their capability in aviation maintenance engineering. Aerospace cannot afford to be mere department in any teaching university, as the sector is so broad and needs intense training and experience to be able to run effectively. You have to understand that the element of aerospace engineering resonates across all disciplines, hence the need for more robust research and entrepreneurship to cement the job market for aviation and vehicular engineers locally. We take our students to Wilson Airport to get practical components as well as partner with other institutions teaching aerospace engineering to effectively equip our engineers.

Any external partnerships required to train Aerospace Engineers?

Recently, we received aviation maintenance training books, training aids, reading materials, used aircraft parts, and aircraft manuals from General Electric, Kenya Airways, and Boeing, a joint initiative to boost the capacity of aviation training for our engineers.

From where you sit, how are you engaging with other professional bodies to champion challenges graduate Engineers grapple with? What remedies exist?

I understand one of the challenges our Institution has is that the aerospace and vehicle engineering course is not accredited by EBK and this poses our graduate engineers with some challenges. We are tailoring our programs to meet the requirements of EBK to be accredited to strengthen the university.

Your key turning points as Professor leading the school of aerospace and vehicle engineering?

I have been the Director of the School of Aerospace and Vehicle engineering for nearly nine months now and the centre of my focus has been building capacity in industrial linkage. Two students are taken on industrial attachment every year by the Kenya Space Agency from the School of Aerospace and Vehicle Engineering.

We continually build capacity among our lecturers and graduate engineers to mentor them to become better products in the market. The institution embodies staff development and collegiality, making it easy to deliver in our area of expertise. We also help our students get industrial attachment as well as encourage our lecturers to apply for their Ph.D.

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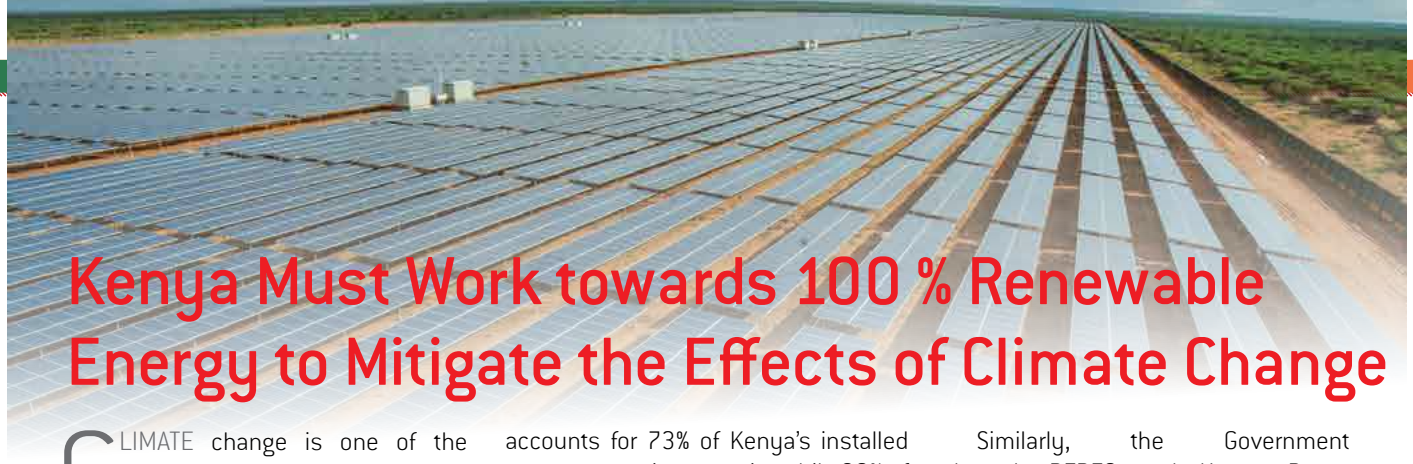


Kenya Must Work towards 100 % Renewable Energy to Mitigate the Effects of Climate Change

CLIMATE change is one of the greatest challenges facing humanity in the 21st century. In Kenya like many other African countries, climate change is intensifying at an alarming rate as is evident from the current rain floods and at the same time drought that is ravaging many parts of the country.

All regions in Kenya are feeling the impacts of climate change and the Government has put in place measures to mitigate and adopt. According to the National Climate Change Action Plan, higher temperatures, unpredictable rainfall patterns, increased incidence of drought and floods, and rising sea levels are impacting people across the country.

The plan further notes that It is probable that climate change will negatively impact Kenya's future development and achievement of the goals of Kenya Vision 2030 – the long-term development blueprint – and the Government's Big Four Agenda for 2018-2022 that focuses on ensuring food and nutrition security, affordable and decent housing, increased manufacturing and affordable healthcare.

One of the mitigating interventions that the country should put in place is to enhance the promotion of investments that work towards attaining the goal of using 100% renewable energy from sources such as solar, geothermal, tidal waves, wind, mini hydros, co-generation green hydrogen and even municipal waste as opposed to using fossil fuel generated power.

Promotion of productive use of clean heating for domestic water, industrial broilers and cooking is another mitigating intervention towards achieving the United Nations (UN) Sustainable Development Goals (SDG) number 7 and 13.

Renewable energy currently accounts for 73% of Kenya's installed power generation capacity while 90% of electricity in use is from green sources. So what measures has the Government of Kenya put in place to ensure that the country achieves the goal of 100% RE by 2030?

First, it is putting in place enabling legislation that supports the development and use of renewable energy sources through the Energy Act, 2019. The Act expands the mandate of the Rural Electrification and Renewable Energy Corporation (REREC) to include the development of Kenya's abundant renewable energy resource to meet the ever-increasing energy needs of the country.

Through REREC, the Government has developed twenty-Six (26) solar mini-grids across off-grid Counties of Wajir, Turkana, Marsabit, Mandera and Garissa, constructed the 54.6MW Garissa Solar Power Plant which is the largest grid connected solar power plant in East and Central Africa located in Garissa County. Other initiatives include solar street lighting, wind and biogas plants in public primary and secondary schools, electrification of public facilities including schools, boreholes and market centres using solar.

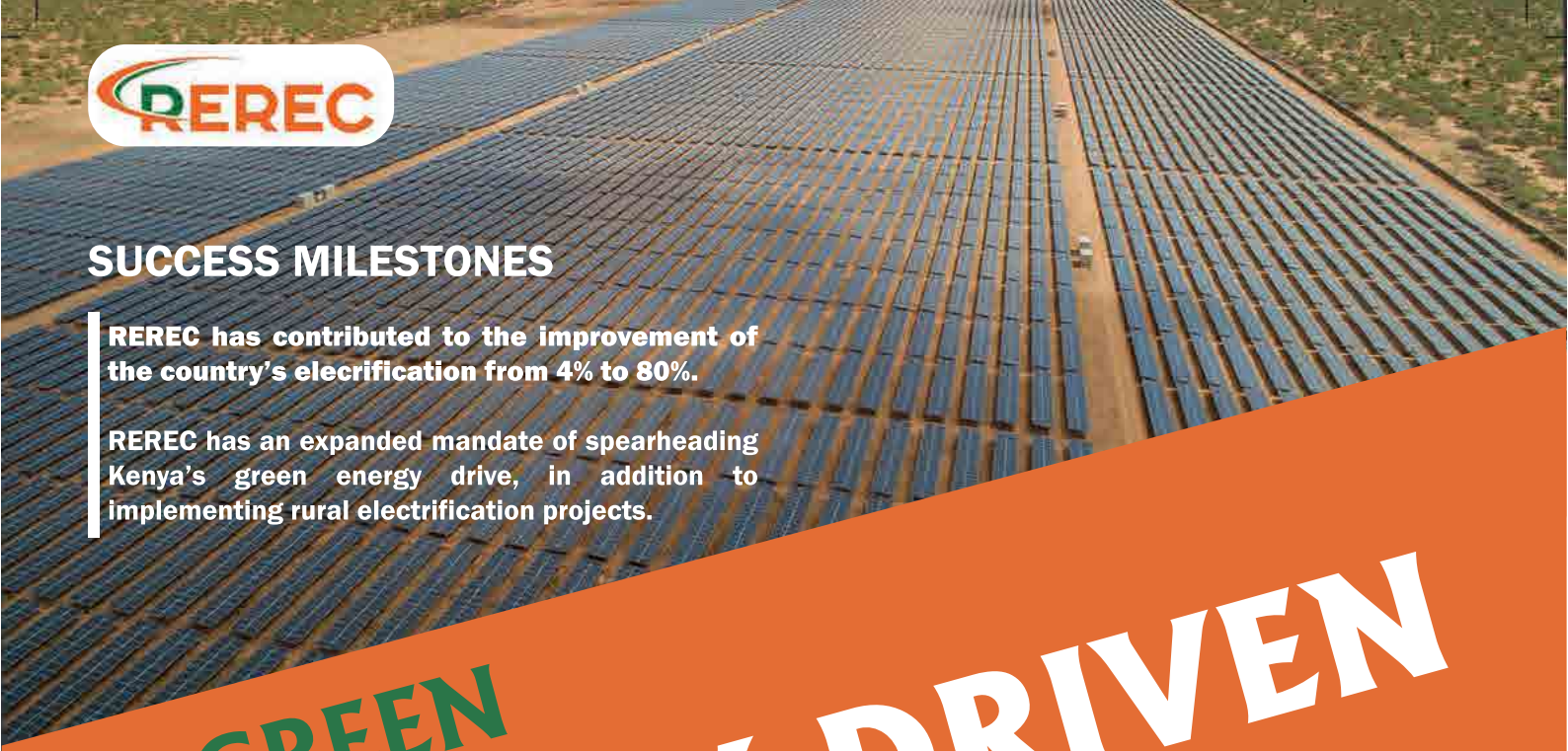
The government has also established partnerships with the private sector and development partners in the implementation of renewable energy technologies to enhance electrification. For instance, the Government has partnered with the World Bank to implement the Kenya Electricity Modernization Programme (KEMP) which will connect customers in off-grid areas of Northern Kenya, Coast and Lake Victoria Region islands to electricity using mini-grids. The installation works for the projects are currently being implemented by REREC.

Similarly, the Government through REREC and Kenya Power is implementing the Kenya Off-grid Solar Access Project (KOSAP). The project includes construction of solar mini-grids, solarisation of boreholes and installation of standalone solar systems in public facilities targeting 14 underserved counties. The counties are; Garissa; Isiolo; Kwale; Lamu; Mandera; Marsabit; Narok; Samburu; Taita Taveta; Kilifi, Tana River; Turkana; Wajir and West Pokot.

As a result of these among many other efforts, Kenya now has one of the most developed power sectors in sub-Saharan Africa. Moving forward, the objective is to accelerate the pace towards achieving 100% RE.

Testimony to this is the commitment that Kenya has made during the 27th session of the Conference of the Parties (COP 27) to the United Nations Framework Convention on Climate Change taking place in Sharm El-Sheikh, Egypt between 6th and 18th November, 2022. President Dr. William Ruto announced that there are opportunities on the continent to produce wind power, geothermal electricity and solar energy citing the case of East Africa whose hydroelectric power potential is 100,000 megawatts.

Consequently, the Head of State revealed that Kenya will partner with the United Kingdom in implementing green energy projects with the United Kingdom committing that it will fast-track new green investments in the country. Some of the envisaged investments include the expansion of the Malindi solar power plant, Menengai Geothermal and the High Grand Falls Hydroelectric Power Station which is a planned hydroelectric power station across the Tana River to harness the energy of the Kibuka Falls among other projects.



SUCCESS MILESTONES

REREC has contributed to the improvement of the country's elecrification from 4% to 80%.

REREC has an expanded mandate of spearheading Kenya's green energy drive, in addition to implementing rural electrification projects.

A GREEN ENERGY DRIVEN NATION

RURAL ELECTRIFICATION

- **REREC** is implementing the Electrification of Public Projects **(EPFP)** in **36** Counties in five regions. Western and Nyanza, North and South Rift, Central Eastern, and Coast region. The project will electrify **1,200** public facilities and **35,460** households.
- A total of **22,927** primary schools throughout the country have been connected to the grid or solar PV for those far away from the national grid.
- **REREC** has installed **104** high-mast floodlights in Kibera, Mathare, Korogocho, Ngomongo, and Mukuru kwa Njenga in Nairobi, as well as Kiandutu in Thika. An additional **747** solar streetlights have also been implemented in Kiambu County
- Out of the **88,750** identified Public Facilities in the country, **60,934** have since been electrified **(68.5%)** and the balance of **27,816** forms the focus for REREC in a bid to attain Universal access to electricity by the year **2030**

RENEWABLE ENERGY

- Renewable energy in Kenya currently accounts for **73%** of the installed power generation capacity, while **90%** of the electricity in use is from clean sources.
- **REREC** provides technical assistance with respect to construction of biogas plants and other relevant renewable energy technologies suited to the areas of jurisdiction.
- **REREC** has implemented **Twenty-Six (26)** solar mini-grids across counties of Wajir, Turkana, Marsabit, Mandera and Garissa.
- **REREC** constructed the **54.6MW** Garissa Solar Power Plant which is the largest grid connected solar power plant in East and Central Africa
- Other initiatives include solar street lighting, wind and biogas plants in public primary and secondary schools, electrification of public facilities including schools, boreholes and market centres using solar.

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Aeronautical & Aerospace Engineering Education at Kenyatta University

By Dr. Eng. Victor M. Mwongera, PE, MIEK, MRAEs

OVER the past 8 years, Kenyatta University has worked hard to ensure it becomes a leading institution in the education of Aeronautical and Aerospace Engineering in Kenya and East Africa. The Aerospace Engineering programme (the only such programme recognized by the Engineers Board of Kenya), Kenyatta University has already graduated its pioneering class in 2020 and is now preparing for the fourth class of students into the industry. The university has invested in the building of this programme through the purchase of various laboratory and workshop equipment, engagement of programme specific staff and lecturers, development of linkages and partnerships, and putting the students and the industry at the center of the programmes priority.

> The Aerospace Engineering programme has developed primarily by focusing on joint research activity and partnership development. Kenyatta University has been one of four Kenyan institutions involved in the design and development of a nanosatellite through a research programme funded by the Kenya Space Agency (KSA).

The design of this satellite began with a student design team tasked with prototyping an initial model, and even now is in the final stages of development of a larger satellite that will be launched into space through one of KSA's partners.

In addition to this, Kenyatta University has led the engineering sector in placing Kenya as the probable choice for the development of Africa's first spaceport. Through a research programme funded by an American launch company, Long-shot space, in collaboration with Viwanda Africa, a report was delivered to the Kenya Space Agency detailing how Kenya is not only the logical choice for Africa's spaceport (primarily due to its equatorial eastern coast position), but also laying out an initial roadmap for the path forward to building the spaceport. This report garnered national and international attention and continues to be the basis for KSA's determination and feasibility study.

Kenyatta University also maintains various academic and educational partners with an aim of developing additional research and knowledge. It has partnered with EPFL and Kenya Flying Labs in an experiment using drones to monitor traffic in Nairobi in peak traffic times at congested areas within the city, developed working relationships with the University of Bristol for the purposes of bench marking, as well as joint funding development channels, and is currently leading the conversation in building a strong Kenyan-EU team for the purposes of applying for the elusive yet resource rich ERASMUS grants.

Particularly, Kenyatta University is a partner of a Marie Curie funded research grant entitled WildDrone which is looking to build global knowledge in the use of drones in conservation activities. By training PhD candidates in various institutions globally towards the same aim, Kenyatta University will have access to and develop knowledge in the unmanned vehicle sector that will continue to put it at the forefront of

Kenyatta University Aerospace Engineering programme students in a learning session.

research and innovation.

Despite all this advancement, Kenyatta University faces a major challenge in the area of Aerospace Engineering education; a critical lack of trained academic staff. Aerospace Engineering, despite growing rapidly, remains a relatively new sector in Kenya. In addition, most Kenyan trained Aerospace Engineers and academics are trained abroad and subsequently work abroad. Thus, growth of academic staff in this area can only happen through the development of local postgraduate programmes, and the training of Kenyan academics in this area. However, this presents the proverbial chicken and egg dilemma, where staff are needed to help develop these programmes and train others. This has been the motivation for Kenyatta University to continue to develop partnerships and linkages with other institutions. It is the hope that the Kenyan universities, rather than competing aggressively as they typically do, will join Kenyatta University in this collaborative exercise, for the good of the industry and the country.

The Aerospace Engineering programme is housed within the Department of Mechanical Engineering, which is headed by Dr. Eng. Victor Mwongera: a registered professional engineer with the Engineers Board of Kenya, and a full member of the Royal Aeronautical Engineering Society and the Institution of Engineers in Kenya. Trained in the University of Bristol with a doctorate in the field of unmanned aerial vehicles, he has extensive work experience in the aerospace sector in the UK and Kenya, as well as a global professional network built over 15 years of work and career experience.

Dr. Eng. Mwongera is an Aerospace & Aeronautical Engineer with a Doctorate in the field of unmanned aerial vehicles (Drones) from Bristol University (UK). He Currently Heads Aerospace Engineering programme at Kenyatta University.

AMREF Flying Doctors - Emergency Medical Air Evacuation in Kenya

By Julian Mbae

AMREF Flying Doctors (AFD) is a Kenyan based Air Ambulance operator boasting over sixty years of specialization in aeromedical evacuations, medical emergency and humanitarian air support logistics and response. This medium sized company fully owned by AMREF Health Africa traces its roots to a humble beginning the early 1950s on the foothills of Mt Kilimanjaro as a noble idea by three surgeons to carry medical outreach missions in self-flown piston powered two-seater aero planes.

From the year 2016, the company embarked on aircraft fleet modernization plan that saw it transition from flying the single-engine Cessna caravan C208's to the modern Pilatus PC12 aircraft and recently the Citation Cessna jets. With a fleet of five fully medivac dedicated and configured aircraft, AMREF Flying Doctors is the leading provider of high quality air ambulance service in the Africa and Middle East regions. The versatility and reliability of the Swiss manufactured Pilatus aircraft gives the company an edge to offer the quickest and most responsive ICU level aeromedical transfers of patients in the whole of Africa, with the long-range Citation Sovereign giving direct transfer capability to Europe, Middle East region, and across to India, China and Far East.

Post- COVID-19 pandemic, the company now has its eyes set to maximize aircraft utilization and improvement of client experience through use of emerging technologies. It is currently running a project to integrate its aviation and business management systems for seamless, efficient flow of information to enable business analytics and quick decision making processes. Plans are underway to invest in its own aircraft maintenance facility to support the aircraft maintenance and engineering services. This is intended at continuous improvement of airworthiness and reliability programs of the aircraft operations.

New Cabinet to Steer Kenya's Development Agenda

President Dr. William Ruto unveils Cabinet Secretaries set to steer the development agenda of his administration at State House Nairobi in October 2022. Climate Change mitigation is one of the challenges the new government has promised to tackle. ***Photo/State House, Nairobi.***

Kenya Power Eyes Self-Reading of Meters to Reduce Billing Complaints

By IEK Correspondent

KENYA Power is targeting to increase the number of postpaid customers reading their meters from the current 145,000 to 200,000 during the current financial year, as the Company moves to address billing complaints.

> Last year, the Company introduced the self-reading service that is available on the USSD Code *977# where postpaid customers can register to read their meters at the end of their billing cycle and submit the readings for accurate billing.

"Self-reading of meters will empower our postpaid customers to proactively engage with us on all matters that relate to billing for their electricity consumption. It is targeted to enhance satisfaction among our customers through accurate and timely billing which will eliminate bill estimations and therefore reduce customer complaints arising from the same," said Eng. Muli.

Currently, 2.1 million customers are on postpaid billing while 6.8 million customers are on prepaid billing (tokens). Apart from self-reading, the USSD Code also enables prepaid customers to retrieve the last three purchased tokens, which is helpful especially when customers want to make reference to their electricity consumption trends.

Customers can also use the platform to report power outages for quick resolution, confirm the authenticity of persons presenting themselves to them as Kenya Power staff as well as track the progress of their connectivity application.

Speaking today at Stima Plaza during the launch of the Company's celebrations to mark Customer Service Week, Kenya Power's Chair of the Board of Directors, Vivienne Yeda said that the Company will continue to pursue an environment that fosters innovation in order to provide the highest level of quality and reliability in customer service.

"We believe that if we can create an environment where we are all empowered to be innovative and accountable, then we will be able to contribute more than ever before. By creating this environment, we will be able to deliver better outcomes for our customers – a move that will ultimately drive electricity demand for the next generation," she said.

During the last financial year, the monthly average customer transaction on the *977# platform stood at 1.6 million. Kenya Power targets to increase these transactions to an average of 2 million by the end of the current financial year.

NuPEA
NUCLEAR POWER & ENERGY AGENCY

VISION

A premier hub for nuclear power development and sustainable energy solutions

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.

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I-TEC: Integrity, Teamwork, Excellence, and Creativity and innovativeness

KRA (Key Result Area)	Strategic Objectives
Nuclear Energy Infrastructure Development	• Ensure readiness of key nuclear power infrastructure • Have an adequate and supportive legal and regulatory framework • Inculcate nuclear safety culture among the key stakeholders
Public Education and Stakeholder Engagement	• Increase stakeholder's awareness and support of NuPEA's mandate
Energy Research and Development	• Champion use of safe, efficient and sustainable energy systems • Enhance uptake of new technologies and innovations in the energy and petroleum sectors
Energy Sector Capacity Building	Ensure availability of skilled and competent human capital in the Energy and Petroleum sectors
Institutional Capacity	• Enhance good corporate governance • Promote a positive corporate image • Have a versatile, competent, highly performing and motivated workforce • Enhance efficiency and effectiveness in service delivery • Enhance financial sustainability of the Agency

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Managing Water and Wastewater in Aerospace and Aviation

By Eng. Ian Mwenda

AIRPORTS are critical pieces of infrastructure of the complex global aviation Aerospace and Aviation system that supports the movement of passengers and air cargo. However, in providing these essential services, airports need clean water and generate wastewater from their activities. Airport management of water and wastewater has become a major element in the air transport industry development. Airports should now focus on sustainable water and wastewater management as a key element of their environmental plans and strategies. Kenya has a number of airports and airstrips with JKIA being the busiest.

Airport Water Management

Water consumption of airports is very substantial, as airports and their key stakeholders require large amounts of water to maintain infrastructure, support and facilitate operational activities. Airports are also the source of run-off waters. Due to the significant impact that the high-water consumption and the runoff waters have on the environment, airports should place high focus on sustainable water management. Indeed, sustainable water management should be a key element in Kenyan airports environmental and sustainability policies and practices.

Airport Stakeholders Water Requirement and Usage

Airports consume substantial volumes of water to maintain both their infrastructure, and thus, sustain their aircraft and ground-based operations. Airport operators, airlines, air traffic management agencies, ground handling agents, aircraft, and ground service equipment (GSE) maintenance organizations, airport concessionaires, and passengers and staff require water for drinking, catering, retail, cleaning, flushing toilets, and system maintenance. Water is also used to maintain an airport grounds and during the landscaping of gardens and parks that are located within the airport precinct.

Airport Water Sources

Historically, Kenyan airports were designed to make use of ground water or water supplied from water companies. Where this water has only been used for non-industrial purposes (for example, washing, cleaning, and laundry), wastewater can be collected by the airport, treated, and reused for activities including toilet flushing, washing, and in some instances irrigation of plants. Such practices may require the airport to introduce a dual drainage system as well as water purification facilities.

A further source of water comes from harvesting (collecting) and storing rainwater. If implemented at an airport, then rainwater harvesting can substantially reduce the volume of water sourced from conventional supplies and acts as a reservoir to guard against water shortages. The most sustainable approach to water management is for airports seeking to become self-sufficient in their water supply by optimizing opportunities for water harvesting, recycling, and reducing consumption.

Airport Run-Off Waters

In an airport's operational area, run-off waters can have a very serious environmental threat. These waters could have a negative impact on both soil and groundwater since they contain a relatively high concentration of contaminants originating from airport operations. The wastewater from the runoff can be recycled and used for airport greening.

Airport Water Processing Plants

Rainwater from the paved areas, can be recycled at the airport. The recycling will separate oil products from the waters. Fuel storage, and aircraft hangars and aircraft and ground service equipment (GSE) maintenance facilities, should be equipped with traps to catch any waste oil products.

Airport Water Conservation Measures

As a result of the increasing pressure on existing water sources, Kenyan airports should implement a range of measures that will enable them reduce their water consumption. These water conservation measures include the overall reduction in water consumption at the airport, re-using water from the treatment of waters at wastewater and sewage treatment plants in toilet facilities and for irrigation purposes, using rainwater for the flushing of the toilets in airport buildings and facilities, protecting groundwater from pollution, the overall monitoring of water consumption at the airport, and monitoring the surface and ground water quality. Airports also need to protect surface and ground water resources.

Eng. Ian Mwenda is an Enforcement Officer at Water Services Regulatory Board

Aerospace & Aviation Engineering Education at Moi University

By Daniel O. Odido

(Photo Courtesy)

AEROSPACE Engineering has been wrongly long-held as an elitist career, far-removed from the issues facing developing countries like Kenya. Career opportunities have also not been apparent to many students; who lack information on the career prospects of the various specialisations in aerospace engineering.

A maintenance engineer in aviation typically refers to a mechanic, and is licensed by the regulator, Kenya Civil Aviation Authority (KCAA). An aeronautical engineer on the other hand is licensed (registered) by the Engineers Board (Council), starting off as a Graduate Engineer. Like other engineers, the emphasis on training is on design. The licensed and registered engineers each have their respective spheres of operation.

Many do not recognise the enormous opportunities in the Aviation and Space sectors, since these opportunities are not always self-evident. Engineering applications are pervasive in aerospace, well beyond the design of aircraft. Navigation equipment are developed, installed and maintained by engineers. This includes ground-based equipment like VOR/DME, runway lights, etc. There are opportunities in aircraft communication as well as in maintenance and ground handling. Opportunities for self-employment have not been highlighted. Entrepreneurs should be encouraged to invest in these fields. There is a lot of opportunity in development and maintenance of, for example air bridges, carousels and various mechanised support and jigs and fixtures for aircraft maintenance. Young entrepreneurs should be encouraged and facilitated to put up workshops to service general aviation aircraft, like at Wilson Airport in Nairobi.

The School of Aerospace Science of Moi University has been offering bachelors qualification with a focus on Aircraft Operations. The product has been Professional Pilot. The course has faced challenges due to high cost of training. The students do not have access to financing from Higher Education Loans Board (HELB). The University is considering offering courses in Aerospace Engineering. There is a new focus in Space Engineering worldwide. Just this summer, I was in Tokyo at the Nihon University for a training on Space Engineering Education Methods organised by Universities Space Engineering Consortium. The knowledge gained in Space Engineering Education will be put to use in developing appropriate programmes in the field.

> Moi University was the first Kenyan University to establish a School dealing with Aerospace Science in 2008. The University built a hangar at its Eldoret Airstrip base. It procured a fleet of aircraft for training students. The University employed qualified personnel and obtained certification from KCAA.

It trained several student pilots. The pilot training programme is now under review and the University is considering other offerings in aerospace. Technology is rapidly advancing in the aviation sector. Unmanned vehicles, once considered a threat in the country have now been legally allowed. This provides great opportunities in developing a vertically integrated UAS industry in the country. There are opportunities for developing, manufacturing, operating and maintaining Unmanned Aircraft in the country. The University is considering opportunities that have been unlocked in this sector.

In the wider aerospace sector, Moi University is one of the pioneers in the space industry in the country. It was one of the five Universities that hosted the Research Chair on nanosatellite development sponsored by the Kenya Space Agency. This provided students from various disciplines hands-on experience in using aerospace technologies to solve problems in society. Cubesats are an emerging technology that provides great opportunity to any country to become a space-faring country. Missions can be designed to answer to the socio-economic needs of the country.

Any training in professional disciplines is regulated by the respective professional body. Kenya Civil Aviation Authority (KCAA) regulates activities in the aviation sector. This includes any aviation training that requires a license, like Maintenance Engineers, Pilots and

Flight Dispatchers. Kenya Space Agency (KSA) has now come in for the space sector. The aerospace industry is highly regulated due to safety, security and environmental considerations. The Engineering Board of Kenya (EBK) accredits training in engineering disciplines. In addition, the Commission of University Education (CUE) regulates the academic courses offered by Universities. Moi University actively consults with the appropriate professional bodies in the design and implementation of curricula.

Moi University actively engages with the private sector. Students go for Industrial Attachment in industry to obtain exposure and hands-on experience.

There is a constant engagement with Stakeholders. All curricula are regularly reviewed so as to re-align them with evolving industry and societal needs. Engagement with Stakeholders is part of the review process. The University is constantly improving the facilities available to students for their training.

The aerospace sector is the new growth field and it is currently a very exciting place to be in. It is essential to develop an industry and community for enthusiasts and hobbyists. This would provide an entry point for a vibrant professional aviation industry. Such a community will provide an opportunity for the youth to develop their skills, as well as act as an incubation for innovations. An enthusiast aviation industry can focus on development of ultra-light aircraft. These can be easily designed and fabricated.

Urban air mobility has been put on the front burner in new technologies. Electric aircraft are becoming a reality. Leading international aerospace companies are on the lookout for the next exciting innovators. There are great opportunities in the development, manufacture and maintenance of drones. All these provide opportunities for start-ups. The environment in the country is also supportive of innovations. There are adequate protections for intellectual property. Budding engineers should take advantage of these openings. The environment also provides exposure to venture capital. Budding engineers should be bold and reach out and take advantage of the available opportunities. The current environment allows innovations from all parts of the globe including developing countries.

Whereas the traditional space industry had enormous resource barriers to entry, the emerging Newspace industry now provides opportunities for even developing countries to develop and launch small satellites. Engineers in this field should try their hands at Mission design and pitch for opportunities to develop and launch small satellites. The Kenya Space Agency has been quite supportive to startups in the budding space industry.

There is now a critical mass of young, well-trained professionals in aerospace. They should grab this opportunity to establish vibrant communities and engage with the international aerospace community. This will enable them to keep abreast of new technologies.

The industry is still relatively undeveloped in Kenya. The community should reach out to bodies like the Royal Aeronautical Society (RAeS) and linked bodies like the Aeronautical Society of South Africa (AeSSA). The community of aerospace engineers should consider establishing their own association along the lines of the ones mentioned above. I especially encourage collaboration with societies from nearby advanced aerospace nations like South Africa. This can provide useful mentorship and networking. Another professional body is the Association of Unmanned Vehicle Systems International (AUVSI).

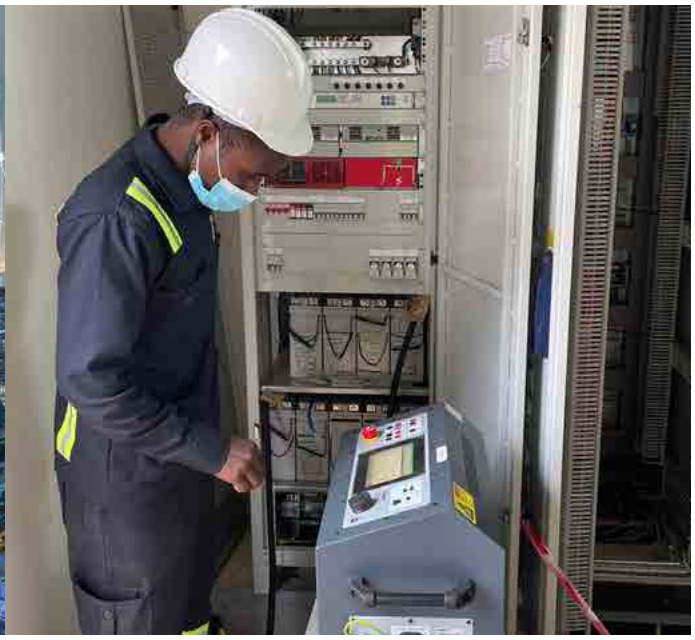
As the Point of Contact for UNISEC-Global in Kenya, I am actively working to establish a vibrant branch in Kenya. This will assist to integrate aerospace engineering students and graduates into the international aerospace community.

Daniel Odido is former Head of the Department of Flying in the School of Aerospace Science of Moi University.


(Photo Courtesy)

Amotech AFRICA

Amotech Africa



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The Role of Aviation Operators in Kenya

By Liz Aluvanze

What is the mandate of the Kenya Association of Air Operators?

THE Kenya Association of Air Operators (KAAO) promotes, fosters and protects the interests of those engaged in civil aviation and associated industries in Kenya. Our mandate includes the promotion and enhancement of operations of a safe, efficient and sustainable national aviation industry by encouraging adherence and maintenance of high civil aviation safety standards and practices.

Our main objectives include but are not limited to collective representation, desensitization of difficult issues faced by individual members, one voice for the aviation industry, influence of policy and regulatory framework, easy access to professional advice, direct access to government and government agencies, self-regulation through code of conduct/ethics, provision of fora to discuss and shape the aviation industry and liaison with other organizations within the industry.

As air operators, what role are you playing in innovation & entrepreneurship in the aviation industry?

Kenya's aviation industry has constantly innovated to remain relevant by concentrating on key income deriving sectors of the economy. Various airlines have concentrated on various income generating sectors including tourism and horticulture even opening new routes corresponding to new markets demands. This specialization allows companies to recover faster from adversity such as effects of the Covid-19 pandemic

Secondly by signing local, regional and international agreements airlines can expand and grow their markets which in turn stimulates the movement of people, goods and services. Airlines have also innovated to enable cashless ticket sales using technological advancements such as mobile money and other e-payments ***systems; and who says that we won't be able to purchase tickets using cryptocurrency soon?***

Kenya is also a leading country in the use of remotely piloted aircraft systems (RPAS) such as drones in the continent. Kenya's national airline has already launched Fahari aviation a division to enhance innovation research and development of unmanned systems including drones. Astral Aviation a leading cargo airline company is also pioneering in movement of goods using RPAS. Astral has already received a 2-tonne payload, 6.3 hrs endurance FlyOx Cargo Drone which can land in unpaved airfields to assist with humanitarian operations.

> "I am happy that women have ventured into this disciple including mother and daughter duo Maureen Okumu and Vanessa Onyullo. Maureen Okumu is Kenya's first licensed female aeronautical engineer. In short, the future is bright!

In terms of entrepreneurship several air operator certificate holders (air operators), approved training organizations (ATOs) and approved maintenance organizations (AMOs) are locally owned (by Kenyans). There is need to encourage and incentivise further development, innovation and sustainability of the industry so as to encourage more local players.

What does the future hold for the aerospace & aviation industry in Kenya?

Kenya is proud to have one of the leading civil aviation training facilities, the East African School of Aviation (EASA) in the region, which is the training directorate of the Kenya Civil Aviation Authority (KCAA). The school provides training in aviation safety and security, air navigation services, aircraft maintenance and aviation business management among others. There are also several other renowned pilot training and flight operations training institutions in Kenya, which have all contributed to ensuring that those in the industry or those intending to pursue a career in the industry continue to acquire knowledge, experience and training that has seen local, regional and international players seek their services.

The Italian-owned spaceport Luigi Broglio Space Center (BSC) near Malindi, Kenya has also seen local engineers get experience through the launch of both Italian and international satellites in the early days of Kenya's independence. Currently, the ground station is still in use for satellite communication, but the BSC is not used as a launch site. The site is governed by a fifteen-year renewable intergovernmental agreement, which was signed for the

first time in 1995 and includes the possibility to carry out launch, data acquisition from satellites, remote sensing and training activities both on the spot and in Italy. On its part, Italy commits to fund the programmes, equip and manage the center, provide the logistics and to train and employ local workforce and depending on the terms of the commercial agreement, the equipment is set to be handed over to the State and become the property of Kenya.

The Kenya Space Agency (KSA) and Exolaunch, have already announced a Launch Services Agreement (LSA) to fly the "Taifa-1" 3U small satellite to a sun-synchronous orbit aboard SpaceX's Falcon 9 Transporter-7 mission in 2023. The Kenya Space Agency is mandated to promote, coordinate and regulate space related activities in the country. ("Kenya Space Agency | LinkedIn") The agency is currently heavily invested in agricultural activities in collaboration with the Directorate of Resource Surveys and Remote Sensing with the two organizations having signed agreements on various Space services and Earth Observation applications.

What role will air operators play in this future?

One of the main strategies is to increase our membership. We want to bring all categories of operators; from fixed-wing, helicopter, hot air balloons, and remotely piloted aircraft systems to approved maintenance organisations and approved training organisations all working together under the association's umbrella. We will also continue to strengthen our working relationships with government agencies such as the Kenya Civil Aviation Authority (KCAA), Kenya Airports Authority (KAA) and other industry associations such as African Airlines Association (AFRAA), Kenya Private Sector Alliance (KEPSA) and Kenya Tourism Federation (KTF) just to mention a few.

The new administration, as part or Kenya's long-term strategy to grow and diversify the economy, amongst other ways, must maintain and grow Kenya's position as an integrated regional hub, like the strategy pursued by other locations such as the Gulf States, Turkey, China and Ethiopia. This requires that government policy and vision must be aligned if the above is to be achieved. Kenya is blessed with an ideal geographical position and a very good business position which should favour an integrated approach to country strategy towards the Aviation Sector. This approach requires first that a National Aviation Policy in place, which would then also focus on how to grow the sector and how to be competitive from a tax and incentives perspective, how to prioritize infrastructure, training of labor, etc. The development of the National Aviation Policy is something that the association has been advocating for, for years.

Liz Aluvanze is the CEO, Kenya Association of Air Operators (KAAO)

KenGen Board Appoints Acting CEO Upon Miano's Exit to Join Cabinet

By IEK Correspondent

THE Board of Directors of Kenya Electricity Generating Company PLC (KenGen) has in its sitting of Friday, October 28, 2022, appointed Abraham Serem as Managing Director and CEO in an acting capacity.

Mr. Serem takes over from Rebecca Miano, who has been appointed Cabinet Secretary (CS) for East African Community (EAC), Arid and Semi-Arid Lands, and Regional Development.

KenGen Ag. Managing Director and CEO Abraham Serem

Until his appointment, Mr. Serem has been the General Manager of Human Resources and Administration of the Company since March 1, 2016, when he joined KenGen.

Mr. Serem will be responsible for overseeing the transition process of the NSE – listed firm at a time when the entire country is undergoing changes, following the August General Elections which ushered in a new government.

Speaking today, while making the announcement, KenGen Board Chairman, General (Rtd) Samson Mwathethe congratulated the outgoing Managing Director and CEO for what he described as an exemplary and stellar performance during her tenure.

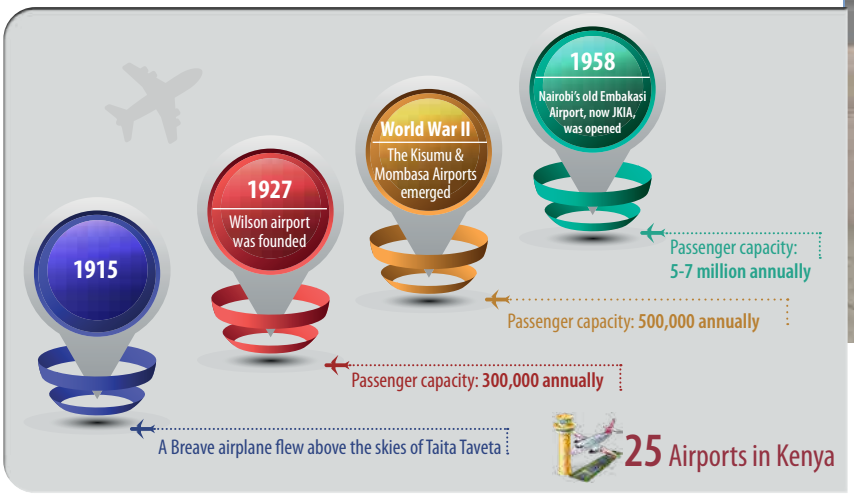
"Mrs. Miano led KenGen through an action-packed phase of steady growth which continued over the duration of her leadership, putting KenGen firmly on an upward trajectory," said Chairman Mwathethe, adding, "Her biggest test was perhaps the COVID-19 pandemic which threatened energy utilities across the world, but she was able to steady the ship and deliver good results, even at the peak of COVID-19 restrictions."

The Chairman hailed Miano for unlocking KenGen's diversification strategy and rolling out several multimillion drilling consultancy projects in the region, most notably, in the Horn of Africa including, Ethiopia and Djibouti, where KenGen currently has active geothermal drilling projects.

"We will also remember Mrs. Miano for her role in championing KenGen's position in the climate action campaign, not only locally, but also going all out to put the company on the global map," said Chairman Mwathethe.

The History of Aerospace and Aviation Engineering in Kenya

By Brian Vuyiya



AEROSPACE Engineering is a field of engineering concerned with the development, testing, production and repair of aircrafts and spacecrafts. The common types of aircrafts are: Aero planes, helicopters, gliders, drones and hot air balloons while types of spacecraftsinclude: rockets, probes, satellites, orbiters, Landers and many others.

The History of Aerospace Engineering

The roots of aerospace engineering can be traced back to the early days of machine engineering commonly referred to as 'Mechanical Engineering'. The first ideas of an aircraft date back to the 15th century, during the days of Leonardo Davinci who developed the earliest sketches of flight vehicles which extensively mimicked the flight of birds.

Over the years, the idea of flight brought up a huge curiosity among men and this made research in that area grow exponentially. Primitive trials to slightly advanced scientific methods saw machines like ***The Hero's Engine*** get invented.

> Most people, researchers and engineers at the time, focused on developing models that could achieve the process of flight, one of these models was the ***hot air balloon***, invented and tested by Montgolfier Brothers and Jean Francois. They became the pioneers of the hot air balloon. This invention was the first successful human-carrying flight technology

In the early 20th century the renowned Wright Brothers got credited for inventing, building, and flying the world's first successful motor-operated airplane. Most of the aviation improvements that came afterwards were done based on their aircraft design, which was but a simple structure made from spruce for straight members of the airframe (such as wing spars) and ash wood for curvedcomponents (wing ribs) with the motor fixed at the centre.

Aerospace, Aviation and the World Order

The Aerospace industry saw its major growth during the First and second world wars where a country's supremacy could be measured by its aviation power. At the beginning of the First World War, aircrafts were primarily used for reconnaissance and the nature of the war zones which comprised of trenches, made them the only means of gathering information beyond enemy lines.

During the Second World War, aviation firmly established itself as an essential component of modernwarfare. Just like in the First World War, military funding and investment drove aviation forward in leaps and bounds during the second war.

Aerospace and Aviation Engineering in Kenya

Aviation was introduced in East Africa in the late 19th century. One expert James Wilson Esq., who in his book 'Guerillas of Tsavo' intensively describes early days of aviation in the region and what happened over a century ago when aerospace was just at its infancy. The first attempt at 'flying' in East Africa was in 1909 using a lighter than air balloon whose purpose was photographing wild animals during America's President, Theodore Roosevelt's hunting Safari to East Africa.

The first powered flight in East Africa was by a Pfalz built Otto Pusher which took place outside Dar es Salaam in German East Africa.

In 1915 during World War 1, a Breave airplane flew above the skies of Taita Taveta and ammunition from it was used to drive the Germans away from the territory. This was the first airplane to ever fly in Kenya.That mission was a military flight. But the occasion to mark it a century later was exclusively a civil aviation affair. The Kenya Civil Aviation Authority (KCAA) partnered with the Kenya Association of Air Operators and the county government of Taita Taveta to congregate at Maktau, from where the plane took off. The Occasion was used to reflect on the gains and misses of the years gone by' (Roy Gathuhi Nation Newspaper, 2015).

Following the events of the First World War, airstrips and airports were built to aid in military logistics. One of

An Airplane ready for take-off at Wilson Airport in Nairobi in October, 2022.Photo/Courtesy

these airports was the Wilson airport founded in 1927 and had the first completed flight in its new aerodrome in 1929 (Times Aerospace, 2017). It served a range of clientele, including members of the British Royal family, prominent European personalities and safari groups. Presently it holds passenger capacity of about 300,000 annually according to Logistics Capacity Assessment. Highlighted in KAA's article *Our History*, Nairobi's old Embakasi Airport, now Jomo Kenyatta International Airport, was built in the 1950s to accommodate the new generation airliners at that time and was opened in 1958 by the last colonial Governor, Sir Evelyn Baring. It served the war that existed between the colonialists and the natives and facilitated travel across Africa to places like Cape Town. Presently it holds a passenger capacity of about five million to seven million annually.

The article *Our History* states that from the Second World War, Kisumu and Mombasa Airports emerged and were mainly used to serve military purposes. The Kisumu airport was strategically set up to support amphibian type of aircrafts landing in the nearby Lake Victoria. It presently holds a passenger capacity of about 500,000 annually.

There are about 25 airports in Kenya. Each of which bare a unique history with some having a shared one, from serving wars to enhancing transportation and movement of services in the region. Hitherto, Kenya Airports Authority has undergone tremendous development in maintenance and policies deemed towards the operation of these airports.

The Kenyan Aerospace Future

The status of aerospace in Kenya is projected to rise exponentially with new sectors in the field being introduced in the country. In the past few years the field has seen advancements and different projects by organizations and institutions that do not just focus on the airspace but also outer space. One of these projects is theTaifa-1 3U Nanosatellite, a Software-defined NanoSat, which the Kenya Space Agency through Sayari Labs Company, is planning to launch in 2023 aboard The SpaceX launch vehicle.

Brian Vuyiya studies Aerospace Engineering at Kenyatta University

How Kenya Space Agency is Enhancing Space Technology Development in Kenya

By IEK Correspondent

SPACE activities in Kenya date back to the 1960s with the establishment of a Satellite Launching and Tracking Base in Malindi, in collaboration with Italy. Over twenty sounding rockets and nine satellites were launched from the facility between 1967 and 1988. Kenya also built the Long'onot Earth Station which became operational in 1970 and provided international satellite communications to the entire East African Community. Today there are several Earth stations in the country including submarine cables that facilitate global communications.

The Kenya Space Agency (KSA) was established in 2009 replacing the former National Space Secretariat. KSA is mandated to promote, coordinate and regulate space-related activities in the country. The agency is currently heavily invested in agricultural activities in collaboration with the Directorate of Resource Surveys and Remote Sensing, with the two organizations having signed agreements on various space services and earth observation applications.KSA is promoting space technology in conjunction with agriculture to discover how to control and ensure healthy crop growth.

Recently, KSA received a courtesy call by Israeli Ambassador to Kenya, Amb. Michael Lotem. The two parties explored areas of collaboration between the Kenya Space Agency and Israeli space companies in earth observation and remote sensing applications for agriculture and natural resources management, as well as other space services.

According to KSA's recently launched 2022-2025 strategic plan, the agency plans to support the development of systems and applications to enhance the uptake and utilization of space-derived data and information for decision-making.

The Agency has identified five space programs of service including Earth Observation, Navigation and Positioning, Satellite Communications, Space Operations, and Systems Engineering and Space Science and Astronomy.

The agency is also working towards positioning the country tap into regional and global opportunities including entering into bilateral and multilateral agreements as it looks to promote the development of space technology in the country.

Engineers Board of Kenya led by Chairman Eng. Erastus Mwongera and an independent review team visited Machakos University and conducted an evaluation exercise for Electrical & Electronics Engineering, Civil Engineering, & Mechanical Engineering Programs. The objective of the visit was to assess engineering programs for recognition by EBK.

Engineers Board of Kenya Registrar/CEO Eng. Margaret Ogai (seated, second left) pays a courtesy call on Vihiga County Governor Wilber Ottichilo (seated, third left) in October 2022. The County Government of Vihiga and Engineers Board of Kenya agreed to work jointly to develop a Capacity Building memorandum of understanding (MoU) for Engineers and Technical Support of county infrastructural projects.

IEK President Eng. Eric Ohaga (Third Left) pays a courtesy call on Liquid Intelligent Technologies CEO Mr. Adil Youssefi (Third Right). He was accompanied by 1st VP Eng. Grace Kagondu (Second Left), Council Member Eng. Paul Ochola (Left) and IEK CEO Eng. Linda Otieno (Right).

IEK Editorial Board Chairman Eng. Prof. Lawrence Gumbe presents a copy of the Engineering in Kenya magazine to H.E Prof. Anyang Nyong'o, Governor Kisumu County when he visited the IEK stand at the Association of Consulting Engineers of Kenya (ACEK) in October 2022. Photo/Maria Monayo.

IEK First Vice President Grace Kagondu (sixth, right) and Council Member Eng. Mumbua Kilatya (fourth right) with participants during mentorship session for JKUAT Society of Engineering Students (SES) in October 2022. The IEK held the mentorship session as one of the highlight events of the JKUAT SES Tech Week.

A training session of IEK Coast Branch Mhandisi Football Club Members in October 2022. The Institution of Engineers of Kenya Football Clubs are active across branches countrywide.

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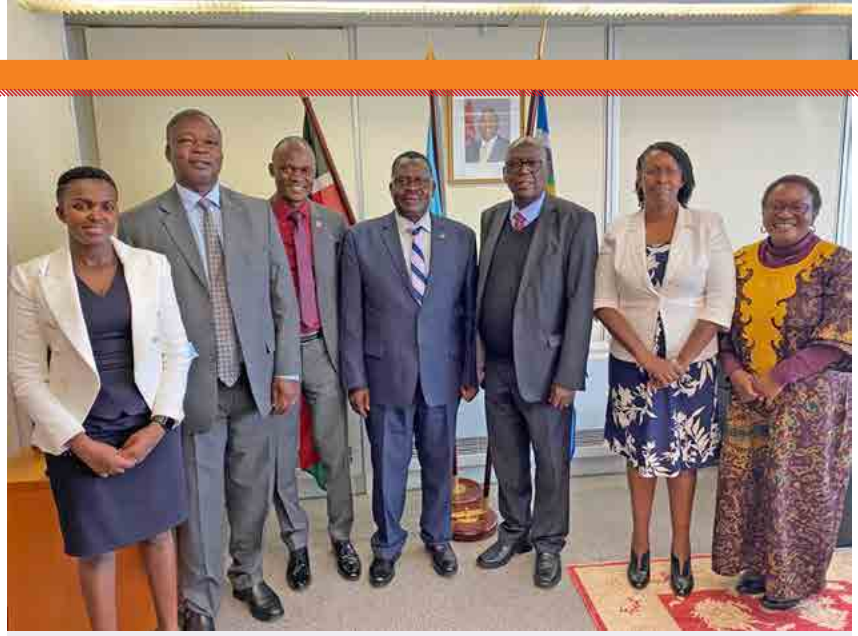


Amb. Prof. Richard Bosire (centre) of Kenya's Delegation at UNESCO hosted Engineers Board of Kenya Chair Eng Erastus Mwongera (third right) on the occassion of accreditation of EBK as an affiliate of World Federation of Engineering Organizations (WFEO). The EBK team included IEK President Eng. Erick Ohaga (third left), WFEO Executive Council member and Immiadiate past IEK President Eng. Nathaniel Matalanga, EBK CEO/Registrar Eng. Margaret Ogai, Eng. Prof Sylvester Abuodha, Chairman Academic Accreditation Com & Fridah Ngalu (left) Legal Director, EBK. They discussed areas of national interest & agreed to collaborate with the delegation to champion support for admission of Engineers Board of Kenya to the Washington Accord.

Climate Change Impact on Roles of the Consulting Engineer

By IEK Correspondent

In October 2022, Eng. Latoya Ouna, an IEK sponsored delegate, presented a paper on climate resilient projects at the International Federation of Consulting Engineers(FIDIC) Global Infrastructure Conference in Geneva. She spoke to Engineering in Kenya magazine.

The Changing Climate. Who is to blame?

Africa as a continent has contributed only about 2-3% of the carbon emissions, but is the hardest hit by the changing climate. This leads to conclusion that Africa is not to blame. However, we cannot bury our heads in the sand, hoping not to suffer from its effects.

What are the associated risks of climate change likely to directly impact future roles of the construction engineer?

The future Engineer must consider the climate at the forefront of any project from its inception to implementation. The changing environment calls for resilient infrastructure, which entails reengineering our projects and recognising that it is not business as usual. For instance, an engineer has to be cognizant that funding from multilateral developmental banks is now geared towards funding net-zero projects and decarbonised infrastructure. These measures are being applied throughout the supply chain. To mitigate redundancy, engineers require exposure and possible retraining to be market ready to meet these requirements and climate challenges

You have emphasized that Construction contracts should factor in pre-emptive construction methods. Explain.

My unpopular opinion is that it is not in our space to advise on or implement climate mitigation measures because our carbon footprint is insignificant. We should, instead, champion more adaptive efforts as we advance through climate-resilient infrastructure procurement practices and project implementation. This begins at the project conception, where difficult questions about a project's environmental impact should be answered, and any considerations to be given precedence during the feasibility and design phase.

Secondly, Engineers should be open-minded to designing infrastructure that can withstand the test of extreme weather events through research, development and innovation. Our dependence on traditional engineering materials and design will not suffice. For example, rising oceans pose a risk to communities that live in coastal areas. The infrastructure there should be designed to withstand flooding. Proper modelling and simulations of extreme climatic events should be considered.

Thirdly, we must update our building standards and codes to match best practices and changing times. Designing using outdated codes is a disservice to our infrastructure's longevity and robustness.

Lastly, emphasis should be made on procuring environmentally conscious contractors by including compulsory provisions and clauses in the bidding documents and contracts that ensure procedures to preserve the environment are taken.

You have called for innovation geared towards achieving net zero emissions to be accessible to all in the construction supply chain. Explain.

Achieving climate-resilient infrastructure is a team effort. Commitment and change in the mindset of all players in the supply chain are necessary for its success. Continuous innovation by Engineers will introduce new standards of design and materials that can withstand constant climatic shocks. In turn, it shall reduce our dependence on "exceptional events" clauses which absolve parties in construction projects following a climatic event. It will consequently ensure that the industry is proactive instead of reactive.

Sustainability and Climate Change Dominate Global Infrastructure Conference

By Andy Walker

THE key issues of sustainability and climate change were given a high profile at the FIDIC Global Infrastructure Conference which was held in Geneva from 12-13 September 2022.

The conference's central theme, delivering sustainable solutions for a better tomorrow, was a constant thread during the sold-out event which saw around 500 industry professionals from the engineering, construction and infrastructure sector in attendance.

In a keynote address on day one of the conference, Raphaël Bello, director for finance and human resources at CERN, the European Organisation for Nuclear Research, said:

> CERN is dedicated to sustainability because of stakeholders, supporters and staff all want it and it really is a must-have for us. It is the right thing to do. We are committed to sustainability, now and into the future.

FIDIC CEO Dr Nelson Ogunshakin speaking at the organisation's annual infrastructure conference in Geneva in September 2022.

Bello made the point that politicians had a key role to play in the journey towards a more sustainable world and there needed to be an absolute focus on influencing them on the industry's behalf.

Susan Reisbord, CEO and managing director of Stantec, highlighted the importance of the social and economic impact of their work, which she said was front and centre to everything they did as a company. William Cox, chief executive officer at Aurecon said that they were focused on "not just our clients, but also our clients' clients – the ultimate end-users of the things we build and create," he said.

Cox also made the point that young people coming into the industry wanted to see a demonstrable commitment to sustainability from the organisations that they work for and that was increasing shaping attitudes and actions in the corporate world.

Thomas Rohner, professor for building information modelling and timber construction at Bern University, said that there were 17 UN sustainable development goals and there needed to be an absolute focus on achieving all of them. Rohner said that the attendees at the conference had it within their power to make things happen and fashion a more sustainable world.

FIDIC CEO Nelson Ogunshakin made an impassioned plea for engineers to enter the political arena. "We don't want to lose anyone from engineering but if we have to then I hope that people move into politics because we need more political leaders who understand the importance of engineering and infrastructure and the positive difference it makes to society and to people's lives."

Andy Walker is a Communications Officer at the International Federation of Consulting Engineers (FIDIC)


(Photo Courtesy)

KAA Invests in Infrastructure Expansion and Optimization to Enhance Capacity of Airports

Arch. Fred Odawo,
General Manager (P&ES) - KAA

Engineering in Kenya Magazine spoke to Arch. Fred Odawo, General Manager (Projects & Eng. Services), Kenya Airports Authority (KAA) on the agency's quest to expand and optimize critical infrastructure so as to enhance capacity of key aerodromes in Kenya for passenger and cargo processing.

The Kenya Airports Authority regional hubs network: How significant are the hubs in regards to the handling of cargo operations?

Kenya Airports Authority operates an airport system of 21 aerodromes involving international airports, national airports and a number of strategic airstrips. International airlines define regional or international hubs for themselves depending on their operations. Jomo Kenyatta International Airport (JKIA) is a regional hub whose level of traffic is only comparable to that of Bole International Airport in Addis Ababa, Ethiopia, within the region. JKIA is the busiest airport in East Africa, currently handling about 40% of all business in the region. Kenya handles roughly 50% of the region's business with JKIA taking 80% of the traffic. JKIA hasan installed capacity of 1 million metric tonnes of cargo per annum and remains the biggest cargo operator in Africa. KAA as a state agency is working relentlessly to improve infrastructure and capacity to handle more cargo, including marketing Kenya as a destination and JKIA, among other airports (Moi International, Mombasa, and Kisumu international Airport), as export points. We are currently at the design stage for three extra parking slots for wide-bodied aircraft at the JKIA Cargo Terminal. COVID-19 made it necessary to re-engineer our cargo operations which remained resilient withpassenger movements almost grinding to a halt during the pandemic. Indeed, cargo operations are at the core of our 2022-2027 Strategic Plan.

What are some of the recent reforms Kenya Airports Authority is re-engineering towards enhancing efficiency of air transport locally and internationally?

We are developing our local routes to make them more efficient by improving and expanding our infrastructure. We have recently finalized construction of a new, and fully rehabilitated several aerodromes, including expansion of the terminal building at Kisumu International Airport.

Security is a key consideration in confirming to the international aviation community that travel through Kenya is secure, and the Government has taken positive steps in ensuring this. Indeed, courtesy of such initiatives, JKIA is now a Last Point of Departure which enables Kenya Airways to fly non-stop to New York in the US. To allow for international flights through or into other countries, they have to sign bilateral air service agreements. This brings to the fore the element of freedoms of the air where countries may need to protect their national airspace and airlines by limiting frequencies and number of destinations. For example, a foreign airline may be allowed operations to JKIA, but not to MIA, or a certain limit of frequencies per week yet they may have requested for more. This would be in the interest of protecting our national airline from undue competition.

Refurbishment and de-congesting of JKIA terminals. Comment on this.

Refurbishment of JKIA terminals will enable us to enhanceJKIA's installed capacity to 8 million from today's 7.5 million, passengers per annum. Terminal 1B is fully operational and the first flight following the refurbishment took off on 15th of October 2022.

Lufthansa Airlines will take off on 1st November from terminal 1C. We are currently working on the projects for permanent international arrivals buildings between Terminals 1B and 1C and 1C and 1D at grade level. We will construct a new Lounge on top of T1D to extend the newly refurbished lounges, thus increasing seating capacity. At Level 2 we will construct an Arrivals Corridor that will facilitate full separation of departing from arriving passengers in line with best practice requirements. These developments will necessitate the requirement for 3 new Passenger Boarding Bridges and extension of PBBs for T1 B, C and D (new) to Level 2 for arriving passengers. The façade for the rest of T1 will then be cladded to match T1A for a common aesthetic.

Full decongestion of T1A will see expansion of the airport to include a new terminal building and construction of the 2nd runway to take pressure off the existing one. JKIA is expected to handle 8.4 million passengers in 2023 with projections for 27.6 million passengers by Yr 2050. Given this scenario, therefore, we have set in motion plans to enhance the airport's capacity to meet the projected demand. The set initiatives include ground access, airside parking, landside parking, utilities and commercial development. These proposals will be guided by a process for undertaking Master Planning for both JKIA and Wilson Airport this financial year, which will subsequently be expanded to include other airports in the system.

With the increased rate of air travel, there is need to increase the number of airports in the country. Any plans to expand hangars or open new airports and airstrips?

KAA doesn't play a direct role in building hangars. We provide space for 3rd party players to establish them. We recently completed the refurbishment of Migori Airstrip, which is now operational but we are planning to build a terminal building. For airports, we are basically enhancing capacity in terms of extension of the runway and building more terminals.

"In the next 10 years JKIA will look very different. We will build capacity through extensive training to locally produce home grown talent to plan, design and supervise the construction of our aviation infrastructure. This includes the need for airlines to be able to fully self-service through training of aeronautical engineers. We are currently working on a national aviation policy that will underpin the development of a more efficient, competitive, environmentally sound, secure, safe and economically and financially sustainable aviation sub-sector in Kenya – Arch. Fred Odawo, General Manager in charge of Projects and Engineering Services at Kenya Airports Authority (KAA).

How do you see the future of Aerospace and Aviation Industry in Kenya in the next 10 years?

We have a very robust program for improving and expanding JKIA to efficiently compete in the region, with Bole International Airport in Ethiopia, for example. Our Strategic Plan 2022-2027 proposes a National Aviation System Plan to define what we need to put in place infrastructure-wise as an Authority sustainably going forward. In the next 10 years JKIA and the rest of the system will look very different. *We will build capacity through extensive training to locally produce home grown engineers that can efficiently service air crafts. We are working on a national aviation policy that will regulate everything in the aviation sector in Kenya.*

In the recent past we have been outsourcing consulting services on aviation engineering services from foreign countries since we lack sufficient capacity and capability locally. In the same vein, I hope that our local contractors will be able to build requisite capacity to be able to execute these tasks. To revolutionize the aviation sector, all stakeholders need to play their roles effectively.

Liberate Skies to Make Air Transport Sustainable – Capt. Gilbert Kibe

By EiK Correspondent

CAPT. Gilbert Kibe prides in having captained the Kenya Civil Aviation Authority as Dirctor General after an illustrious career flying planes around the world. The aviation industry veteran now serves as Chairman of the Board of Communications Authority of Kenya.

"The prospects for growth in the aviation sector in Kenya remains substantial. Air transport plays a significant role as it gives leeway for development and economic growth. The demand for air transport has seen the country increase and modernize airports and airstrips. Heavy taxes and high cost of fuel need to be looked into to make the aviation sector more profitable and sustainable," he told Engineering in Kenya magazine.

According to the Captain, African countries should implement and ratify the Single African Air Transport Market (SAATM) to Promote Development in Air transport in the continent. SAATM is a flagship project of the African union's agenda 2063, meant to liberate skies for all African countries. "This will see significant growth in air traffic in Africa," he says, adding that The African Continental Free Trade Agreement (AfCFTA) will be more impactful if SAATM is implemented as transport cargo operations will increase. The Agreement has accelerated the need for Kenya to increase capacity and invest in air cargo operations

"An open sky for a single African air transport market will allow African carriers to operate as domestic flights rather than operating as international flights. The implementation can start on a regional basis; East African Community flights should operate as domestic flights. This will reduce the high taxation imposed on flight tickets and allow countries to share codes", he reiterates.

> "Air transport plays a significant role as it gives leeway for development and economic growth"

Capt. Kibe discovered his interest in flying at 10 years of age. He acquired his flying license at 17 years, and started working as a flying instructor at 19 years of age. He encourages young graduates to stay focused. He strongly urges professional bodies in the country to develop skills in young people.

An aerial view of Jomo Kenyatta International Airport Aerial - JKIA

Role of the East Africa School of Aviation (EASA)

By Maureen Mwangi

Dr. Mugambi M'Nchebere Director, East African School of Aviation and President of the Association of African Aviation Training Organization (AATO)

THE East African School of Aviation (EASA) is mandated to provide aviation training for Kenya Civil Aviation Authority (KCAA) and the aviation industry, providing competency-based training to Africa and the Indian Ocean (AFI) Region in compliance with the International Civil Aviation Organization(ICAO) and Kenya Civil Aviation Authority Regional Training Centre of Excellence (RTCE) agreement. The Institution coordinates aviation research and development among other roles. Dr. Mugambi M'Nchebere is currently the Director, East African School of Aviation and President of the Association of African Aviation Training Organization (AATO).

Recently, the East African School of Aviation became recognized for the fourth time in a row by the International Air Transport Association (IATA), as the Top Regional Performer in Africa and the Middle East in 2022. Besides, the school has attained the highest ICAO accreditation, Training Centre of Excellence- Platinum. The institution is the regional preferred civil aviation training centre with capacity to offer training in all disciplines of civil aviation except pilot training. The school's core programmes include Air Traffic Control (ATC), Communication Navigation and Surveillance (CNS), Government Safety Inspector (GSI), Aviation Security (AVSEC), Aeronautical Engineering, Flight Dispatch among other IATA courses.

> The International Civil Aviation Organization identifies three challenges facing the aviation sector. Infrastructure development in air transport is one of the challenges hindering growth in air transport. Safety and Security is a very sensitive subject in aviation. The aviation sector is growing very fast but with deficit of specialized personnel, a gap we are working to bridge as EASA

"The Institution is committed to offering competency-based training and ensuring that our graduates have the requisite knowledge, skills, and attitude for the rapidly growing aviation industry. The courses are delivered by competent instructors who are leaders in their fields of expertise", says Dr. Mugambi.

The aviation sector is faced with a myriad of challenges, especially in developing countries. EASA is tailoring training courses to solve pertinent challenges relevant to approved aviation training organizations so as to meet international market demands.


(Photo Courtesy)

Efficient Management of Air Safety – Mandate of Kenya Civil Aviation Authority

By EiK Correspondent

This year marks 20 Years since the establishment of Kenya Civil Aviation Authority (KCAA). Engineering in Kenya magazine looks at major milestones that have been accomplished by the agency.

Economic Sustainability

KCAA ensures the costs applied to services provided are able to continually cover their production. These services include ANS & Training whereby KCAA operates under a cost recovery framework which ensures the Authority is able to cover the cost of these services. The Regulator is supposed to apply charge affordable for the industry. KCAA also ensures it does not burden clients by buying equipment that are analyzed in advance and are related to the demands of the industry to ensure we only make necessary investments on behalf of clients. In undertaking these investments, we procure equipment/ facilities competitively to ensure we get the best prices. This helps KCAA incur necessary costs only.

Efficiency

KCAA ensures that whatever what the agency produce as the Regulator, it gets paid for it. Air Transport comes in during the issuance of Air Service Licenses (ASL) which are granted to air operators who have the capacity to deliver these services. These approvals are granted with the view of encouraging competition and competitive prices in the market. This helps prevent overpricing by air operators. When it comes to aerodrome operators, investments are guided by the levels of traffic in specific aerodromes and as the Regulator, KCAA carries out inspections to make sure investments undertaken by aerodrome operators meet ICAO standards.

Effort to Ensure Adequate Facilities to Train Aviation Personnel

KCAA has rationalized Air travel across the country by ensuring activities involving planning and decision making are concentrated to a specific location, in this case the Head Office. This facilitates centralization of activities of the aviation industry hence easing air travel. KCAA regulates the Aviation sector and enhances liberalization of Kenya's skies. It oversights Kenya Airports Authority (KAA) by checking and ensuring all the requirements of safety, standards and recommended practices of international Civil Aviation organization (ICAO) are being performed well and operating in compliance. KCAA is also oversight agency for aviation security, checking that KAA security screening services are running well and optimally.

The control tower in Kisumu will facilitate growth of understanding of digitization and its role within the aviation industry. It will help centralize air traffic services hence smaller airports may save money in terms of ATC costs and remove the need for subsidies. Remote ATC Technology is also beneficial for airports where air traffic varies depending on the season and real time system. It will also optimize stability. Just as a control tower coordinates busy flying time to ensure the right planes land and unload in the right place at the right time. KCAA is also party to Strategic Partnerships with member states of Civil Aviation Safety and Security Oversight Agency (CASSOA) so as to facilitate achievement of the agency

mission which is to enhance safety and security oversight systems in all partner states.

Liberalization

In terms of liberalization, KCAA acts as the state advisor during the drafting and regulation phases on bilateral service agreements within the African region. There is an ongoing effort to have a liberalized market of open skies within Africa which is spearheaded by the AU under the Single African Air Transport Market (SAATM).

New Control Tower at Kisumu International Airport

The New Control Tower at Kisumu International Airport will help in training and internship opportunities (new systems expected to be available) to provide hands-on experience to young graduate engineers. This experience is crucial for the registration as professional engineers.

The Tower will have a modern design of the equipment room that is characterized with by efficient cable management, efficient cooling system and enhance equipment performance. It boasts improved design and documentation of all wiring works, efficient fire suppression system deployment, adequate space and good aeration due to bigger floor space in the equipment room providing or yielding, an ambient working environment for personnel and equipment to reduce failure rate and thus improve the reliability and availability of the equipment, workshops/technical rooms for testing and repairs room, and improved organization in the equipment room due to separation of equipment for efficient functioning and operation due i.e.;

The New Control Tower at Kisumu International Airport is intended to be fully equipped with power supplies, UPS and power regulators, housed in separate (power) room to avoid electrical interference with function system, essential equipment, function equipment, core CNS systems to be housed in the equipment room at specified temperatures free of frequent human traffic, General Systems -ICT equipment, intercom switches and technical positions to be housed separately away from critical equipment and essential equipment.

It will also have an Ergonometric set up of equipment in the tower made possible due to space. This will lead to efficient utilization of operational equipment, enhanced staff welfare at the workplace, improved office space to cater for increasing number of staff and better rest rooms and mothers' room among other rooms to cater for staff welfare.

Partnerships and Collaboarations

KCAA undertakes joint collaboration, coordination and engagements with various Aviation stakeholders such as Security agencies, KAA, KQ, KAAO. These include:

NAVSEC and Civil/Military Coordination Technical Committees

Members of the committee comprise of representatives from Kenya Civil Aviation Authority (Chair), Kenya Defence Forces, Kenya Space Agency, National Police Service (Kenya Airport Police Unit – KAPU, The Police Air wing), Kenya Airports Authority, Kenya Airways, Kenya Association of Air operators, National Disaster Management Unit, Ministry of Infrastructure and Transport, and Office of the Attorney Generals & Department of Justice.

In order for air transport industry to operate as a safe and harmonious system, the International Civil Aviation Organization (ICAO) has urged States to have agreements on how to collaborate on a common regulatory infrastructure, which includes the access and use of airspace. As airspace becomes more of a scarce and sought-after resource, States need to take a balanced approach to airspace management in a way that harmonizes and meets the needs of international traffic flows and national security. This requires communication, collaboration and cooperation.

The tremendous effort and commitment by both civilian and military aviation sectors, in the interest of aviation safety and security is highly appreciated.

Civil military cooperation is critical in airspace management due to challenging operations based on new technological advancement in both the civil and military fronts. Success depends on effective coordination, cooperation and synchronization of various functions in order to properly train and operate.

Arrangements need to be made for the common use of the airspace, facilities and services to ensure safe, secure, regular and efficient flow of Civilian Air Traffic. Evolving worldwide security threats require continuous adaptation of military strategies and tactics, which in turn result in changing military airspace and airspace management requirements.

Kenya Civil Aviation Authority has the duty of ensuring that appropriate coordination of ATM operational concepts with the military is achieved with maximum cooperation and integration in an effort to implement and realize a flexible and cooperative approach to airspace organization and management.

It is only through closer partnership with the military, particularly the KAF, that the KCAA will be able to achieve Flexible Use of Airspace (FUAs), Free Routing Airspace (FRAs), and Direct Plannable Routes concepts as required by the ICAO ASBU Block Upgrade 0 and 1 are prerequisite in achieving all the 5 ICAO Strategic Objectives (i.e., Safety, Air Navigation Capacity and Efficiency, Security & Facilitation, Economic Development of Air Transport, and Environmental Protection).

Aviation Industry Affairs

Efforts have been made and discussions are continuously being held aimed at enhancing operational efficiencies, safety and security at

our airports and within the Kenya airspace through the Aviation Industry Affairs Committee. This committee comprises of the KAA, Kenya Association of Air operators (KAAO) – Co-Chair, KAA and KCAA – the Chair. The discussions therein have yielded progresses that have resulted in but not limited to the following:

a) Decongestion at Wilson Airport – Dispatch points. Plans had been made to turn the Prestige Hangar at Wilson Airport to a full departure-arrival terminal. The main idea is to open up the whole airport and remove congestion especially at Customs which is a serious security issue.

b) Conduct of Airport Emergency Exercises - All rounded emergency exercises are being conducted regularly, and not just table top exercises guided by the outputs of risk assessment at various airports. Different kinds of simulations for different scenarios are usually carried out covering security and public health areas.

c) Simplification of Registration & Certification of Aircraft processes – Issues had been raised regarding a mix up between the technical guidance for Registration with that of Certification. These have since been separated to avoid duplicating efforts thereby simplifying and accelerating the process of clearing aircraft for flight.

d) Updates on Runways/Taxiways dimensions at airports – safety concerns due to inconsistencies that had been raised between information that was presented in the AIP and what was actually on the ground especially at Wilson. This has since been corrected and updated by the KCAA relevant Department (AIM).

e) Effective safety oversights through limitation and regulation of construction of buildings, structures such as wind power plants along Safety Funnels following feedback and reports from aircraft operators/ pilots.

Major Milestones Accomplished by KCAA in the Aviation Sector

Key Milestones Achieved by KCAA in the Last Seven (7) Years

No.	KEY ACHIEVEMENT/ MILESTONE
	Aviation Safety and Security Oversight
1.	Improved performance in ICAO Universal Safety Audit Oversight Programme - Carried out in 2018, Kenya attained a score of 78.02 %
2.	Improved performance in ICAO Universal Security Audit Programme -Carried out in 2015, Kenya attained a score of 91.77 %
3.	Attainment of FAA's IASA CAT Status- The CAT ranking obtained in February 2017, and this made it possible for first direct flight to USA to happen in October 2018.
4.	Growth of aviation industry as evidenced by the following: ▪ Air craft Registration- Increased from 1440 in 2016/17 to 1,600 in 2020/21 ▪ Licensing of aviation personnel-Increased from 9975 in 2016/17 to 11807 in 2020/21
5.	Management of Covid 19 Pandemic. The Authority coordinated implementation of Covid protocols related to aviation enabling industry to resume operations.
6.	Construction of EAC Centre for Aviation Medicine
	Air Navigation Services
1.	Modernization of Air Navigation Facilities/Equipment: Key facilities/equipment implemented include: ▪ Construction and equipping of Wilson Control Tower ▪ Establishment of Mobile Control Tower in Diani ▪ Construction of Building at Mlolongo that will serve as new ACC and Disaster Recovery Centre. Plans are underway to equip and operationalize the new ACC & DRC. The new building is also serving as headquarters of ANS ▪ Establishment of New Air Traffic Management System at JKIA ▪ Establishment of Voice Control and Communication Systems at Jomo Kenyatta and Moi International Airports, Malindi and Kisumu Airports. ▪ Installation and Commissioning of HF Communication Systems ▪ Installation and Commissioning of ADS-B and MLAT System ▪ Installation and Commissioning of Digital Airport Terminal Information System(D-ATIS) at Wilson Airport ▪ Supply and Commissioning of AIS/AIM System ▪ Supply and Commissioning of VHF Area Cover and RCC
2.	Improved availability of Air Navigation equipment- Due to robust modernization of air navigation facilities, availability of equipment has improved from 94.6 in 2017/18 to stand at 99% 2020/21 which is above the threshold set by ICAO of 97%
3.	Construction of staff houses in Wajir, Lokichoggio and Poror
4.	Increase in aircraft movements. Prior to the pandemic there was consistent growth in number of air craft movements
	East African School of Aviation
1.	Approval of EASA as Training Centre of Excellence (TCE)
2.	Categorization of EASA into Platinum, which puts the school among the four TCEs with such categorization globally
3.	Construction of a modern library facility
4.	Installation and commissioning of following training equipment: ▪ Air Traffic Control Simulators ▪ Engineering Laboratory Equipment ▪ Hydraulics Laboratory equipment ▪ Search & Rescue Training Equipment
5.	Renovation of access and internal road network
6.	Construction of Chapel
	Corporate Services
1.	Automation of a number of business process
2.	Establishment of Risk Management Framework
3.	Implementation of business management systems
4.	Improvement in staffing levels

Why Investing in Space Technology will be Profitable for Kenya

Graduate Engineers participate in Engineering Partnerships Convention organized by Engineers Board of Kenya (EBK) in June, 2022. Photo/Pool

By Harun Gaka Mamboleo

TO be technologically advanced and a top economy, Kenya needs to invest in space technology as commodity to sell to the international market. But almost all the options for such commodities are running out. The discovery of oil in Turkana is proving a tiny resource. Agriculture is being affected by climate change and Kenya's agro technology is in infant stages. Perhaps bigger opportunity is in science and technology - more specifically, Space Technology.

When space exploration technology took a major trajectory about seventy years ago majorly by two players – the United States and the Soviet Union, it was majorly about science, military and politics. But today that has advanced to commercial applications. But out of the thousands of satellites in space, how many of those does Kenya or Kenyan companies own and operate? Besides the silent San macro satellite tracking and launching station, there is no other major known space exploration initiatives being carried out by the country.

Commercialization of Space Technology

There are increasingly many activities that take place in outer space, according to the trend. The predominant commercial activity in the space right now is satellites. These satellites carry out operations in a variety of industries, including meteorology, remote sensing of the earth's resources, telecommunication, and navigation. Additionally, space-created activities make use of space resources, such as the Moon's Helium-3 as a component of nuclear power or the production of cost - effective pharmaceuticals and electronics in zero gravity. All these are happening in a backdrop of an internationally undecided demarcation for use of space. International law states that a state has jurisdiction over the airspace over its territory. National sovereignty, however, does not apply to space.

Kenya should therefore be looking at controlling billions of worth of satellites that are able to generate trillions of shillings in revenue. Even the Kenya department of Defense in its Kenya Space Policy admitted that space science has not only the advantage of driving the growth of science technology in nations that apply themselves to it but that it also has a significant and positive impact on other industries and sectors of the economy.

Space Resources, Tourism and Transportation

With stable and reliable space technology, space tourism is one area that Kenya can dominate. In the recent past, we saw a single space tourist pay a whopping Ksh. 2 billion for a few hours' suborbital tour flight. A promising industry indeed. Another area that Kenya can take advantage of is the exploitation of valuable space resources that may be crucial for development of modern technology. And even with the demand for transportation of such resources from space, space transportation is another area that Kenya can be the frontrunner.

Kenya's Advantage

There is a validated argument that the East coast of a continent close to the equator is a combination of natural resources that Kenya has access to. Satellites launched from locations close to the equator in the direction of the east benefit from an initial boost equal to the speed of the Earth's surface, which saves the rockets a significant amount of fuel and lowers the cost of launch. This vital resource has only mostly benefited foreigners seeing that Italy in partnership with the National Aeronautics and Space Administration (NASA) conducted 27 launches comprising sounding rockets and 9 satellites from the San macro satellite tracking and launching station.

Kenya should invest in space technology. It should put its mind, deliberate efforts and a lot of resources to develop the space technologies as commodities it can sell internationally. The nation must find ways to be on the forefront in space technologies.

Eng. Harun Gaka Mamboleo Zamconsult works at Consulting Engineers Limited.

Invest in Mhandisi SACCO for Financial Re-engineering

By Eng. Johnsson Matu

ON 29th September 2022, President Dr. William S. Ruto, during his inaugural speech in parliament, stated that he will be proposing a national savings drive to encourage those in informal sector to set up their retirement savings plan.

He further added that for every Sh 2 saved in the scheme up to a maximum of Sh 6,000 per year, the government will contribute a shilling for every Sh 2 saved. Meaning every Kenyan who will save Sh6,000 a year, the government will give them Sh 3,000 per year.

> Currently, SACCOs are responding to the dynamic and competitive financial environment which will have a great impact on the well-being of individuals says Eng. Johnson Matu, himself among the founding fathers of Mhandisi SACCO.

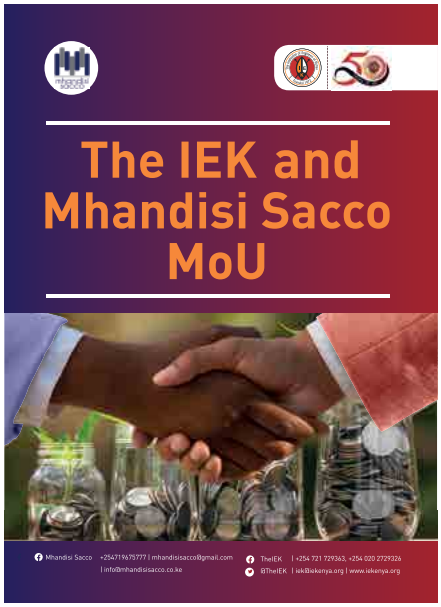
He argues that this will boost the SMEs sector and encourage a culture of saving, thereby discouraging situations of living from hand to mouth.

Eng. Dr. Matu also argues that investing in SACCOs gives one financial freedom and liberates one from unforeseen expenses. "When it comes to financial independence, saving should be considered as a sure way to financial freedom. When you have financial freedom, circumstances of where one has to depend on others to provide even the simplest basic needs will be unheard of. Your savings kitty will be there to bail you out of such circumstances".

He adds that "we have seen various situations where people especially the youth holding fundraising for weddings and unfortunately, they are not able to raise the intended amount. The savings kitty helps one become stress free," says the Engineer who started his career at East African Engineering Consultants. He was first introduced to saving in a SACCO and was within the first 6 months eligible to borrow a loan with which he bought a welding machine and a pickup. He explains it's through the SACCO that he managed to buy a house in South C and a parcel of land in Nyahururu.

"Those employed you are at an advantage as their employers can deduct a certain amount direct to the Sacco, an amount that may not be considered part of your expenses as one will still be receiving the net salary. "I can comfortably say the SACCO assisted me in achieving my objectives. For sure SACCOS are very useful in that they help you save automatically".

Eng Matu has called upon all Engineers to support their own SACCO. "I encourage those Engineers who have not started saving to join Mhandisi SACCO and start saving. Those who are in Mhandisi SACCO should continue saving and if possible increase their monthly contributions."



Immidiate Past President of IEK Eng. Nathaniel Matalanga (Right), Council Member Eng. Christine Ogut (Second Right) and Konza Technopolis Chief Engineer Eng. Anthony Sang (left) join a guest during launch of Mhandisi Benovelent Fund in August, 2022. Photo/pool

TANA WATER WORKS DEVELOPMENT AGENCY

Dr. Eng. David Muthoga
TWWDA Chairman

Eng. Philip Gichuki
TWWDA Chief Executive Officer

Tana Water Works Development Agency (TWWDA) is a successor of Tana Water Services Board (TWSB) and it emanated from the reform that realigned the water sector to the Constitution of Kenya 2010. It was established under Section 65 (1) of the Water Act, 2016 vide Legal Notice No. 27 of 26th April, 2019. TWWDA officially commenced operations on 3rd May, 2019 following the operationalization of Section 152 of the Water Act. The Agency is one of the nine (9) water works development agencies under the Ministry of Water, Sanitation and Irrigation. TWWDA supports the Government in developing, maintaining, and managing national public water works to attain sustainable access to quality water and improved sewerage services within the area of its jurisdiction. The Agency runs operations in five (5) Counties, namely: Embu, Kirinyaga, Meru, Nyeri and Tharaka Nithi (figure 1). The total area of coverage is 17,195 Km2 with a total population of 3,917,065 (KNBS, 2019).

TWWDA is committed to increase the water and sewerage coverage from 57.8% and 8.1% to 90% and 30% respectively by 2027.

VISION

Universal access to quality water and sanitation services.

MISSION

To enhance quality of citizenry life by improving access to safe water and sanitation services through infrastructure development and capacity building at the county level.

CORE VALUES

In the quest to provide quality products and services, the Agency is bound to the following core values of respect, professionalism, teamwork, integrity, transparency and diligence.

TWWDA'S PHILOSOPHY

Quality water works for improved livelihood

County	Area (KM²)	Population 2019	Population 2027	Projected Household Size 2027	Projected Households 2027	Projected Households with water (%)	Projected Households with water (No.)	Household size	Population with water	Water Coverage (%)
Embu	2,820.70	608,599	832,917	3.20	260,286	93.89%	244381	3.2	782019	93.9%
Kirinyaga	1,478.30	610,411	835,390	2.90	288,065	87.00%	250617	2.9	726789	87.0%
Tharaka Nithi	2,564.40	398,177	538,090	3.50	153,740	86.55%	133062	3.5	465717	86.6%
Meru	7,006.30	1,545,714	2,115,415	3.50	604,405	87.40%	528612	3.5	1850143	87.5%
Nyeri	3,325.00	759,164	1,088,968	2.90	358,265	95.10%	340710	2.9	988059	95.1%
Total/Average	17,195	3,917,065	5,360,774	3.20	1,664,759	90%	1,497,382.04	3.20	4812727	90.0%

County	Area (KM²)	Population 2019	Population 2027	Projected Household Size 2027	Projected Households 2027	Projected Households with sewerage (%)	Projected Households with sewerage (No.)	Household size	Population with sewer	Sewer Coverage (%)
Embu	2,820.70	608,599	832,917	3.20	260,286	33.33%	86753	3.2	277608.8	33.3%
Kirinyaga	1,478.30	610,411	835,390	2.90	288,065	32.50%	93881	2.9	272253.5	32.6%
Tharaka Nithi	2,564.40	398,177	538,090	3.50	153,740	13.99%	21491	3.5	83717.7	15.9%
Meru	7,006.30	1,545,714	2,115,415	3.50	604,405	21.11%	127590	3.5	446564.4	21.1%
Nyeri	3,325.00	759,164	1,088,968	2.90	358,265	47.78%	171179	2.9	496419.1	47.8%
Total/Average	17,195	3,917,065	5,360,774	3.20	1,664,759	30%	503,893	3.20	1576563	30.1%

The following are the water and sewerage projects coverage in the next five years. An estimated Kshs 63.5 billion is required for the same.

ON-GOING PROJECTS

Chuka Water Supply under construction

Chuka sewerage: Ponds under construction

COMPLETED PROJECTS

Chogoria Water Supply Masonry storage tank and Treatment Works

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P.O. BOX 1292 – 10100. Nyeri, Kenya
Tel: +254 724 259 891 | +254 61 2034118 | +254 61-2032282

Email: info@tanawwda.go.ke
Website: www.tanawwda.go.ke
Tana Water Works Development Agency | @tanawwda

The Use and Importance of Finite Element Analysis in Aerospace Engineering

By Jackson Musyoka Kioko

Introduction

THE word aerospace is essentially a combination of two words: aeronautics and spaceflight. Therefore, aerospace deals with the design, manufacturing, and maintenance of aircrafts or spacecrafts and can be thought of as the science of flight within Earth's atmosphere as well as outside it.

Aerospace verses Aviation engineering

Aviation, on the other hand, has to do with mechanical flight and the aircraft industry. It is basically all things aeroplane-related within Earth's atmosphere. In fact, the term 'aviation' is derived from the Latin avis meaning 'bird'. Aviation is all things aircraft-related within the atmosphere of Earth. In general term, aviation means flying of aircraft for commercial or/and military purposes. Aviation represents a massive and complex industry that is crucial to our global economy.

Finite Element Analysis (FEA) in Aerospace

By definition, Finite element analysis (FEA) is the process of simulating the behaviour of a part or assembly under given conditions so that it can be assessed using the finite element method (FEM). FEA is used by engineers to help simulate physical phenomena and thereby reduce the need for physical prototypes, while allowing for the optimization of components as part of the design process of a project.

The aerospace industry is one of the true origins of finite element analysis. The necessity for safety is obvious and the drive for light-weighting and thermal performance will be just as well recognized by experts in the industry. Almost every component of an aircraft requires some form of analysis, and often multiple.

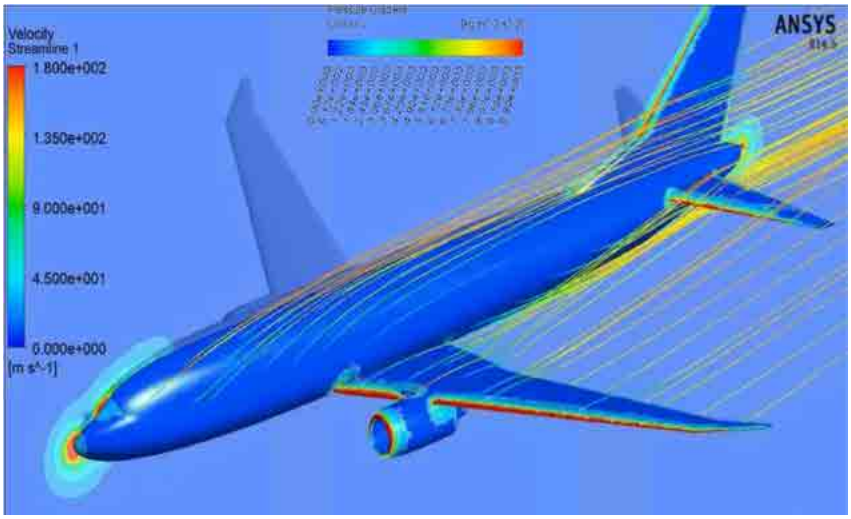


Figure 1: Use of Ansys software to determine transient simulation of a flow through the Boeing 737 body, (Image courtesy, Jarray.Med Engineering).

The FEA algorithms are integrated into simulation software like Autodesk Inventor Nastran or ANSYS's suite of software. These programs are usually integrated into computer-aided design (CAD) software, making it much easier for engineers to go from design to running complex structural analysis. In aerospace, Engineers mostly use FEA software such as Nastran, Ansys, Abaqus, or LS-Dyna (depending on the analysis type).

In aerospace manufacturing, the above mentioned software are used to predict how aerospace parts will react to structural and thermal loads. Aerospace parts must withstand extreme stress from a variety of forces, including air pressure, inertia forces, and impact stresses during takeoffs and landings. Known as loads, these forces and movements can apply extreme stress to an aircraft's structural integrity. Aerospace parts must be able to continuously withstand these stresses to keep the aircraft intact and its passengers and crew safe.

Why FEA is important in Aerospace?

Figure 2: Aeroplane Model simulation, Ansys.

Aerospace manufacturers face enormous challenges to design, test and build their products on-time and on-budget. They are tasked with engineering products of the highest technical complexity which also must meet the strictest safety and performance requirements. Finite analysis software programs are therefore used to predict how a product will withstand its environmental stresses by simulating the conditions it will be placed in. These conditions can include real-world forces such as temperature, vibration, points of contact, distribution of weight, quality of welds, and exposure to certain chemicals. These factors can affect the structural integrity of the product. Aerospace parts must be tested thoroughly before being released for distribution.

It is simply said that there is no room for error in aerospace industry. To succeed, aerospace engineers rely heavily on FEA technology to gain accuracy, to save time and to reduce design cycles. Engineers use FEA software throughout the entire design process - from early in the process to predict performance as well as later on, to accurately verify that designs meet strict criteria. There are other several advantages to using finite analysis software vs physical prototype testing, including:

Faster testing speed (minutes or hours instead of weeks or months)

Reduced materials expense because of the ability to test designs without needing multiple physical prototypes

Reduced labor because less manpower will be needed to conduct a simulation vs physical testing

Ability to simulate years or decades of use, increasing test thoroughness and predicting future aerospace product behavior

Jackson Musyoka Kioko, is a Student, MSc. Structural Engineering, Budapest, Hungary.

Collapsed Buildings Did Not Involve Professional Engineers - EBK Findings

IEK Building Sector Committee Chairperson Eng. Benjamin Nyawade raises concerns of the Engineering fraternity at the site of structural collapse in June ,2022. Regulator Engineers Board of Kenya has adopted a "Zero Tolerance to Collapse of infrastructure" policy to end unsafe and unregulated developments in the counties. Photo/Pool

By IEK Correspondent

PRELIMINARY findings on the collapse of six storey buildings in Kiambu and Kajiado counties show the projects did not involve professional engineers, Engineers Board of Kenya Registrar Eng. Margaret Ogai has confirmed.

On 26th September 2022, a six-storey residential building in Kirigiti, Kiambu County, collapsed. Three days later, on Thursday, 29th September 2022, another six-storey building in Kajiado County collapsed.

Officers from Engineers Board of Kenya conducted site visits on the respective days of the incidences and established that the project in Kirigiti was not registered by the County Government of Kiambu, and was also not registered by the National Construction Authority.

There was no evidence of involvement professional engineers in the design and construction supervision of the project. "There is no evidence of involvement of professional engineers in the project in Ololua, Kajiado County. The Board is carrying out further investigations and will share the report on the findings and recommendations to mitigate the collapse of buildings," EBK said in a statement by Registrar Eng. Margaret Ogai.

The Board is now encouraging developers to engage professional engineers, registered and licensed by EBK in the implementation of their projects (from design as well as supervision during the actual construction). "This will not only prevent the needless loss of lives and investment, but also ensure the investors, developers and clients get value for money for their projects," says EBK.

The general public, clients, developers and county governments can confirm the engineers and engineering consulting firms in good standing from the Board's website https://ebk.go.ke/ or by visiting the Board's Offices located at Fortis Suites, Off Ngong Road, Nairobi.

The Registrar reiterated that EBK is committed to the realization of a safe, efficient, and effective engineering infrastructure, systems and processes for Kenya for the attainment of national developmental agenda. She noted that the Board has embraced a "Zero Tolerance to Collapse of Infrastructure" strategy and will redouble efforts to continue working with all the stakeholders including the public, county governments, policy makers, ministries and agencies for sustainable solutions in the realization of resilient infrastructure.

29TH IEK INTERNATIONAL CONVENTION

21st to 25thNovember 2022
Diani Reef, South Coast

EARN 25 CPD POINTS

THEME: *Sustainable Engineering in the Era of Climate Change*

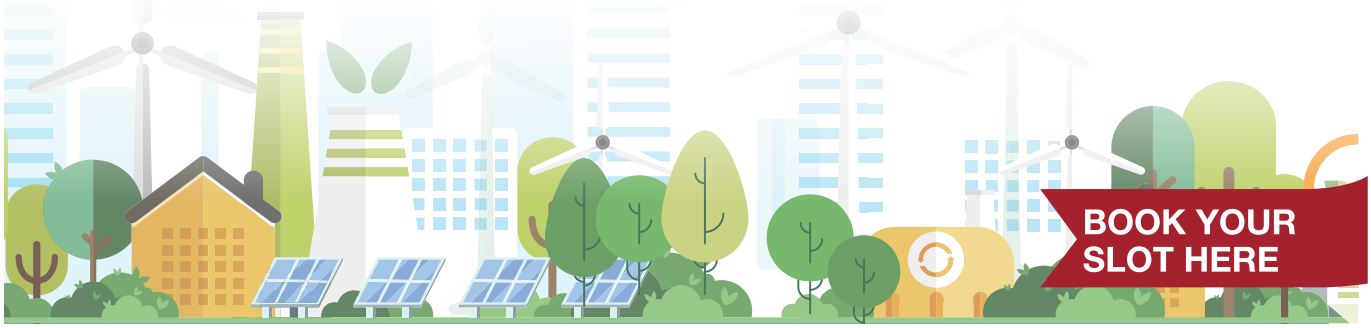
CONVENTION SUBTHEMES:

a. Building resilient infrastructure
b. Harnessing emerging technologies for sustainable development
c. Innovation
d. Mitigation measures against climate change
e. Climate adaption
f. Climate change Impact & Engineering
g. Artificial intelligence
h. Energy transition
i. Role of Nuclear and Renewable Energy in Combating climate change
j. Role of Green Financing and Green Economy

CONVENTION FEES

Physical Attendance	
Early Registration (before 1st October)	40,000
Late Registration (after 1st October)	45,000
Foreign Delegate	USD380

Virtual Attendance	
Early Registration (before 1st October)	15,000
Late Registration (after 1st October)	20,000
Student	3,000
Foreign Student	USD150



Bank Payment Mode
Standard Chartered Bank: Kenyatta Avenue
Account Name: Institution of Engineers of Kenya
Account Number: 0102024134900

M-PESA Payment Mode
PAYBILL: 976295
Account No.: Participant's Name

For further information
Email: convention@iekenya.org
iek@iekenya.org
Call: +254721729363 or +254020271692

Kenya National Highways Authority

Quality Highways, Better Connections

KeNHA is a proud sponsor of

Engineers Convention

A Focus on KeNHA Coast Road Network

Kenya National Highways Authority (KeNHA) is commited to developing and managing quality and adequate National Trunk Roads through innovation and optimal utilization of resources for sustainable development. In order to achieve this, the Authority has continuously improved the country's road network through construction, rehabilitation, maintenance and management aspects.

Mombasa region as the major gateway to Kenya's regional trade, the Authority has extensively improved coastal road network as highlighted through the major road projects below:

DONGO KUNDU BYPASS - MOMBASA PORT AREA ROAD DEVELOPMENT (MPARD) - PACKAGE II & III

The road project is located in Mombasa and Kwale Counties. The project was packaged into three lots, Package I: Miritini - Mwache - Kipevu Link which is approximately 10.1Kilometres was completed in 2018. The remaining two lots are at an advanced stage of completion as follows:

MPARD Package II: Mwache - Tsunza - Mteza (Dongo Kundu) Road, an approximate length of 9Km *(at an advanced stage of completion).*

MPARD Package III: Mteza (Dongo Kundu) - Kibundani Road, an approximate length of 7Km . *(substantially complete).*

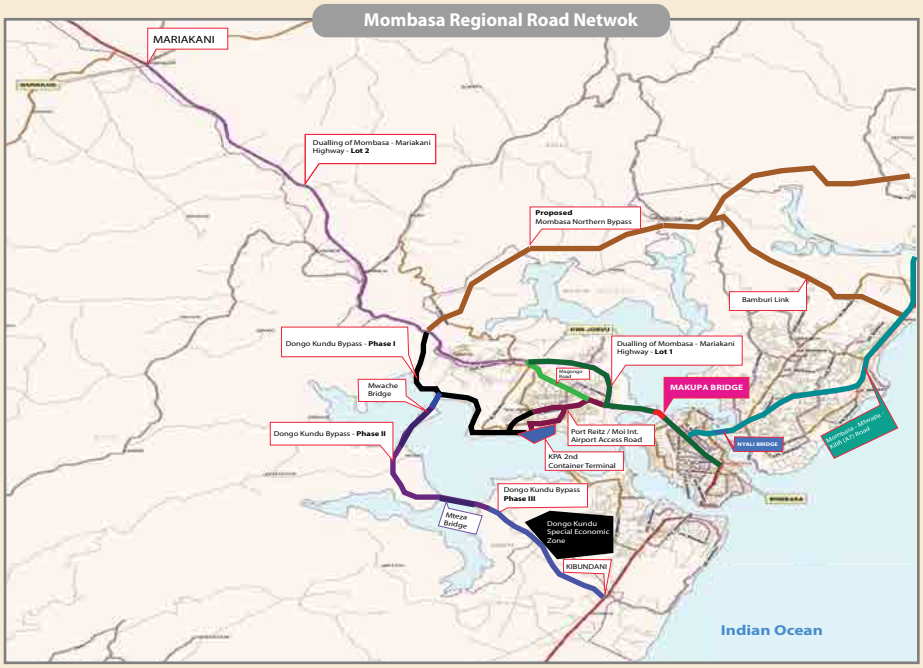
DUALLING OF MOMBASA - KWA JOMVU - MARIAKANI (A8) ROAD

The Mombasa - Mariakani road is situated in Mombasa and Kilifi Counties. The road project is an upgrade of the existing single carriageway to dual carriageway and will facilitate freight transport from Mombasa to other inland destinations of the Northern Corridor. The project is being implemented in two lots.

Lot I: Mombasa - Kwa Jomvu Road, an approximate length of 12Km, *(at an advanced stage of completion).*

Lot II: Kwa Jomvu - Mariakani Road *(yet to commence).*

Mwache Bridge



CONSTRUCTION OF MAKUPA BRIDGE

The Makupa Bridge which is located in Mombasa County, replaces a causeway was built in 1929 as one of the links between Mombasa Island and the mainland, which separated the waters that surrounded Mombasa Island into Tudor Creek to the east and Port Reitz Creek to the west, hindering the free movement of water and marine life, and damaging the ecosystem.

The Bridge now allowes the free movement of water and marine life. It is approximate 9Km in length, *(the bridge is completed).*

Makupa Bridge

CONSTRUCTION OF MOMBASA - MTWAPA - KILIFI (A7) ROAD

The Mombasa - Mtwapa - Kilifi road project involves the dualling of the existing highway into four-lane dual carriageway. The project is situated in Mombasa and Kilifi counties. The project is divided into two lots.

Lot I: Mombasa - Mtwapa (A7) Road, an approximate length of 13.7Km, *(yet to commence)* .

Lot II: Mtwapa - Kwa Kadzengo - Kilifi (A7) Road, an approximate length of 40.4Km, *(ongoing)* .

Mtwapa - Kilifi Road during construction

Why Were Skyscrapers Built?

By Eng. Monda Makori

SKYSCRAPERS may be older than you think. Towers and tall buildings have been used for over 10,000 years to allow for defense observation, clock visibility, and communication. And while skyscrapers are definitely newer, they're still over 100 years old. Just like towers, skyscrapers are built with a specific purpose in mind. Reducing housing costs, to level inequality, and allowing more people to live in city centers are three of the founding reasons why skyscrapers were built. Whether these are still true today depends on where you look.

Why Were Skyscrapers Built?

It was the understanding and advancements of building with steel and iron that allowed for skyscrapers to be born. More specifically, it was the Bessemer Process of mass steel bean production that truly made way for skyscrapers. Now that high-quality iron beams could be produced quicker and at a lower cost, all bets were off. Architects and builders could invent and dream of new buildings that didn't seem possible before.

> As skyscrapers became more possible and the first one was actually built. City planners, architects and engineers were fascinated by the ability to fit more people into smaller spaces, to provide more housing – ideally – at a lower price. But the first skyscraper wasn't a residential building at all.

The Very First Skyscraper

The very first skyscraper was built in 1885 in Chicago, Illinois. It was a 10-story home insurance building designed by William LeBaron Jenney. The building was constructed with a "modern" (AKA modern for the 1880s) steel frame that could go taller and have more stability than traditional masonry construction.

A fire had decimated Chicago in 1871 which led to mass construction in the city in general. They were hoping to rebuild the city to set it up for economic growth and revitalization. The Home Insurance Building was to sit in the middle of Chicago's business district. They wanted it to act as a leading example of new construction trends featuring stone, iron, and steel instead of wood and bricks. The building also featured other modern applications such as safe elevators and plumbing.

The Fear of Reaching New Heights

Stretching 138 feet in the air, the project was actually halted by city authorities because they were worried it would fall over. It's hard to believe that today, one of the tallest buildings in the world – the Burj Khalifa – reaches over 2,716 feet into the sky. Authorities conducted a number of safety inspections and tests before allowing the project to continue.

Two more floors were added to the building in 1890. The building was demolished in 1931 to make way for today's LaSalle Bank Building.

The Evolution of the term "Skyscraper"

You may be wondering why a 10-story building was ever referred to as a "skyscraper". In fact, the classification of the term has transitioned since the 1880s. At the time, a skyscraper had to have at least 10 floors. As technology advanced during the 20th century, this classification was too attainable.

The Classification of Modern Skyscrapers

Today, a building must have over 40 floors, be taller than 150 meters (492 feet) and be free-standing without any support or tension wires in order to be called a skyscraper. Another standard for skyscraper-classification is that 50% of the building must be habitable floor space. That's why the CN Tower in Toronto, for example, is called a tower and not a skyscraper.

The Purpose of Skyscrapers

Skyscrapers grew in popularity mainly because of mass migration to urban areas. City centers are appealing to live in because of accessibility, being in close proximity to events, restaurants, shops and having access to transportation hubs. Although they were first used as office spaces in city centers, they have become more and more popular as a housing option as well.

Ideally, the concept of fitting more people into a smaller piece of land and building upwards would have created lower buying or renting prices. It seems that the opposite has happened. Condos have grown to represent a luxury lifestyle, living in the heart of a city and close to all events. Although there is always the possibility of finding cheaper housing, the average cost of condos is still high. In Toronto, an average one-bedroom apartment could cost upwards of $550,000 CAD. In New York, that price jumps closer to $1 million.

Aside from providing housing, skyscrapers help to reduce urban sprawl, add visual creativity to a skyline, and even impact the creativity and invention of those who live or work within the building.

Skyscrapers Today

Skyscrapers have grown into iconic buildings and almost pose a challenge to modern architects. Supertall and mega-tall buildings have become sub-classes of skyscrapers, being classified as greater than 300 and 600 meters in height.

A building in Saudi Arabia, the Jeddah Tower, is set to be the world's tallest skyscraper. It was started in April 2013 and was set to finish in 2020. However, the construction hasn't been progressing as expected. By the end of its completion, the tower should have over 200 floors, reaching over 3,280 feet into the sky. It will cost over $2.2 billion.

In 2015 alone, over 106 buildings were built that were over 200 meters tall. With projects like the Jeddah Tower, it's clear that skyscrapers will only continue to get taller and taller. Who would have thought it all began with a 10 story insurance building in Chicago?

CO_2 Emissions From Commercial Aviation

By Oduor Florence Akoth

CLIMATE change brings about increased global temperatures, rising sea levels, ocean acidification and shrinking ice sheets. Transportation is one of the major contributors to climate change accounting for 23% of total global greenhouse gas (GHG) emissions from fossil fuel combustion. In Kenya, it accounts for 13% of total national emissions and is projected to rise to 17% by 2030. (National Climate Change Action Plan: 2018-2022).

Road transport contributes the largest percentage of GHG emissions as it is the main mode of public transport in urban centres and cities. Commercial aviation however, is growing at a faster rate than other transportation modes and is likely to outpace them in the coming years. The International Civil Aviation Organization (ICAO) projects that aviation emissions will triple by 2050, at which time the aviation sector might account for 25% of the global GHG emissions, if the current trends hold.

The main sources of emissions in Kenya's Aviation industry include; Aircraft, auxiliary power units, ground access vehicles (GAVs) and ground support equipment (GSE). These emissions include but are not limited to; carbon dioxide, nitrogen oxides, sulphur dioxides, carbon (Soot), hydrocarbons and volatile compounds. The table below shows baseline emissions from flights.

Table 1: Kenya aviation sector emissions

Year	Fuel burn (tonnes)	Fuel burn (L)	CO_2 emissions (kg)
2011	673.4	841,750	2,127,944
2012	672.8	841,000	2,126,048
2013	553.5	691,875	1,749,060
2014	531.6	664,500	1,679,856
2015	654.0	817,500	2,066,640
2016	624.0	780,000	1,971,840
2017	653.5	816,875	2,065,060
2018	693.2	866,500	2,190,512
2019	709.6	887,000	2,242,336
2020	396.7	495,875	1,253,572

Source: Kenya National Bureau of Statistics (2021)

Carbon emissions were estimated using the accepted constant of 2.528kg of CO2 emitted from the consumption of one litre of aviation fuel. The graph below shows the growth of aviation emissions based on the fuel consumption from 2011 to 2020.

Aviation industry was negatively impacted by Covid-19 pandemic resulting to the sharp decline of fuel sales by 44% in 2020 compared to 2019. There is however a general upward trend throughout the years.

Domestic and international air traffic is forecasted to grow at an average annual rate of 7.5% from 2024 until 2035. (Action Plan for Co2 Emissions Reduction in the Aviation Sector 2022-2028) Passenger traffic is expected to grow from 6.7 million in 2021 to 12.0 million in 2024 with a constant growth of 5% which is above the Africa average growth rate of 4.4%. Freight traffic is also projected to grow from 377,504 tonnes in 2021 to 476,526 tonnes in 2024 with an average growth rate of 8% above the global average of 3.5% per annum. This has prompted the rapid growth of aircraft fleet and further development to meet current demand and future capacity needs. These directly result into an increase in emissions from airport related activities. Managing this growth in order to curb its contribution to this growing global crisis is what remains a question of interest.

The Kenyan aviation industry has developed an action plan to reduce greenhouse gas emissions from aviation. The plan seeks to abate its GHG emissions by 32% by 2030 in line with its sustainable development agenda. To realize this potential, the aviation sector ought to use cleaner alternative sources of power generation and employ fuel efficiency initiatives. Constant monitoring and evaluation should also be done to ensure realization of the set targets.

50 YEARS OF IEK
The Engineering Journey in Kenya

A Speech By Eng. Prof. Francis John Gichaga at the University of Nairobi

IEK Honorary Sec Eng. Shammah Kiteme together with Eminent Engineers Prof. Francis Gichaga (Second Left), Eng. Francis Ngokonyo (Second Right) and Eng. Dr. Martin Nzomo.

I was very pleased when the Honorary Secretary of the IEK invited me to be a keynote speaker during the IEK AT 50 Public Lecture.

I am saying this because I attended the meeting held in 1972 at the Intercontinental Hotel in Nairobi when it was agreed that we register the Institution of Engineers of Kenya. I also like telling people how, when we were admitted to do engineering degree course at the University College Nairobi (a constituent College of the University of East Africa), our Lecturers persuaded us to join British engineering institutions as student members and accordingly I joined the Institution of Civil Engineers in the UK as a student member.

It is important to acknowledge that engineering involves the art of harnessing the resources of nature for the benefit of society. For example, the engineer is trained to develop infrastructure to make it possible for people to enjoy wholesome water and hydropower; again the engineer is capable of converting sunlight into solar energy for use by society; and the engineer can use rocks, sands and soils to build houses, roads, airports etc. for use by the society. It is to be noted that the South East Asian countries were able to achieve rapid economic growth due to the emphasis they directed towards the provision of basic infrastructure such as roads, water supply, sanitation, irrigation, energy, telecommunications, schools and health care. They also emphasized the development of small and medium enterprises that facilitated the supply of goods and services.

It is also to be noted that for us to improve the standard of living of Kenyans and in order to achieve Vision 2030, there is need to train those engineers who are able to implement the plans which are geared towards the goals of the Vision 2030.

We must invest in both the development of strategic industries and also in the development of the required human resource that is adequately trained to manage the type of technology that is relevant to the knowledge economy. In this respect universities must rise to the occasion by offering well-structured degree programmes which are relevant to the demand of the industry now and into the future.

The plan by the Kenya Government to establish an institute in Nairobi for teaching technical and commercial courses started in 1947. The Gandhi Memorial Academy Society agreed to merge interests with those of the Government and was accordingly incorporated into the Royal Technical College which opened its doors for the first intake in April 1956 offering technical and commercial certificate courses.

In the 1960/1961 academic year the college was renamed the Royal College Nairobi on 25th June 1961 and was allowed to offer engineering degree courses of the University of London.

In the 1963/1964 academic year, following the Kenya's attainment of independence, the Royal College Nairobi changed its name on 20th May 1964 to University College, Nairobi as a constituent college of the University of East Africa. The other constituent colleges were Makerere University College and University College Dar Es Salaam.

At that time in East Africa engineering degree programmes were only available at the University College, Nairobi, Law degree programmes were only available at the University College Dar Es Salaam and those who wished to do Medicine could only do so at Makerere University College. On 1st July 1970 the University of East Africa was dissolved and each of the former constituent colleges became the national universities in their respective nations.

In the case of the Republic of Kenya the University of Nairobi was set up by an Act of Parliament while Tanzania set up the University of Dar Es Salaam and Uganda set up Makerere University. With establishment of national Universities in Uganda and Tanzania both universities established their own faculties of engineering in the 1970's.

1972 – 2022

THIS YEAR, IEK CELEBRATES

The East African Association of Engineers (EAAE), which was the precursor to the Institution of Engineers of the Kenya (IEK), was formed in 1945 as a professional and learned body, independent of control by governments and with membership spread in the original East Africa i.e. Kenya, Uganda, and Tanzania (Tanganyika and Zanzibar). The break up of the East African Community in the early 1970's resulted in the splitting of most of the professional/learned bodies, among them the EAAE. IEK was born out of this split. IEK was registered as a professional/learned and independent body in 1972.

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ABOUT US

Kenya Urban Roads Authority (KURA) is a state Corporation established under the Kenya Roads Act 2007 to manage, develop, rehabilitate and maintain all national urban road networks.

1 OUR VISION

A world class urban road network for sustainable development

2 OUR MISSION

To provide and manage quality, safe and adequate urban road network

3 OUR VALUES

- Professionalism
- Excellence
- Equity
- Integrity
- Commitment

KEY MILESTONES

- Development of designs for over 1,100Km of National Urban Roads.
- Construction of over 102 bridges to improve access and mobility.
- Upgraded and rehabilitated over 104Km of the urban road network.
- Construction of over 2,000km of urban roads.
- Mainstreaming of Social Safeguards and Environmental Stewardship in project implementation, climate proofing of urban roads development and maintenance.

KEY ACHIEVEMENTS

- Dualling of Nairobi Eastern Bypass road from Baraka roundabout upto Ruiru, Kiambu junction.
- Construction of access roads to Mai Mahiu and Suswa SGR station.
- Upgrading to Bitumen standards of Isiolo town roads
- Construction of 408km informal settlements roads in Nairobi
- Upgrading to Bitumen standards of Mandera town roads
- Dualling of Ngong Road (Dagoretti Center-Karen Roundabout Section)
- Construction of Tarbaj town roads in Wajir county

CSR PROJECTS

- **New classrooms at Lake Baringo Secondary School, Baringo County**
- **Ablution facility for Kiiri Secondary School, Murang'a County**
- **Ablution facility for St. Basil Lurambi Primary School, Kakamega County**
- **Construction of a classroom at Karoli Girls High School in Kirinyaga County**

Key Upcoming Projects

- **Dualling of Limuru Road and UN Avenue**
- **Dualling of Karen, Ngong Road**
- **Construction of Traffic Management Centre**
- **Bus BRT lanes (Outer Ring Road)**
- **Installation of ITS in Nairobi**

Sustainable Engineering in the era of climate change

NAS INTERNATIONAL GROUP

Eng. Nicholas AIRO is the *CEO and Founder, Nas International Holdings Limited.*

He holds a BSc. Degree in Civil Engineering from the University of Nairobi and proffessional course on smart mobility and artificial intelligence at Massachusetts Institute of Technology (MIT) –and traffic signal operations at James Clark School of Engineering – University of Maryland.

The Main Component of ITS (Intelligent Transport Systems)

Rapid changes in technology and the emergence of the information age are having profound impacts on society. Choices related to when, where and why we travel are affected by technology and are, in some respects, greater than ever before. Yet, we rely heavily on the surface transportation system and take for granted that it will enable us to travel wherever we need to go, whenever we choose to go, and in a timely and predictable manner. Use of the surface transportation system is greater than ever, and growth in travel and changes in travel patterns point to the need to improve management and operations of the existing system. The application of technologies in the transportation sector offers the potential to substantially improve operations and management, which is the foremost challenge to transportation planners and systems operators today. Intelligent Transportation Systems (ITS) include the application of computer, electronics, and communications technologies and management strategies -- in an integrated manner -- providing traveler information to increase the safety and efficiency of the surface transportation system. ITS also provides useful, real-time information to system operators.

Intelligent Transportation Systems Applications covers many aspect of mobility paramaeters and this includes Multi-modal Regional Traveler Information that provide real time travel information to the public, allowing them to predict trip times accurately and make route and mode choices this can be extended to include FMOD (Flexible mobility on Demand) and demand responsive sytems like Uber, bolts etc. En-route traveler information such as kiosks at transit stops with real time information on bus schedules and arrival times as for the case of BRT. We also have incident Management that is deployed with CCTV servailance with video systems and loops detectors that identify slowdowns and allows traffic managers to view the couse if slowdown in traffic and divert traffic through VMS (Variable Message signs) from congestions caused by any incident. An emergency response can also be dispatched based on the incident reported. All call locations through 999 calls appear in digital maps and it is easy for emergency personel to locate the calls.

The Main componet of ITS functions is the Traffic signal controls. This consist of traffic lights technology that is functions either a s fixed time, Vehicle actuated (VA) or adaptive signal technology. Signal control can repsond to events , security ,emergency priority , VIP access and allows for free traffic flows . Fare collection systems, Bus management systems for BRT and Bus information management systems and the expresways toll colletion systems forms compoents of ITS.

ITS infrastructure investment will generate an overall benefit-cost ratio of 5.7 to 1 with even stronger returns to the top 75 most congested metropolitan areas (8.8 to 1)." Safety benefits of ITS investments are equally as important as those derived from congestion reduction. It is Important to note that once all is said and done in implementing all the comonents listed, the govonment agency needs to intergrate all the ITS parameters into one plartform and this will only be easy when we allow data sharing across the agencies.

The National ITS Architecture is a framework for the application of keyelements of ITS functions and data that must be exchanged between ITS subsystems. The National ITS Architecture is a resource for planners, builders, designers and operators of highway and transit systems to use in extending and integrating their ITS operations. It supports a wide range of functions and services and can be tailored to address local and regional transportation goals.

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Best Practices for Energy-Efficient Machines Through Oil Management

By Gary Shaw

> Oil is the life blood of your machine - Keep it clean, enhance component life.

OILS are a vital part of almost all factories and equipment that make use of hydraulic, diesel or lubrication systems in one way or another. The current worldwide situation for the petroleum industry is dramatically changing and companies are looking at oil expenditure and finally listening to people that have been preaching proper oil management for years.

This poses an opportunity for companies to adapt quickly to a new maintenance formula so as not only to save themselves a lot of money on oil but also benefit from other aspects like reduced downtime, equipment reliability and unscheduled stoppages.

So, what should you look at to gain some of this much needed cost savings?

The Quickest and Biggest Direct Cost Saving is Easy to Implement - Oil Changes

Changing your oil "*Once a year*" because the manual says so or "*We have always done that*" is wrong on two levels. Firstly, you could be changing oil that is perfectly good for another year or two, and secondly, if your system has been exposed to extreme conditions like heat or bad contamination it could mean that you should have changed the oil before your annual change over.

Oil should only be changed under the following conditions that additives in the oil have broken down beyond recovery. This affects the properties of the oil itself and accelerates wear and damage to components, bearings and sealing. Oil that has been exposed to excessive heat should be changed. Once oil passes its maximum operating temperature it breaks down the additive package and reduces the oil viscosity accelerating wear. Oil types that have been mixed should also be changed. Different types or different viscosity oils being mixed can also cause reactions and adversely affect the oil. Oil must also be changed if it has suffered Excessive Water contamination. Water can be removed but if the volume is too great and the system runs too long with this water, it damages the oil.

Particle Contamination Damages the System Components and Accelerates Wear

Any foreign items and particles in the oil are considered contamination and affect the system components as well as the oil itself. It's a well-documented fact that up to **80%** of hydraulic system breakdowns can be directly accredited to contamination. Particles smaller than the eye can get in between tight tolerance clearances causing scouring, jamming or generating more wear to the existing contamination.

Liquid Contamination Degrades the Oil additives

Liquid contamination of which water is the most common directly affects the oil additives and breaks down the oil composition over time. The other side effects of water in the system are cavitation and "Diesel Effect" in components like pumps and cylinders as well as the obvious potential of oxidation (corrosion) to the internals of components in systems.

Oil Temperature Reduces Oil Lifespan

Once an oil has passed its maximum temperature its additive package is broken down affecting the required properties of the oil like lubrication, shear strength and ability to create sealing. The oil Viscosity dramatically reduces and the acidity of the oil increases with obvious side effects.

New Oil Does not Necessarily Meet Cleanliness Requirements of the System

Most modern engineering systems make use of high-performance pumps, valves and actuators which have been developed over many years. New technology requires higher pressures and flows to meet consumer demands. These components have tighter tolerances and as such require cleaner oil to meet their expected life. As such cleanliness levels of oil required today are most often higher than the standards supplied by the oil manufacturers.

With reference to the above points consider the following to mitigate these issues and manage your oil to see some cost savings:

Oil Changes

Implement Oil sampling, either through a partner laboratory or invest in your own equipment to analyze your oils. Measuring things like particle count (ISO Cleanliness), Water Content, Viscosity, Wear particles, spectrometer analysis and TAN Test (Total Acid Number) will give you an indication of the quality of your oil and if it is breaking down or simply just needs cleaning. Tracking and trending these results will warn you of pending issues. Dirty Oil should be cleaned. Oil with water contamination should have the water removed. Only change your oil if it cannot be recovered to within

the manufacturer's tolerances with respect to the above tests.

Monitor Particle Contamination

Regular checking (and recording) of your oil using a particle counter will quickly give you an early waring that something is going wrong in your system and allow you time to schedule a shutdown to address the problem or changeout a failing component before it destroys itself. Permanently installed units with switching points or a portable unit should be considered for this.

If the system is prone to dirt consider an offline "Kidney" filtration unit that will continuously clean your oil from dirt and water without affecting your normal system operation.

Monitor Liquid Contamination

As above monitoring the water content gives you early warning that something is wrong and thus save your oil and components. The particle counters mentioned above often have water sensors in them too or an AquaSensor can be considered for permanent installation.

Installing an offline "Kidney" filtration system can continuously remove water entering the system.

Monitor Oil Temperature

Oil temperature sensors with switching points will warn you in advance before the oil reaches excessive temperatures and save your oil. Temperature tracing will indicate early system or component failure preventing a breakdown before component failure.

New Oil

Investing in an oil transfer unit or offline "kidney" filtration system will ensure new oil is filtered before entering the reservoir. Water contamination of incorrectly stored containers can also be removed before getting to the system. Cleaning oil below 3 micron (µm) is possible.

Gary Shaw is Technical Director at Power Twins Ltd

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IEK Engineers pose for a group photo after Isuzu East Africa industrial visit. The delegation was led by CEO Eng. Linda Otieno.

IEK Industrial Visits Improving Technical Capacity within Membership

By Maureen Mwangi

INDUSTRIAL visits highlight significant roles engineers are playing in expanding industrialization space in Kenya.

Isuzu East Africa, Associated Battery Manufacturers East Africa Limited (Chloride Exide), Schneider Electric, Sika. These are some of the engineering stakeholders that Engineers of the Institution of Engineers of Kenya have visited lately, in a bid to strengthen industrial experiences.

The Institution of Engineers (IEK) conducted an industrial visit to Sika Factory, a company that produces Adhesives, Sealants and Sound Damping solutions in the building sector.

> The delegation was led by IEK's 1st Vice President, Eng. Grace Kagondu. The visit attracted more than 15 Engineers from across engineering disciplines. The tours are tailored by IEK to enable Engineers have a better understanding of industrial operations and the production environment.

Sika's factory team demonstrated for engineers in attendance theoretical skills as well as practical techniques and its various products used for roofing, waterproofing and flooring.

Speaking to Engineers, Milutin Milosevic, the General Manager Sika Kenya, said the company offers technical support to all clients including Engineers to ensure they acquire proper knowledge on the application of their products.

He added that Sika strives to provide value-added products and systems to the construction industry in Kenya and many other countries around the world so as to benefit the industrial and household consumer market through a robust distribution network.

"This industrial visit is crucial for shared understanding in the upgrading of sites, preventing future calamities and continued provision of value-added products and systems to the construction industry," says Mr. Milutin Milosevic. "Training and mentorship are important pillars at Sika. The company has designed local programs to empower its employees through Sika Academies and the SikaLearn digital platform," he says.

The four Sika Academies include; Contractors Academy, Concrete Academy, Industry Academy and Procurement Academy. The company says its academies enable the transfer of knowledge on technical information from practical to theoretical information.

ABOUT US

Kenya Rural Roads Authority is a state Corporation established under the Kenya Roads Act 2007 to manage, develop rehabilitate and maintain Rural Roads as defined in Kenya Gazette Legislative Supplement No.4 (Special Edition) of 22nd January, 2016.

VISION

Easy Access to Resources and Services

MISSION

To Develop, Manage and Maintain the National Secondary Trunk Road Network

CORE VALUES

- Good Governance
- Professionalism
- Innovation
- Integrity
- Equity
- Team Work
- Collaboration

VARIOUS PROJECTS IN THE COUNTRY

Moi South Lake Road

Ongoing Baricho Bridge

Oinamoi-Barwesa

KEY ACHIEVEMENTS

The Authority has continued to connect devolve Kenya by achieving a robust network of new roads through the following programmes:

1. Low Volume Seal Roads (LVSR) Roads 10,000Programme
2. Roads constructed through Conventional Approach
3. Construction of Roads under the contractor facilitated road development mechanism referred to as AnnuityProgramme/PPP
4. Roads 2000 Programme
5. Roads Reconstructed and Rehabilitated
6. Periodic Maintenance

Details of the achievements in each of the above is tabulated below:

Deliverable Title	Project Description	Status		
		Total Scope (Km)	Completed (Km)	Outstanding(Km)
Roads 10,000 Programme: Low Volume Seal Roads (LVSR)	Upgrading to bitumen standards	8608.26	4722.10	3886.16
Conventional Approach	New roads constructed	1288	900.74	387.26
Annuity Programme/PPP	New roads constructed	90.73	90.73	**0**
Roads 2000 (LVSR)	New roads constructed	261.65	226.65	35
Total Construction to bitumen standard		**10,248.68**	**5940.22**	**4308.42**
Roads Reconstructed and Rehabilitated	Roads Reconstructed and Rehabilitated	630.5	188.5	442
Periodic Maintenance	Periodic Maintenance	131.7	103	28.7

CORPORATE SOCIAL RESPONSIBILITY

- Donated 20 beds to Kenyatta National Hospital("Donate a Bed")
- Nyeri Hospice for terminally ill Patients
- Don Bosco Rescue Team
- Mater Heart Run

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REPUBLIC OF KENYA

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ABOUT US

Athi Water Works Development Agency is one of the nine (9) Water Works Development Agencies established under the Ministry of Water, Sanitation and Irrigation.

CURRENT WATER STATUS FOR NAIROBI CITY

Water Demand for Nairobi City
810 Million litres/day

Current water supply to Nairobi City
546 Million litres/day

Water Deficit for Nairobi City
264 Million litres/day

IMPLEMENTATION OF FLAGSHIP PROJECTS

The 4th Nairobi Bulk Water Supply

1. The Northern Collector Tunnel Phase 1

Construction of a (12km) raw water transfer tunnel along the Eastern fringes of the Aberdare Conservation Area (ACA) to divert flood flows from Maragua, Gikigie and Irati Rivers to supply an additional 140,000m3/day to Thika dam.

2. Kigoro Water Treatment Plant

140,000 m3/day ultra modern water treatment plant

3. Raw and Treated Water Transmission Pipelines

Laying of 5.4 km of DN1200mm raw water pipeline from Ndakaini Dam to Kigoro Water Treatment Works; 12.6 km of DN1200mm treated water pipeline between Kigoro Water Treatment Works and Ngethu Water Works; 36 km DN1200mm, pipeline between Ng'ethu Water Works, Kiambu and Gigiri Reservoirs.

Laying of water pipeline at Kasarani

4. Nairobi City Water Distribution Modification Project

- *Kiambu - Embakasi Water Transmission Pipeline*
- *Kabete - Karen - Uthiru Water Transmission Pipeline*
- *14,000 m3 Water Reservoir in Embakasi*

Karimenu II Dam Water Supply

Water Intake Tower

Water Treatment Plant

Construction of a 59 metre high dam with a storage capacity of 26.5 Million m3. The daily production is 70,000m3 per day of treated water which will be distributed to Nairobi, Ruiru, Juja and Gatundu benefiting more than 800,000 people.

SEWERAGE INTERVENTIONS

Nairobi Rivers Sewerage Improvement Project Phase 1 & 2

Dandora Ruai Waste Water Treatment Plant

Kariobangi Waste Water Treatment Plant

To increase sewerage coverage from the current 48% to 55% benefitting more than 400,000 residents

Construction of 242km secondary reticulation sewers including last mile connectivity support within Nairobi areas

The Nairobi Water and Sanitation Project

- *220km Expansion of Sanitation Network & 12,500 household connections*
- *Improving access to Water & Sanitation for Informal settlements*
- *Building the operator's capacity*

Accelelerating Access to Water and Sanitation

African Journal of Engineering Research and Innovation

AJERI

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The Leading Journal of Engineering Research and Innovation in Africa

Student Voices

EXPAND AEROSPACE AND AVIATION OPPORTUNITIES TO GROW ECONOMY

Aerospace and aviation remains one of the most vital sectors of engineering in Kenya today. A number of initiatives are ongoing to expand aviation opportunities and their contribution to the larger economy. As more colleges and universities in Kenya continue to train aviation engineers and research expands in the fields of aircraft, missile, spacecraft, drones and military aviation studies, demand for these engineers will increase rapidly.

There is need for more research to be done to reduce flight costs and emissions through electric and hybrid engines, introduction of autonomous flight systems for the future as well as new aviation technology which will rely on simulated data and additive Manufacturing that consolidates and incorporates light weights aerospace parts. With the growing complexity in the aerospace industry, there arises need for some multi-physics simulation solutions by the aviation and aerospace industry in Kenya.

Alex Katuso Kilwaya is a Bachelor of Science Aerospace Engineering student at Kenyatta University.

HOW CIVIL AVIATION STUDENT'S UNION THRIVES AT MOI UNIVERSITY

At Moi University, aviation students have an association by the name Civil Aviation Student's Association (CASA). It is one of the most active clubs in Moi University. It offers learning opportunities to students through debates, discussions, field trips, airport visits and as well a relaxing moments through fun activities. The association also accommodates and supports talent through sporting activities, such as, CASA Football Club, which has a membership of 33 students. They engage and interact not only in class but also in the field. The and badminton team has drawn lots of attention to our female fellow colleagues. In this organization, I found great interest in expounding my leadership skills, holding a position in the secretariat.

Aviation is indeed one of the most interesting and prestigious courses. It accords a student opportunity to explore the world and have a different taste of life in the skies. Since the beginning of my course, I have discovered my new hobby as reading aviation autogaphs. I find it interesting creating imaginary images of how interesting the world looks. To potential aviation students, I would like to encourage you that that it's an area driven by skill, interest and talent. It is a very small industry but with one of the most viable opportunities and open doors for the African child.

Moses Gitonga is a third year Bachelor of Civil Aviation Management, student at Moi University.

HIGHLIGHTS OF THE 2022 JKUAT SES TECH WEEK

The 2022 J.K.U.A.T SES tech-week was a spectacular event that brought all the engineering fields together. It started with an official opening from the Principal College of Engineering and Technology Dr. Eng. Hiram Muriithi Ndiritu, who doubles up as the society's patron, and from there the fun begun. We got into different streams from Structural, GIS, Electrical to Software engineering. Everybody fit into a place they felt at home.

The speakers on the first day were Dr Bright Gameli, Antony Kiplimo, Eng Ezekiel Fukwo, Eng Bentley Nango, Daphin Juma, Joyce Siundu, Eng. B.K Kariuki. All had vast knowledge to impart on us from lessons after graduation to how engineers should be leaders. We were also graced by high school students who had sacrificed their time to come and hear about this giant career called engineering. Starehe Boys center and Lenana school were also divided into the different streams of engineering with one assignment: To make sure that by the time they go back to school they have heard about all the different engineering fields. They absolutely enjoyed the day!

The second day the whole IEK team was represented by Eng. Grace Muthoni Kagondu, Eng Lilian Kilatya, and other officials. Calvin Mwadime, Gerald Colyvas, Eng Elijah Osuga and Eng. B.K Kariuki also graced the day with insights on how engineering bodies work and information on the Future Leaders, which we are part of.

We also had a line following robot challenge and a school park renovation challenge on the second day. The participants were critiqued by the engineers and guided on how to do project presentations and were also rewarded handsomely.

We thank everyone who attended the event and made it as colorful as it was. To all the sponsors who agreed to be part of this Annual event, we sincerely appreciate. We also expect to have a bigger and better week next year!

Ian Bunyasi is Secretary General, JKUAT Society of Engineering Students (SES).

MY VISION FOR MUKESA

I recently took office as Chairperson of Multimedia University of Kenya Engineering Students Association (MUKESA). The Association provides a platform for the development of engineering students, ensuring that the members are ready for the job market. As the current Chairperson MUKESA, I have a vision to steer the club forward and realize it's goals. Engineering forms a strong foundation of a country's economic growth. Academic institutions play a fundamental role in the growth of an Engineer. We engineering students need to equip ourselves with both practical and theoretical skills to become productive in the industry.

I will prioritize collaboration with industrial partners, professional bodies and other Engineering Students Associations, organizing technical trainings for members, industrial visits, sport activities, mentorship programs and CSR projects. In the recent past, MUKESA has been characterized by activities like the Annual Engineering Dinner, where students interact with professional engineers from various industries. This has helped change students' perception about the profession. I look forward to organizing more activities that will bridge the gap between the students and the industry.

Industrial visits, being the main avenue of creating a closer practical enrichment to the students, is a priority during my tenure. This will help improve innovation and creativity of students as they will practically interact with different machines, and projects from various engineering fields. The IEK Future Leaders Committee has been of great impact to the engineering students and I look forward to their continuous support. I anticipate championing for students' creativity through project exhibitions and competitions to ensure that the students become problem solvers in the society.

Stephen Odhiambo is the current Chairperson of the Multimedia University of Kenya Engineering Students Association (MUKESA).

UNMANNED AERIAL VEHICLES (UAVS) IN KENYA

Aerospace engineering involves the study, design, development and techniques of operation of machines and spacecraft capable of flight. Aerospace engineering is divided into Aeronautical engineering and Space engineering. Aeronautical engineering mainly studies aircraft within the earth's atmosphere such as helicopters, airplanes, and the upcoming Unmanned Aerial Vehicles (UAVs) while Space engineering entails the study of machines outside the earth's atmosphere such as rockets, missiles, and satellites.

Innovations are still being witnessed in aerospace and aviation engineering with the latest one being Unmanned Aerial Vehicles (UAVs). In Kenya, the Kenya Civil Aviation Authority (KCAA) has already set aside laws to govern the operations of UAVs in the country. The UAVs commonly referred to as drones are being used in various fields ranging from entertainment to health and even agriculture. The drones are cost-efficient, have more flexible design and manufacturing techniques, and rarely pollute the environment. University students in Kenya are also taking part in projects geared toward the development of aerospace and aviation engineering. For example, aerospace engineering students at Kenyatta University have two projects underway, The Sounding Rocket Project and the Drone Project. In the past, students from various universities were able to develop different nanosatellites which were presented to the Kenya Space Agency (KSA). The nanosatellites assisted in the monitoring of illegal fishing in Lake Victoria (Technical University of Kenya). However, aerospace and aviation engineering in Kenya still has a long way to go to unleash its full potential. In Kenya, Engineers in in this field are up to the task and together, we shall soar high. The sky is never the limit!

Stacey Ogombe Minabo and Rachael Jelagat are Aerospace Engineering Students at Kenyatta University. Their contact is rachaeljelagat47@gmail.com

QUALITY ASSURANCE IN AEROSPACE INDUSTRY

Aerospace is one of the most heavily-regulated industries in the world. Since lives depend on the function of complex machines, this is probably to be expected. The standard most aerospace companies must shoot for is AS9100 which is the primary global standard for aerospace quality management. It's an adaptation of ISO 9001, a quality management system (QMS) developed by the International Organization for Standardization (ISO). In aerospace, FEA software quality assurance professionals ensure the design software programs meets all the company's quality standards and meets the client's expectations and demands.

Aerospace engineering draws heavily upon physics and mathematics; even tiny miscalculations can be fatal when working with aircraft and spacecraft. Aeronautical engineers work on aircraft; that is, they design and test vehicles that fly within the earth's atmosphere. Drones, helicopters, commercial aircraft, fighter jets, and cruise missiles all fall within the purview of an aeronautical engineer. Astronautical engineers deal with the design, development, and testing of vehicles that leave the earth's atmosphere. This includes a wide range of military and private-sector applications such as rockets, missiles, space vehicles, planetary probes, and satellites.

What cannot be overlooked is the tremendous amount of effort and dedication of those working with aerospace companies such as Boeing, Boom Supersonic, Ball Aerospace, Relativity Space, Aurora Flight Services, SpaceX among others to advance innovation. These companies each possess unique capabilities crucial for ensuring spacecrafts and satellites are safe, reliable and efficient.

Jackson Kioko is an MSc. Structural Engineering student at the University of Budapest, Hungary.

Climate Change, Aviation and Sustainability

By Sifa Kinoti

PLAYERS in the engineering space urgently need to reconsider our actions in light of the severe effects of climate change. According to ***Our World in Data***, about 2% of the world's greenhouse gas emissions are attributable to aviation. Although 2% might seem insignificant, it equates to around 950 million metric tons of emissions annually. Consider the year 2019 (pre-pandemic), when there were 4.5 billion passengers flying. Per person, this might result in 211 kilos of emissions. We definitely have a lot of work to do in this area to comply with the global agreement to reduce emissions to net zero.

The first step towards mitigation is perhaps to consider deploying hydrogen-fueled planes. The first hydrogen-powered aircraft, a single-seater that Boeing flew in 2008 from an airport close to Madrid, Spain, demonstrated the viability of the technology. Initial experiments indicate hydrogen-powered aircraft can fly almost as quickly as conventional aircraft, carrying more than 100 passengers per flight over thousands of kilometres while emitting just water. Together with CFM International, which is creating the hydrogen combustion engine, the aircraft manufacturer Airbus is creating the first zero-emission commercial aircraft, which is expected to hit the market by 2035. Infrastructure will be needed to manufacture, transport, and store hydrogen for use in hydrogen-powered aircraft. Currently, most hydrogen produced is made from methane, a process that releases carbon dioxide as a waste product. The solution being explored is to produce green hydrogen from water using electrolysis driven by renewable energy. While this technology is promising, the process is expensive, making acquiring hydrogen fuel more expensive than jet fuel, therefore derailing the efforts towards green hydrogen flight.

Secondly is the use of biofuels. Using biofuels that are generated sustainably would reduce CO_2 emissions throughout their whole lifecycle. While growing crops, transporting raw materials, refining fuel, and other processes necessary to make biofuels, emissions are produced. When all of these factors are taken into consideration, it is still expected that biofuels would result in an 80% reduction in overall CO_2 emissions when compared to fossil fuels. Parts of the world with significant amounts of marginal or unusable land for food crops but suited for growing second-generation biofuel crops can also gain economically from the use of biofuels. Biofuel is more expensive than jet fuel, though, thus limiting its wide use.

Thirdly, the industry must consider adoption of solar powered aircrafts. This implies that solar panels will be incorporated into plane designs. A solar-powered aircraft made its inaugural flight in California in 1974. Fast forward, a plane created by Solar Impulse travelled around the globe in 2015 and 2016, shattering 19 world records, including the record for the longest solo flight in an aircraft. The inability of solar-powered aircraft to fly in certain weather situations, particularly on lengthy trips where recharging would be required, is one of the difficulties with this endeavour. Additionally, the tools and technologies needed to capture and use solar energy are very expensive.

Incorporating electric aircraft comes in fourth. The first entirely electric passenger aircraft, Eviation Alice, made its maiden flight in September 2022. For the test flight, the plane departed from a runway in Washington, rose to a height of 3,500 feet, and then returned to the ground. The eight-minute flight proved that the aircraft and its battery-powered engine are capable of carrying out their intended functions. The poor energy density of batteries is the main obstacle to the development of electric aircraft, according to Aviation Week. While commercially available lithium-ion batteries have an energy density at the cell level of about 250 Wh/kg, jet fuel has an energy density of roughly 12,000 Wh/kg. Research is ongoing to develop commercially viable small, short-range aircraft using available batteries.

Lastly, improving fuel efficiency also ensures sustainability. For instance, NASA and Boeing are developing a revolutionary wing design that might reduce fuel consumption for aircraft by 50% compared to the existing model. Airlines can also choose other routes with fewer stops, as less time spent in the air means less gasoline will be utilised. It is significant to note that aeroplane design has advanced over the years, decreasing fuel consumption.

With ongoing research and investment, I am hopeful of a net zero aviation industry.

Sifa Kinoti is an Environmental and Biosystems Engineering Student and also Finance Secretary, The University of Nairobi Engineering Students' Association (ESA).

Dispatch from Victoria Falls: A Letter from Zimbabwe Engineers Biennial Conference

By Ivy Mwango Getanda

THE 2022 Africa Asia Pacific Accord & WFEO-CECB International Capacity Building in Engineering Education Forum and the Zimbabwe Institution of Engineers Biennial conference was held from 15th -19th August 2022 at Elephant Hills Resort, Victoria Falls. I was honored to attend this event physically courtesy of full sponsorship from the Institution of Engineers of Kenya (IEK).

I presented a research paper at the conference entitled: Optimization of Career Bootcamps as a capacity Building Effort for Engineering Students and Graduate Engineers. This presentation focused on career boot camps being objective oriented to enhance and intensify requisite skills for young engineers in the industry.

There's need for career boot camps to be implemented in all engineering disciplines and not just the tech related fields, this will aid in enhancing competent young Engineers with quality skills required to transform and improve Engineering in this constantly evolving world.

The conference had an ongoing parallel Robotics Bootcamp for Highschool and primary school students, I was privileged to attend this and happy to see the youngsters develop working machines and programmes from scratch to big projects, that was really impressive!

Kenya needs courageous, audacious, competent and revolutionary engineers to brainstorm, transform and reform the deformed platforms in engineering and finally conform to the re-formed information uniformly.

The conference was graced by seven Kenyan delegates: Eng. Erastus Mwongera- Chair EBK, Eng. Margaret Ogai- Registar EBK, Eng. Nathaniel Matalanga- IPP of IEK, Eng. Grace Onyango- Director, Capacity Building and Accreditation EBK, Eng. Abich- EBK, Catherine W. Macharia- EBK and Ivy Getanda- Student member of IEK. Key takeaways from the conference presentations including need for graduate engineers to be skillfully trained to attain substantial equivalence on the global platform, Education 5.0 - the doctrine that promotes Engineers who think and do - The Education of Doing things. Education 5.0 pillars include: Programmes, Human capital, Digital and Physical Infrastructure, Legal Infrastructure and Financial Infrastructure.

Kenya Delegates led by EBK Chairman Eng. Erastus Mwongera, EBK Registrar Eng. Margaret Ogai and Immidiate Past President of IEK Eng. Nathaniel Matalanga at the Conference.The author (inset) makes a presentation at the conference.

The conference was also graced by Engr. Mustafa B. Shehu- President elect of the World Federation of Engineers (WFEO) and Ing. (Mrs.) Carlien Bou- Chedid -President of the Federation of African Engineering Organisations (FAEO). Delegates from Malaysia, Ghana, South Africa, Nigeria and other African countries were also well represented.

I will fondly remember the courtesy of the Zimbabweans, their kindness, intelligence, humility, great organizational skills and willingness to share information without grudge. Thank you IEK for this golden opportunity to network, grow, learn and share my knowledge to the world, the support is greatly appreciated.

I encourage Graduate Engineers and Engineering students to be actively involved in making this world a better place. Regular participation in IEK or any Engineering activities is important, Engineering students should register as members of IEK. Education is not just a certificate, it's a proof of what you can do.

Grow your skills - both technical and soft skills - and get a mentor to guide you in the Engineering Industry. Grateful to all my mentors from family, IEK, EBK, JKUAT and State Department for Housing and Urban Development for holding my hand this far.

Ivy Getanda is a student member of IEK 5th year Civil Engineering Student- JKUAT.

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 502nd 503rd and 504th council accepted the following members under various membership categories as shown below;

Membership Class	Number Accepted - 502nd Council	Number Accepted - 503rd Council	Number Accepted - 504th Council
Fellow	1	-	-
Corporate	14	7	11
Graduate	77	76	134
Graduate Engineering Technologist	4	-	7
Graduate Engineeringechnician	8	4	2
Student	17	2	6
TOTAL	**121**	**89**	**160**

During the period we had members who transferred from the class of Corporate to Fellow member and 32 who transferred from Graduate to Corporate member. In addition we had 287 graduates, 11 graduate engineering technologists, 14 graduate engineering technicians and 25 students were accepted as members

Gender Data

Class	Male	Female	Percentage (Male)	Percentage (Female)
Fellow	1	-	100%	-
Corporate	31	1	96.8%	3.2%
Graduate	253	34	88.2%	11.8%
Graduate Engineering Technologist	10	1	90.9%	9.1%
Graduate Engineeringechnician	13	1	92.8%	7.2%
Student	23	2	92%	8%
TOTAL	**331**	**39**	**80.9%**	**19.1%**

Summary

Gender	No	Percentage
Male	331	89.5%
Female	39	10.5%
	370	**100%**

502ND APPROVAL

FELLOW

S/NO	NAME	MEMBER NUMBER
1	David Patrick Mwaniki	F.3274

CORPORATE

S/NO	NAME	MEMBER NUMBER
1	Bramuel Muliro Wanyonyi	M.7225
2	Chemeril Chepyegon	M.3272
3	Edwin Ochieng Awiti	M.5960
4	Felix Gitonga Nthiga Mutuura	M.3295
5	Franklin Muchiri Gitari	M.7522
6	Ibrahim Njau Juma	M.6339
7	James Mwangi Kariuki	M.9070
8	John Onyiego Mogaka	M.6547
9	Joseph Kimani Wandue	M.8152
10	Kennedy Macharia Karimi	M.8814
11	Njaramba Mureithi	M.7148
12	Spencer Odiwuor Oluoch	M.7862
13	Wilson Wamahiu Munene	M.3358
14	Hillary Thyaka Muli	M.8628

503RD APPROVAL

CORPORATE

S/NO	NAME	MEMBER NUMBER
1.	Brian Kibet Mabatuk	M.7928
2.	George Onyango Ohore	M.9218
3.	Jeremiah Anyango	M.8175
4.	Sammy Kariuki	M.8481
5.	Simon Logorio Edapal	M.8567
6.	Stanley Ngari Irungu	M.10069
7.	Umakant Manubhai Patel	M.6691

504TH APPROVAL

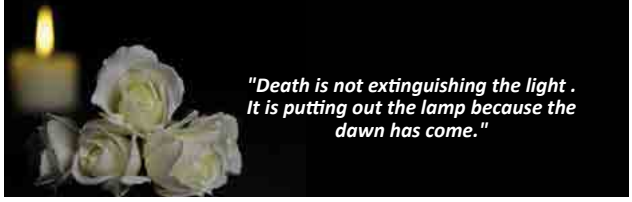
CORPORATE

S/NO	NAME	MEMBER NUMBER
1.	Thomas Nick Kibor	M.6796
2.	Francis Onyango Owuor	M. 3027
3.	Benard Osoro Bonyi	M. 9297
4.	Sarah Nabadda Kimpaye	M. 9530
5.	Were Owiti Wycliffe	M.8166
6.	Christopher Gachaba Ngure	M.5428
7.	Wilfred Waithaka Njoki	M.9486
8.	Shadrack Kiplangat	M.6340
9.	Barrack Wamakaya Wanjawa	M.3375
10.	Ben Sewe Onyango	M.7170
11.	Hebert Onyiengo Ratemo	M.6345

The council invites Engineers and affiliate firms to apply for membership in the various membership classes, kindly follow the link **Membership Classes (iekenya.org)** for a list of classes available.

Graduate and Corporate members are encouraged to apply for transfer of class to Corporate and Fellow class 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.



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