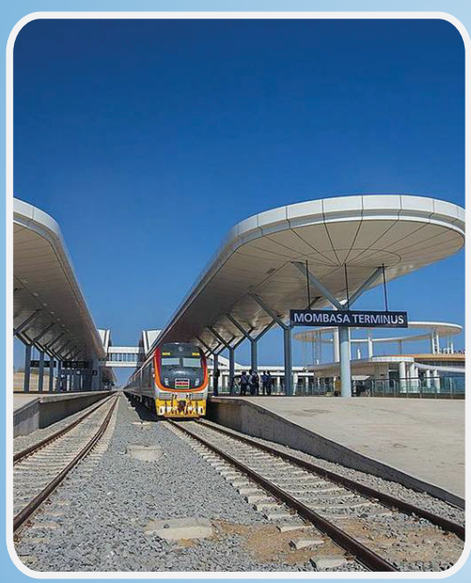
Harvesting Blue Economy for Accelerated Economic Growth: The Role of the Engineer

Kenya ENGINEER

17th -21st September, 2018 | Pridelnn Paradise, Mombasa



UNESCO 5TH AFRICA ENGINEERING WEEK / 3RD AFRICA ENGINEERING CONFERENCE & 25TH IEK INTERNATIONAL CONFERENCE.

ENGINEERS BOARD OF KENYA
Enhancing Professionalism

WFEO/FMOI
World Federation of Engineering Organizations

United Nations Educational, Scientific and Cultural Organization

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The Institution of Engineers of Kenya (IEK)

UNESCO 5TH AFRICA ENGINEERING WEEK / 3RD AFRICA ENGINEERING CONFERENCE & 25TH IEK INTERNATIONAL CONFERENCE

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The Institution of Engineers of Kenya (IEK)

Our Vision

To be an inspiration of excellence to the engineering proffession and practice in Kenya and beyond.To promote and develop the engineering proffession, best practices for sustained development and welfare of Kenyans

The IEK. Council is committed to ensuring the continued improvement of the performance in service delivery to members and engineering service to the nation. By accomplishing this, the IEK will become a model institution for other proffessional institutions in the country and beyond. The Vision of the IEK is therefore: “To be an inspiration of excellence to the engineering proffession and practice in Kenya and beyond..”

What We Do

The Institution of Engineers of Kenya works in conjunction with other institutions and organizations that seek topromote and develop the engineering proffession and best practices in the world

Mission

“To promote and develop the engineering proffession, best practices for sustained development and welfare of Kenyans.”

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UNESCO 5TH AFRICA ENGINEERING WEEK / 3RD AFRICA ENGINEERING CONFERENCE & 25TH IEK INTERNATIONAL CONFERENCE

Organisers

The Institution of Engineers of Kenya
Founded 1972

ENGINEERS BOARD OF KENYA
Enhancing Professionalism

FAEO
FEDERATION OF AFRICAN ENGINEERING ORGANISATIONS

WFEO/FMOI
World Federation of Engineering Organizations

UNESCO
United Nations Educational, Scientific and Cultural Organization

Foreword: President of the Institution of Engineers of Kenya

It is my great pleasure to welcome you all to the 5th African Engineering Week and the 3rd African Engineering Conference. As the President of The Institution of Engineers of Kenya (IEK), I am humbled to be co-hosting this special event for the very first time in Kenya. To all our guests from within the continent and beyond, *Welcome to Kenya! Karibuni Kenya!*

The Engineering fraternity in Kenya is extremely proud of the rapid infrastructural and industrial developments taking place in our country. Hosting this conference is an opportunity for the world to witness these developments. The Engineering profession plays a critical role in advancing economic growth and improving the quality of life of citizens of any country.

The theme of this year's conference - *Harvesting Blue Economy for Accelerated Economic Growth: The Role of The Engineer* - could not have been more suited for Kenya. Kenya is an important player in the marine industry in Africa and the world and is happy to be part of the discussion towards developing a more advanced blue economy. I therefore most sincerely appreciate the World Federation of Engineering Organizations (WFEA), Federation of African Engineering Organization (FAEO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) for supporting this kind of platform and for choosing Kenya to host this important conference.

The IEK has been in existence for more than 70 years. The predecessor to IEK, the East African Association of Engineers (EAAE) was formed in 1945, while the IEK was registered as a professional body in 1972. The mission of IEK is to cooperate with national and international institutions to promote the engineering profession and best practices for the benefit of humanity. IEK boasts of a membership of more than 3000 engineers, some of whom are practicing outside Kenya.

As the president of IEK, I am working with a dedicated team of distinguished engineers in the Council. Our ideal from the onset has been to promote, encourage and improve the application of engineering to technical and other related practices. This is why I am particularly excited to participate in the ground breaking discussion under this conference's theme of *"Harvesting Blue Economy for Accelerated Economic Growth: The Role of The Engineer".*

Africa has for a long time been taunted as a sleeping giant in many areas. As engineers from Africa, this is our moment to show the world that we can lead Africa into a future of prosperity by harnessing the resources in our vast oceans. We must capture the aspirations of our continent and use our skills in engineering to design projects that will make the entire Africa proud.

This conference does not only offer an opportunity for engineers from our respective organizations to network but also provides the opportunity appreciate presentations by engineers from across the continent. It is my hope that we will all leave the conference with numerous lessons learnt for the benefit of our continent. Most importantly, it is my hope that this conference and engineering week will be a significant step towards actualizing the dreams that we have as engineers to tap the resources in our oceans for posterity.

As engineers, we are required to not only design sustainable engineering solutions in the marine environment, but to also ensure that the output from our engineering projects promote the integrity of marine ecosystems.

Karibuni Kenya.

Eng. Collins Juma, FIEK
President, Institution of Engineers of Kenya

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EBK Chairman's Message

As the chairperson of the Engineers Board of Kenya (EBK), it is my pleasure to welcome you to the 5th African Engineering Week and the 3rd African Engineering Conference. On behalf of EBK, I wish to register my utmost honour in co-hosting this special conference.

I am happy that we can meet as the people of this continent and as professionals from various sectors to discuss how we can sustainably use the resources at our disposal to achieve economic growth and to improve the livelihoods of our people.

I am privileged to be part of the discussion on the state of the resources in our oceans. Africa is blessed to be surrounded by a number of oceans and seas. In particular, the Mediterranean Sea to the north, the Suez Canal and the Red Sea to the northeast, the Indian Ocean to the east and southeast, and the Atlantic Ocean to the west. To sustainably harness these resources for the benefit of our people, the knowledge, skills and expertise of engineers is required.

I take this opportunity thank the World Federation of Engineering Organizations (WFEO), the Federation of African Engineering Organizations (FAEO) and UNESCO who have supported this conference to be hosted in Kenya at this time. The theme of the conference, which is - ***Harvesting Blue/Ocean Economy for Accelerated Economic Growth: The Role of The Engineer,*** is closely related to the main pillars of the economic blueprint of our country, which are the Big 4 Agenda and the Vision 2030.

For instance, we are currently implementing Lamu Port, South Sudan, Ethiopia Transport Corridor (LAPSSET) project which aims at building infrastructure to link the new port of Lamu in Kenya to Juba in South Sudan and Addis Ababa in Ethiopia. The successful completion of this project is going to create new opportunities through which we can harness the ocean resources for the benefit of the countries involved in the project.

It is therefore important that our engineers are adequately prepared though training and through the necessary regulation to anticipate the opportunities that are going to emerge from the latest global interest in the blue economy. It is my hope that our engineers will gain lessons from variety of papers that will be presented in this conference.

In appreciation of the important role that engineers continue to play in promoting economic growth and aiding the development of our country, the Engineers Board of Kenya was established as a legal institution through the Engineers Act 2011 to regulate engineering practice in Kenya. Apart from regulation, the board is mandated to champion the development of the engineering profession by promoting capacity building and training of engineers, registration and regulation of their conduct for improved performance of the profession.

Today we are proud to have more than 10,000 well trained, talented and experienced engineers in Kenya who are registered with the board. It is therefore my pleasure that we have this conference for our engineers to come and share with the world the output of their work and similarly, to network, learn new technologies and trends from engineers from across Africa and the world.

Currently, we are proud to be working closely with other government agencies to meet the objectives of Vision 2030 and the Big 4 Agenda economic blueprints. The focus areas of the Big 4 Agenda include manufacturing, food security, universal healthcare and affordable housing for all. The areas of fisheries development, manufacturing, offshore energy potential, marine transport and mining are indeed integral parts of the Big 4 agenda.

At the Board, we understand that the success of the economic blueprint will depend on the effectiveness of the engineering profession and a conducive enabling environment where our engineers can freely practice their profession. We therefore have a comprehensive strategic plan that guides our work and helps ensures that engineering services are efficiently and effectively rendered.

Ladies & Gentlemen, this conference provides a good platform for engineers to network with other engineers and other key sector players and learn from the best practices across the continent and beyond. It indeed provides a good opportunity for us to discuss common standards that can be adopted to ensure mutual working relationships between engineers from different parts of the continent.

In conclusion, the Engineers Board of Kenya will promote an enabling environment and continue collaborating with all stakeholders towards creating capacity in all engineering fields for effective delivery of professional services in this space. The Board similarly challenges engineers to provide services in an ethical and professional manner, adhering to our Code of Ethics.

"The oceans are not exclusive domains of engineers, we, as engineers must also think of how we are going to interact with other sector players in the oceans ecosystem, only then will we have sustainable innovations that protect our ecosystem"

Welcome to Kenya.

Eng. D M. Wanjau, PE

Chairman of Engineers Board of Kenya

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Message From the Director of UNESCO Regional Office for Eastern Africa, MME. Ann Therese Ndong-Jatta

The United Nations Educational Scientific and Cultural Organization (UNESCO) is honoured to be associated with the 5th UNESCO African Engineering week and Engineers' Conference.

UNESCO's programmes focus on contributing to the building of peace, the eradication of poverty, sustainable development and cultural dialogue through education, the sciences, culture, communication and information. This includes the strengthening of science, technology and innovation systems and policies – nationally, regionally and globally and the promotion of international scientific cooperation on critical challenges to sustainable development with an emphasis on Africa and on gender equality as global strategic priorities.

The theme for the African Engineering Week – Harnessing the Blue Economy for Accelerated Growth is particularly relevant to the UNESCO's Ocean Sciences Programmes. UNESCO's Intergovernmental Oceanographic Commission (IOC) has established a Sub Commission for Africa and the Adjacent Island States (IOCAFRICA) to promote scientific research and understanding of the ocean and coastal environment and resources, and provide the science-base necessary for the development of the Blue Economy in Africa as outlined in the African Union's Agenda 2063 ("The Africa We want"). The African Union's Agenda 2063, recognizes that 'Africa's Oceans, which is three times the size of its landmass, shall be a major contributor to continental transformation and growth, advancing knowledge on marine and aquatic biotechnology, the growth of an Africa-wide shipping industry, the development of sea, river and lake transport and fishing; and exploitation and beneficiation of deep sea mineral and other resources." The Sub Commission is implementing a wide range of programmes, including the development of an African Ocean Observations network that focuses on ocean information for human and economic security, oceans and assessments, ocean data and information management, capacity development for marine science and technology, as well as ocean science and policy interface.

UNESCO is also contributing to the implementation of the United Nations 2030 Agenda for Sustainable Development which envisages a world in which: consumption and production patterns and the use of all natural resources – from air to land, from rivers, lakes and aquifers to oceans and seas – are sustainable.", and "…. development and the application of technology are climate sensitive, respect biodiversity and are resilient". In particular, UNESCO's Intergovernmental Oceanographic Commission has been tasked by the United Nations General assembly to develop an implementation plan for the UN Decade for Ocean Science for Sustainable Development (2021-2030) which provides a global framework that will ensure Ocean Science can help governments and societies achieve the major goals of our generation. The Decade will provide a *'once in a lifetime'* opportunity to create a new foundation, across the science-policy interface, to strengthen the management of our oceans and coasts for the benefit of humanity.

UNESCO welcomes all the participants from its Member African Member States to this important continental conference and looks forward to sharing with you our experiences in the field of ocean sciences and the development of the Blue Economy in the region and globally.

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Welcoming Statement By The President, Federation Of African Engineering Organizations

On behalf of the Federation of African Engineering Organizations (FAEO), I join the Organizers of this conference and the Institution of Engineers of Kenya in welcoming you all to the fifth version of UNESCO/WFEO/FAEO Africa Engineering Week and the 3rd Africa Engineering Conference. I congratulate the President of the Institution of Engineers of Kenya, Eng, Collins Juma, his Council and the Organizing Committee for organizing this very important event in the calendar of the Federation.

The first of the UNESCO/FAEO Engineering Week and Conference was held in South Africa in 2014, the second one in Zimbabwe in 2015 the third one In Nigeria in 2016 and the fourth one in Rwanda in 2017. This event is held to enable the African Engineers to meet together and share ideas and find solutions to the engineering challenges facing the continent.

FAEO was formed in 1972 as Federation of African Organizations of Engineers (FAOE). It was re-energized in 2012 as FAEO. The federation was formed with the objective of building a solid, united umbrella body for all African Engineers and to represent the engineering profession in Africa, internationally among other objectives.

I congratulate the organizers of the conference for choosing a very timely theme of the conference namely, "Harvesting Blue/ Ocean Economy for Accelerated Economic Growth: The Role of The Engineer." The theme is in tandem with the United Nations Sustainable Development Goal (SDG) 14, which seeks to conserve and sustainably use the oceans, seas and marine resources for sustainable development.

Africa has 37,723KM of coastline and, therefore, a vast access to the sea. By exploiting the resources available in the expansive ocean, Africa will be able, to a large extent, satisfy the Sustainable Development Goals Nos.1 (no poverty), 2 (zero hunger), 7 (affordable and clean energy), 8 (Decent work and economic growth) and 9 (industry, innovation and infrastructure). Engineers will be required to play a major role in the exploitation of these vast resources in the oceans. In addition, it will be necessary for engineers to deliberate on how our oceans can be protected for maximum benefit to our people.

I note, with great satisfaction, that several papers will be presented in this conference with innovative ideas on how the engineers in Africa can harness these resources in the blue economy. I hope that through our interactions during this conference, the African Engineers who will be gathered in this wonderful coastal city of Mombasa will come out with practical ideas on how our Governments can utilize the services of our engineers for sustainable development of the blue economy.

I thank UNESCO and the World Federation of Engineering Organizations (WFEO) for the support that they have continued to give to this event. My very sincere thanks go to the Government of Kenya, The Institution of Engineers of Kenya and the Engineers Board of Kenya for agreeing to host this very important event. I also would like to thank all our other partners and sponsors. I wish you all a nice stay in Mombasa and an enjoyable conference. May God bless us all and may God bless Africa.

Eng. Julius Marimi Riungu, FIEK
President, Federation of African Engineering Organizations

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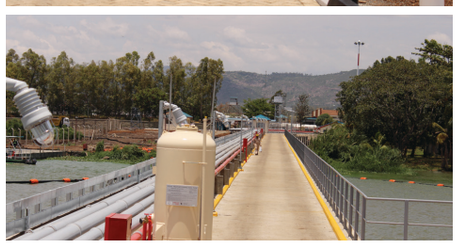
KPC delivers; technical handover of the Kisumu Oil Jetty



KISUMU COUNTY

1.7 BN
SHILLINGS
Cost of constructing the oil jetty

1 BN
LITRES P.A
Oil jetty throughput in phase 1

3 RD
LARGEST EXPORT
Refined petroleum ranks third after tea and cut flowers

8
MONTHS
Period it took to construct the oil jetty

3 BN
LITRES PER YEAR
Oil jetty throughput by 2028

Kenya is on the path to regaining its share of the East African petroleum market following the completion of the Kisumu Oil Jetty.

The oil jetty will facilitate transport of petroleum products via Lake Victoria to neighbouring Rwanda, Burundi, Uganda, Eastern DRC and parts of Tanzania, setting Kisumu on course to become one of the largest inland ports in Africa.

The construction of the jetty commenced in June 2017 following a successful tendering process that saw a Kenyan engineering firm, Southern Engineering Company (SECO), awarded the Kshs 1.7 billion contract to construct the oil jetty.

Project Benefits

- The Jetty is expected to position Kisumu as a centre of oil and gas commerce in the region through safe transportation of fuel across the lake using properly certified barges and ships. The Jetty will boost throughput in Kisumu by 1 billion litres a year in phase 1 and up to 3 billion litres per year by 2028.
- The new project will significantly boost Kenya's chances of regaining its share of the East African petroleum market with improved fuel supply to western Kenya.
- It will integrate marine fuel transportation to the current system, making it more efficient and commercially viable for oil marketing companies in the region – due to the reduction on transportation costs and reduced incidences of illicit practices like fuel adulteration.
- Enhance safety and environmental conservation via a reduction on the number of road accidents, fuel fires and siphoning incidences.
- Increased saving on road maintenance costs, opening up funding for other development projects.

@kenyapipeline @KenyaPipelineCompany

a flagship project of KENYA VISION 2030

KPC prioritizes blue economy in regional growth strategy following completion of oil jetty

By Jason Nyantino

KPC has prioritized the blue economy as a key driver to achieving its growth agenda with the recent completion of the Kisumu oil jetty.

The jetty, which was completed in February this year and awaits to begin its commercial operations very soon when Uganda completes constructing her jetty, supports the blue economy initiative and will spur economic activities around the Great Lakes Region.

"The addition of the Kisumu oil jetty into our projects portfolio speaks to our growth aspirations as Africa's premier oil and gas company. Remember that recently the regional Heads of State resolved to develop the Lake Victoria inter-modal transport system to boost regional trade, during the 14th Northern Corridor Integration Projects Summit held in Nairobi in June this year," said KPC Managing Director Joe Sang recently.

With the jetty now on board, KPC is set to regain its share of the East African petroleum market part of which has been lost to Tanzania's Central Corridor. The jetty is expected to deliver petroleum products to neighbouring Rwanda, Burundi, Uganda, Eastern DRC and parts of Tanzania. Speaking during the technical handover ceremony in Kisumu earlier in the year, the KPC boss said that the oil jetty is expected to create an efficient and commercially viable integrated marine fuel transportation system in the region resulting in reduced transportation costs for the oil marketing companies.

"The introduction of an oil jetty will transform Kisumu into the region's petroleum export hub. The emerging opportunities both on the Lake and on land will in turn stimulate economic activity across the Great Lakes region with an increase in vessels inspiring other industries to take up this mode of transport," said Sang.

KPC Chairman, John Ngumi said emerging opportunities both on the Lake and on land will stimulate economic activity across the Great Lakes region with an increase in vessels inspiring other industries to take up this mode of transport.

"The jetty is expected to increase maritime transport activities on the lake with the shipping and docking facilities required to support the venture also enabling other industries to develop additional transport services along the lake," said Ngumi.

Ngumi said a sufficient and efficient infrastructural system is vital to ensuring adequate, reliable and cost effective supply of petroleum products across East Africa. The construction of the jetty commenced in June 2017 following a successful tendering process that saw a Kenyan engineering firm, Southern Engineering Company (SECO), awarded the Kshs 1.7 billion contract to construct the oil jetty.

The Jetty will boost throughput in Kisumu by 1 billion litres a year in phase 1 and up to 3 billion litres per year by 2028.

To ensure that the new jetty is adequately supplied and can sustain the export market, KPC has already completed the construction of the new 122km Sinendet-Kisumu pipeline (Line 6) which was commissioned in July last year.

Although refined petroleum is the third largest export product after tea and cut flowers, the country's grip in the regional market has been shaken by Tanzania's central corridor which is said to have less market entry barriers than the Kenyan route. It is therefore expected that one of the drivers to position Kenya strategically in the region is the blue economy which is now ranked as the seventh sector to drive the achievement of Vision 2030 development agenda.

The Institution of Engineers of Kenya

The Institution of Engineers of Kenya (IEK) is a profession body of the engineers in Kenya. The aim of IEK is to promote and develop the engineering profession in the country. In addition, IEK aims at promoting best practices in the field of engineering to spur socio-economic development and welfare of Kenyans.

In order to achieve its aims, IEK collaborates with national and international institutions in developing and applying best practices of engineering in manufacturing, infrastructure development, clean energy development, urban planning, water resource planning, biosystems engineering, construction and equipment. To maintain the professional and administrative autonomy, the IEK is registered as an independent body whose council and other officials are democratically elected by the eligible members.

History of IEK

Prior to independence, the interest of engineers in Kenya and in other East African countries was represented by the East African Association of Engineers (EAAE). The EAAE was registered in 1945. With the collapse of the East African Community (EAC), engineers from individual countries formed their separate institutions of engineers. Consequently, IEK in its present form was registered in 1972.

The Ideals and Objectives of IEK

The Institution continually works in partnership with EBK and various universities to develop the capacity of the engineering departments in Kenya to be able to competently train graduates in emerging disciplines like petroleum engineering and marine engineering. The specific ideals and objectives of IEK include;

1. Facilitating the exchange of information and ideas on technical and other related matter in the engineering field.
2. Commitment to continuous professional development of the members.
3. Representing and articulating the diverse interests of all branches of engineering
4. Safeguarding the dignity and integrity of engineering profession and the standards that have been set to guide the application of engineering knowledge.
5. To contribute to and set standards for theoretical, practical and management training leading to acceptance to membership of IEK and registration by EBK.
6. Working together with the Engineers Board of Kenya (EBK) to develop regulations and standards that can promote the highest level of professional values in the engineering profession while keeping the Kenyan engineers at par with their peers in other countries.

IEK Regional Branches

Apart from the IEK council that sits in Nairobi, there are three other branches across the country that carter for the interest of engineers in the different regions of Kenya. The three branches include;

- The Coast branch which is based in Mombasa,
- Western branch in Eldoret
- Central Kenya branch which is based in Nyeri.

The interest of all members are represented by the Council of IEK, which coordinates the interests/activities of the regional branches and various other associated bodies. On the other hand, regional branches and their committees play a vital role in membership contract by organising lectures, demonstrations, technical visits and in upholding professional standards. Regional branches also ensure that maximum benefit is obtained by members and help to expand the membership of the IEK.

IEK Committees

Further, to drive the affairs of the IEK and to ensure that more members are involved in the management of the institutions. There are committees to address specific issues of the engineers. The committees include finance and administration committee, membership committee, training and capacity building committee, functions committee, discipline and dispute resolution committee, women engineers chapter, young engineers forum and the conference forum.

Membership

There are currently more than 3000 engineers registered members of IEK. Most members of IEK are residents in Kenya with a number of members from outside Kenya. The membership is drawn from practicing engineers in the local/central departments of the government, parastatals, private industries, consultants, contractors, educators, designers and manufacturers.The membership is categorized into Honorary Members, Fellows, Corporate Members, Associate Members, Companion Members, Graduate Members and Student Members. Graduate engineers

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from recognized universities can register for specific membership classes based on their qualifications and their experience.

Membership Benefits

To meet the specific needs of the members and to build the capacity of the members, IEK organizes regular seminars, lectures and conferences. IEK currently manages a bi-monthly publication titled the "Kenyan Engineer" whose aim is to publish cutting engineering applications and solutions with the hope of providing engineers with relevant information on the current trend in engineering in Kenya and in the world. In addition, IEK members can voluntary join Mhandisi SACCO which is a Savings and Credit Cooperative society that is dedicated to the engineers.

In conclusion, IEK is proud of our members, the Kenyan engineers, who have been actively involved in all major engineering projects in the country since independence. Some of the flagship projects that the members of IEK have been involved in the country include the Nairobi-Thika Superhighway, Lake Turkana Wind Power Project, the Standard Gauge Railway project among many other projects.

I.E.K COUNCIL MEMBERS

ENG. COLLINS JUMA
President

ENG. JANE MUTULILI
1st Vice President

ENG. EMELDA ODHIAMBO
2nd Vice President

ENG. NATHANIEL MATALANGA
Honorary Secretary

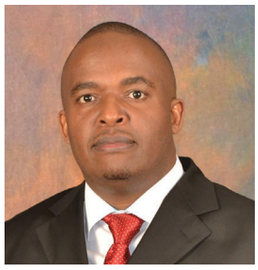
ENG. FANUEL MWASHIGADI
Honorary Treasurer

ENG. MARGARET OGAI
Member

ENG. CHRISTINE OGUT
Member

ENG. SHAMMAH KITEME
Member

ENG. ERIC OHAGA
Member



ENG. STANLEY MUSAU
Member

ENG. JULIUS ODUMBE
Member

ENG. ANTHONY SANG
Member

PROF. AYUB GITAU
Member

ENG. MICHAEL ONONJI
Immediate Past President

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Engineers' Board of Kenya

The Engineers Board of Kenya (EBK) is a statutory body that was established by the Engineers Act 2011. The Board is responsible for registration of engineers and engineering firms, regulation of engineering professional services, setting of standards, development and general practice of engineering.

The EBK has a strong and broad mandate to regulate the development and practice of engineering as indicated in the Board's mission statement which is to: *"To ensure production of competent engineers and quality engineering services through regulation, capacity building and enforcing compliance with set engineering standards for improved socio-economic development."*

Composition of the Board

The Board consists of twelve (12) Members. The chairperson who is appointed by the Cabinet Secretary from amongst the members appointed. Three (3) members include; the Principal Secretary in the Ministry responsible for Engineering matters, Principal Secretary in the Ministry responsible for Finance, Principal Secretary in the Ministry responsible for Higher Education, the President of the Institution of Engineers of Kenya, seven (7) persons appointed by the Cabinet Secretary of whom three (3) representing different Engineering disciplines nominated by the Institution of Engineers of Kenya, one (1) from the public sector involved in engineering matters, one (1) representing Universities, two (2) from the private sector and the Registrar who is an ex-official member of the Board and Chief Executive Officer of the Board who is responsible for the day to day management of the Board.

Specific Functions

To effectively meet the functions as stipulated in the legislation, the Board operates with three committees including academic qualifications committee, professional engineering training committee and a professional interview panel. The specific functions of EBK include;

1. Approving and accrediting engineering programs in universities and tertiary level education institutions offering training engineering.
2. Assess, approve or reject engineering qualifications of foreign persons intending to offer professional engineering services in the country.
3. Collaborating with engineering training institutions, professional associations, engineering organizations and other relevant bodies to promote the training and development of engineers.
4. Ensuring professional training and competence of engineering
5. Setting standards for engineers in management, marketing, professional ethics, environmental integrity, safety, legal aspects and other relevant aspects of the engineering profession.
6. Hearing and determining disputes related to the professional ethics and conduct of engineers.

Membership

The Board registers different categories of engineers namely, graduate engineers, professional engineers and consulting engineers. In terms of membership, the Board has registered 393 consulting engineers, 1893 professional engineers and 12,143 graduate engineers.

To qualify for registration as a graduate engineer, one must hold a degree in engineering from a recognized university or such other qualifications as the Board may determine.

To qualify for registration as a professional engineer, one must have worked for a period of three years as a graduate engineer under supervision of a professional engineer, must pass professional exams conducted by the Board and must be a corporate member of the Institution of Engineers of Kenya.

Finally, to qualify for registration as a consulting engineer, one must be registered with EBK as a professional engineer and must have at least 9 years continuous professional experience of which 5 years must be post registration as a professional engineer.

Accreditations

In fulfilment of its function, the Board has currently accredited 42 academic programs in 10 universities in Kenya. Moi University leads with the number of accredited engineering programs in the country at 13 and followed by the University of Nairobi and Jomo Kenyatta University of Agriculture and Technology (JKUAT) with 6 programs each.

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BOARD MEMBERS

Role of EBK in Vision 2030

To facilitate the delivery of its mandate, the board developed a comprehensive strategic plan to guide its activities and to ensure that its services are efficiently rendered. The strategic plan covers the period between 2013-2019.

EBK has collaborated with the implementing agencies in different sectors in particular, sectors involved in implementation of Vision 2030 economic blueprint. Such collaborations include those with industry players in energy, agriculture, science and technology and in education. In addition, EBK is working closely with the national government in Kenya to ensure the success of the 5-year 4-pillar plans which include food security, universal health care, manufacturing and the provision of affordable housing.

In conclusion, our greatest achievement is in promoting discipline in the engineering profession in Kenya. We have been working with the universities to ensure the competence of graduate engineers and developing a clear strategic plan to guide the development of the engineering profession.

Mr. Charles Obiero

Eng. (Prof.) Francis J. Gichaga

Mr. Abednego Etyang'a

Eng. D.M Wanjau

Eng.Aruna Patel

Eng. Julius M. Riungu

Eng. Stanley K. Kamau

Eng. Collins Juma

Eng. Abdullahi Samatar

Eng. (Prof.) Bancy Mati

Eng. Nicholas M. Musuni

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Brief On Federation Of African Engineering Organisations

1. INTRODUCTION

The Federation of African Engineering Organisations (FAEO) was initially formed as Federation of African Organization of Engineers (FAOE) in Cairo, Egypt in 1972.It was re-energised in 2012 in Nairobi when it obtained its current name. The Secretariat is currently located in Abuja, Nigeria, where it is hosted by the Nigerian Society of Engineers. FAEO is an International Member of the World Federation of Engineering Organizations (WFEO) representing the African Continent, having been elected in 1989.

2. MANDATE AND MISSION

The mandate of FAEO is to build a solid, united, umbrella body for all African engineers to speak with one voice; aimed at entrenching unity of purpose amongst all nations of the world to emancipate Africa from poverty through application of science and technology.

The mission of FAEO is to serve humanity through the use of best practiced technology and to represent the engineering profession in Africa, internationally. To achieve this mission, FAEO has been recognized by international organisations as the overall leader of the engineering profession in Africa.

3. OBJECTIVES OF FAEO

FAEO was established with the following objectives:-

- To build a solid ,united umbrella body for all African Engineers
- To Promote high standards of engineering professional education and practice
- To create an avenue where engineers from different states in Africa could meet to network and share information on the latest trends of engineering profession.
- To promote and encourage the use of best practiced technology in Africa.
- To represent the Engineering Profession in Africa, internationally.
- To partner with all stakeholders amongst all nations of the world to emancipate Africa from poverty through application of science and technology.

4. CONTINENTAL AND INTERNATIONAL PARTNERSHIPS

In 2016, FAEO signed a Memorandum of Understanding (MoU) for Technical

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Cooperation with the African Union Commission. The aims of the MoU included establishing and strengthening professional engineering organizations in member states of African Union. At that moment only 24 states within the 54-member States were members of FAEO and WFEO. It was, therefore, a good opportunity for FAEO to assist in establishing Institutions of Engineering in AU Sates where they did not exist and to strengthen the organizations in states where they existed. FAEO continues to seek other Continental and International Partnerships in order to carry out various projects

5. PROJECTS UNDER THE AUC/FAEO MoU.

Based on the MOU, the following are the projects that FAEO with the support of AUC proposes to carry out:-

- To support development of engineering curriculum and accreditation of engineering faculties and departments with the aim of developing a benchmark of minimum academic standards for engineering programmes for purposes of training, certification and accreditation across AU member states with long term view of attaining global standards.
- To create an African Engineering Council to oversee implementation of the benchmark standards in member states.
- To work with the AU states to establish and strengthen engineering regulatory bodies by encouraging the establishment of engineering regulatory bodies in countries where they do not exist and strengthen such bodies in countries where they exist.
- To establish regional engineering innovation hubs in Africa to bridge academia- industry gap and increase the quantum of indigenous African entrepreneurs.
- To promote gender equality in the engineering profession in Africa, by establishing a regional forum for developing/ increasing women in leadership position through women in engineering and technology. This would in turn develop their leadership skills while providing an opportunity to increase the number of women in leadership positions.
- To create harmonized engineering codes and standards for buildings and infrastructure in Africa in order to ease development of infrastructure throughout the African continent.

6. STRUCTURE OF FAEO

The General Assembly is the highest authority of the Federation. It is held once every two years.

For the administration of FAEO, there is established an Executive Committee comprising the President, President –Elect, Treasurer, Immediate Past President, Five Vice-Presidents, who are Presidents of the Regions, the Chairpersons of the Technical Standing Committees and the Executive Director.

The Standing Technical Committees drive the various technical Affairs of the Federation. The standing committees include anti-corruption, capacity building, energy, engineering education, information and communication technology, infrastructure, water, women in engineering and young engineers' forum.

7. Regional Branches

FAEO has five Regional Bodies namely:-

- North African Federation of Engineering Organisations (NAFEO)
- West African Federation of Engineering Organisations (WAFEO)
- Eastern Africa Federation of Engineering Organisations (EAFEO)
- Central African Federation of Engineering Organisations (CAFEO)
- Southern Africa Federation of Engineering Organisations (SAFEO)

The Presidents of the five (5) regional bodies are constitutionally accepted as Vice Presidents (VP) of FAEO representing their respective regions.

Apart from working closely with the WFEO and African Union to promote the engineering profession in Africa, the FAEO has been at the forefront in the organization of annual African Engineering Week with the hope of using the fora to communicate the role of engineering and engineers in sustainable development and also as a way of reaching out to students who are the potential engineers of the future. This current engineering week and conference is the fifth of the events that have been successfully organized with the support and input of FAEO.

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BRIEF ON WORLD FEDERATION OF ENGINEERING ORGANIZATIONS (WFEO)

The World Federation of Engineering Organizations (WFEO) is an international, non-governmental organization representing the engineering profession worldwide. WFEO was founded in 1968 under the auspices of the United Nations Educational, Scientific and Cultural Organizations (UNESCO) to champion the interest of engineers across the world and to guide the development of engineering profession in the member organizations. Today, WFEO boasts of bringing together national engineering organizations from more than 100 nations and representing more than 30 million engineers from around the world.

Mission and Objectives of WFEO

WFEO aims to serve society and to be recognized, by national and international organizations and the public, as a respected and valuable source of advice and guidance on the policies, interests and concerns that relate engineering and technology to the human and natural environment. Specifically, WFEO works through its national and international members;

1. To represent the engineering profession internationally, providing the collective wisdom and leadership of the profession to assist national agencies choose appropriate policy options that address the most critical issues affecting countries of the world.
2. To enhance the practice of engineering.
3. To make information on engineering available to the countries of the world and to facilitate communication between its member nations about the world's best practices in key engineering activities.
4. To foster socio-economic security and sustainable development and poverty alleviation among all countries of the world, through the proper application of technology.
5. To serve society and to be recognized by national and international organizations and the public, as a respected and valuable source of advice and guidance on the policies, interests and concerns that relate engineering and technology to the human and natural environment.
6. To cooperate with Funding Agencies such as development banks.
7. To encourage public private partnerships by including the engineering dimension.
8. To address the issue of what public policies need to be implemented.

Structure of WFEO

For the administration of the WFEO, there are two levels of governance which are the Executive Board and the Executive Council. The Executive Board consists of the president, president-elect, past President, two executive vice-presidents, a treasurer, one non-voting member who also serves as the executive director.

The Executive Council is expanded to include the executive board, chairpersons of various technical committees (currently there are 11 technical committees), national members and international members. To guide its operations, WFEO has a constitution which was last passed in 2012. In addition, there are rules and procedures which are passed by the general assembly. The current version of rules and procedures was passed in 2017.

Our Activities

In order to disseminate information that is relevant for engineers across the globe, WFEO collaborates with other agencies to organize events including seminars and conferences in different countries. Some of the international events that WFEO is directly involved in this 2018 include World Urban Forum which was held in Kuala Lumpur in February, Gender Equality and Empowerment Forum which was held in France in February. Global SDG 7 Forum on Energy in Thailand and 8th World Water Forum in Brazil.

To be noted for this conference, is that WFEO in collaboration with UNESCO have been actively involved in supporting the African Engineering Week from the first one South Africa in 2014 to the current event.

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5 TH UNESCO AFRICA ENGINEERING WEEK / 3RD AFRICA ENGINEERING CONFERENCE & 25 TH IEK INTERNATIONAL CONFERENCE

17-21 SEPTEMBER 2018 - PRIDE-INN HOTEL MOMBASA –
CONFERENCE PROGRAMME HARNESSING BLUE ECONOMY FOR ACCELERATED ECONOMIC GROWTH

INSTITUTION OF ENGINEERS OF KENYA (IEK) FIRST AFRICAN WOMEN ENGINEERS SUMMIT - MONDAY 17TH SEPTEMBER 2018 PRIDE INN HOTEL, SHANZU, MOMBASA WOMEN DRESS CODE FOR THE SUMMIT AFRICAN ATTIRE		
TIME	**EVENT**	
0800 –0900 HRS	**Arrival and Registration**	**Secretariat**
0900 -1000 HRS	Opening Ceremony MC - Eng. Grace Onyango, MIEK	Introduction Eng. Emelda Odhiambo, MIEK - 2nd Vice President IEK
		Welcome Remarks Eng. Collins Juma, FIEK - President IEK
		Speech Eng. Valerie Agberagba, FNSE
		Speech by President, FAEO - Eng. Julius Riungu
		Keynote Address of the Summit Marlene Kanga President, WFEO
1000 – 1030 HRS	Role of women engineers in achieving Sustainable Development Goals (SDGs)	UN Women representative Zebib Kavuma
1030 – 1100 HRS	**Tea Break and Photo Session**	
1100 -1200 HRS	**Plenary discussion;** **Moderators: Angeline SSebanakitta/** **Eng. Rosemary Kung'u** African Communities: Issues & Challenges and the Women Engineers	Panelists: • Eng. Christine Ogut - Kenya • Eng. Hema Vallabh - South Africa • Eng. Funlola Ojelade - Nigeria • Carlien Bou-Chedid -
1200 – 1300 HRS	**Innovations: Moderator: Naila Umubyeyi**	
	African Communities: Provision of Infrastructure for Sustainability and Women Engineers	Eng. Umar Gambo jibrin, FNSE, OON
	"Innovations in Solar Water Pumping Systems: Taking Kenya's Economic Development to the Next Level through Green Energy	Prof. (Eng.) Bancy Mati
	Onsite Waste water Recycling	Eng. Lucy Wanjiku
	Innovation solutions to affordable energy	Eng. Catherine Nyambala
1300 – 1400 HRS	**LUNCH**	
1400 – 1500 HRS	**Scaling the Heights Moderator: Eng. Susan Ombuya**	
	Building Capacity amongst Women Engineers for innovation	Phillipa Makabre 2017, Africa Innovation Award
	Stakeholders' Supporting programmes for Diversity & Inclusion	Eng. Ruomei Li Executive Committee Member, WFEO
	Moving out of the shadows: excelling in Innovation and creativity in a male dominated field	Engr. Funmilade Akingbagbohun FniMechE
	Vote of Thanks	Eng. Margaret Ogai
1500 – 1530 HRS	FAEO- WIE Meeting	WIE Secretariat.
1530 – 1600 HRS	**Tea**	
1600 – 1700 HRS	Zumba	All
1800 HRS	Engineer's Conference Welcome Cocktail	

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Conference chairperson: Eng. Collins Juma

DAY 2(TWO); TUESDAY 18TH SEPTEMBER 2018			
MENTORING PROGRAMME FOR SCHOOL CHILDREN TO RUN FROM 0800 -1300HRS			
0800 – 0830 HRS	REGISTRATION	IEK SECRETARIAT	Speakers
0830 – 1030 HRS	Opening Session	Eng. Nathaniel Matalanga, Hon. Secretary	Eng. Collins Juma. FIEK – President IEK
			Eng. D. M. Wanjau, FIEK - EBK Chairman
			Eng. Julius Riungu, FIEK – President FAEO
			Introduction of WFEO Delegation: Prof. Eng. Yashin Brijmohan, Vice President, Chair CECB
			Dr. Marlene Kanga, President WFEO
			Unesco Regional Director Ms. Anne Therese Ndong -JATTA
			African Union Representative
			Welcome of Chief Guest: Eng. Collins Juma, FIEK - President IEK
			Chief Guest Mr. James W. Macharia, EGH - CS Ministry of MoTIH&UD
			Vote of Thanks
1030 – 1100 HRS : TEA BREAK			
1100 – 1115 HRS	**KEY NOTE SPEAKER**	**MRS. NANCY KARIGITHU**	**PS MARITIME AND BLUE ECONOMY**
1100 – 1245 HRS	SESSION 1 Session Chair: Prof. Jonas Redwood-Sawyer Session Co-Chair Eng. Emelda Odhiambo	Marine Engineering	1.1. **TOWARDS SUSTAINABLE BLUE GROWTH, THE ROLE OF PORT PROJECTS IN HARNESSING BLUE ECONOMY IN KENYA. THE CASE OF PORT EXPANSION PROJECT** Ryan Oremo KPA,
			1.2**. HARVESTING THE BLUE ECONOMY FOR ACCELERATED ECONOMIC GROWTH: THE ROLE OF THE ENGINEER IN MARINE CONSTRUCTION AND EQUIPMENT.** Eng. Festus Wambua
			1.3. **STANDARD GAUGE RAILWAY DEVELOPMENT.** Eng. Mwangi Matu
			1.4. **TOWARDS SEAMLESS CONNECTIVITY BETWEEN MOMBASA PORT AND THE NATIONAL HIGHWAY NETWORK –** Eng. Peter Mundinia – Eng. Peter Mundinia DG KeNHA
			1.5**. NUCLEAR TECHNOLOGY A PATHWAY FOR CLIMATE CHANGE MITIGATION, PROVISION OF CLEAN AFFORDABLE AND RELIABLE ELECTRICITY** Edwin Chesire and Eng. Collins Juma *Kenya Nuclear Electricity Board*.
1245 – 1300 HRS	**Platinum Sponsor**		**KENYA NUCLEAR ENERGY BOARD**
1300 - 1400 HRS: LUNCH BREAK			
1400 – 1415 HRS	**KEY NOTE SPEAKERS**	**Eng. Grace Onyango**	**THE PLACE OF CONTINUING PROFESSIONAL DEVELOPMENT IN HARNESSING THE BLUE ECONOMY**
		Eng. Yashin Brijmohan	**NEED FOR ENGINEERING PROFESSONAL DEVELOPMENT**
		Prof. Dr. Jürgen Kretschmann	**EMPOWENT TEACHING**

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1415 – 1530 HRS	SESSION 2 WFEO Workshop Moderator Eng. Julius Riungu	Prof. Yashin Brijmohan IEA Accreditation	International Engineering Alliance Representative Capacity Building Initiatives in process in Engineering Education Facilitated workshop with attendees, with proposed projects Questions and Answers
1530 – 1600 HRS	**TEA BREAK**		
1600 – 1730 HRS	SESSION 3 WFEO Workshop Moderator Eng. James Mwangi	Prof. Yashin Brijmohan Eng. Martin Manuhwa Dr. Martin van Veelen	Africa Engineering Report & Capacity Building Anti-Corruption Strategies – Global Experiences & Models Infrastructure Score Card
1900 – 2000 HRS	FAEO	Executive Committee meeting	
DAY 3(Three); WEDNESDAY 19TH SEPTEMBER 2018			
MENTORING PROGRAMME FOR SCHOOL CHILDREN TO RUN FROM 0800 – 1300HRS			
0815 – 0830 HRS	**KEY NOTE SPEAKER: Dr. ENG. JOSEPH NJOROGE PS STATE DEPARTMENT OF ENERGY**		
0830 – 1030 HRS	SESSION 4 Session Chair Eng. Rosemary Kung'u Co-chair Eng. Stanley Musau	Renewable Energy	4.1. **RENEWABLE ENERGY IN BLUE ECONOMY** Maryam Kidere KPA 4.2. **EXPLORING BLUE OCEAN ECONOMIC ACTIVITIES IN RENEWABLE ENERGY IN KENYA**. Eng Peter Gitura Kenya Power 4.3. **OPPORTUNITIES FOR PUMPED STORAGE HYDROPOWER PLANTS IN KENYA: UTILIZING HIGH HEADS IN RIFTVALLEY** Eng. Francis X. Makhanu KENGEN 4.4. **CHALLENGES AND OPPORTUNITIES IN GRID INTEGRATION OF OFFSHORE WIND FARMS – A REVIEW** *Eng. Julius Ndirangu and Eng. Stephen Nguli – Standards Department, Kenya Power* 4.5. **MARINE CONSTRUCTION AND EQUIPMENT-CONNECTION OF ELECTRICAL POWER TO THE GRID FROM OFF-SHORE SOURCES**. Eng. Kahoro Wachira. Kenya Power
1030 - 1100 HRS : TEA BREAK			
1100 – 1300 HRS	SESSION 5: Session Chair: Eng. Ngwisa Mpembe, FIET Session Co-Chair: Eng. Julius Odumbe	Marine Administration & Tourism	5.1. **AFRICAN CONSULTING ENGINEERS AND THE BLUE ECONOMY IN AFRICA.** Moncef Ziani FIDIC Vice-President 5.2. **DEVELOPMENT OF MARINE TOURISM IN AFRICA FOR SUSTAINABLE ECONOMIC GROWTH.** Alexis S. Amachree University of Port Harcourt Nigeria. 5.3.**THE INVESTMENT IN CONNECTING MARINE PORTS BY RAILWAYS IS THE KEY TO UNLOCKING AFRICA'S TOURISM POTENTIAL TO ACTIVATE THE CONCEPT OF AFRICAN COOPERATION** *Aiman A. Rsheed Nada University, Egypt,* 5.4. **TOURISM IN COASTAL AREAS: IMPACT ON SHORELINE CHANGES** J. W. Mburu1, Y.W. Shaghude2, R.S. Arthurton3 **5.5 BLUE ECONOMY SUB-THEME: MARINE CONSTRUCTION AND EQUIPMENT Maj. Jane Bengat Kirgen Kenya Navy**
1300 - 1400 HRS : LUNCH BREAK			
1400 – 1415 HRS	**KEY NOTE SPEAKER MRS. REBECCA MIANO MD KENGEN**		

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1415 – 1530 HRS	SESSION 6 Session Chair: Ing. Steve Anoff Amoaning-Yankson, FGhIE Co-Chair: Eng. Fanuel Mwashigadi	Marine Construction Equipment	6.1. **CHALLENGES OF CORROSION ON MARINE STRUCTURES AND THEIR EFFECTS ON THE CONSTRUCTION OF MARINE STRUCTURES IN KENYA** Eng**.** Samuel Charagu
			6.2. **DURABILITY OF STEEL REINFORCED STRUCTURES IN THE MARINE ENVIRONMENT-WHAT IS THE WAY FORWARD?** Dr. Mike Otieno *University of the Witwatersrand, South Africa*
			6.3. **IN PURSUIT OF DURABLE MARINE STRUCTURES** Prof. David O. Koteng Department of Civil & Construction Engineering, Technical University of Kenya.
			6.4. **MARINE CONSTRUCTION AND EQUIPMENT**. Eng. Paul C. K. Kioko
			6.5. **STRUCTURAL DESIGN CONSIDERATIONS OF OFFSHORE WIND TURBINES** Juste T. Gatari, Institute of Engineers Rwanda & Joe Gisharu, Houston,
1530-1600 HRS : TEA BREAK			
1600 – 1730 HRS	SESSION 7 Session Chair: Eng. Reuben Kosgei Co-chair: Eng. Peter Wanday	Desalination	7.1. **DESALINATION** *Eng. Francis Maina*
			7.2**. HARVESTING FRESH WATER FROM OCEANS USING SOLAR POWERED DESALINATION SYSTEMS** W.O. Onkundi
			7.3: **DESALINATION** Akoth, Celestine Inros Lackner Kenya
			7.4. **SYSTEMS ENGINEERING APPROACH TO SELECTION OF BMSMR FOR POWER GENERATION AND DESALINATION** Eng. Eric Ohaga
			7.5. **GENERATING FRESH WATER ONBOARD SHIPS FROM SEAWATER** Engr. (Commodore) J. C. Orji (Retired), CEng FIMarEST COREN MNSE
1900 – 2000 HRS	EAFEO & SAICE	Executive Committee meetings (Separate rooms)	

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DAY 4 (FOUR); THURSDAY 20TH SEPTEMBER 2018			
MENTORING PROGRAMME FOR SCHOOL CHILDREN TO RUN FROM 0800 -1300 HRS			
0815 – 0830 HRS	**KEY NOTE SPEAKER**	**PROF. JAPHET NTIBA**	**PS FISHERIES AND BLUE ECONOMY**
0830 – 1030 HRS	SESSION 8 PAPERS Session Chair: Eng. Isaiah Mutonyi Co-chair: Eng. I Rwodzi, President Zimbabwe	Marine Fisheries & Aquaculture	8.1. **FADS FISHERY ALONG THE KENYAN COAST: SOCIO-ECONOMIC PROBLEMS AND PROSPECTS** H.O. Onyango, J. Ochiewo, N. Karani, C. Abunge & C. Magak Kenya Marine and Fisheries Research Institute (KMFRI)
			8.2. **BLUE VICTORIA: THE POTENTIAL FOR RECREATIONAL FISHING INDUSTRY IN LAKE VICTORIA TOWARDS PROMOTING BLUE GROWTH** Nyaboke H., Nyaundi J. Owili M., Nyamweya C., Aura C., Gichuru N., Okechi J., Owiti H.,Mwanzala F.,Sudoi V.and Liti D. Kenya Marine and Fisheries Research Institute & University of Eldoret
			8.3. **BOUNTIES OF LAKE VICTORIA: A CASE FOR BLUE ECONOMIC INVESTMENT** Chrisphine Nyamweya Marine and Fisheries Research Institute
			8.4. **HAVE INNOVATIVE TECHNOLOGIES REDUCED FISH POST HARVEST LOSSES ALONG LAKE TURKANA? CASE STUDY OF THE POLYETHYLENE SOLAR DRYER** Keyombe J.L.A, Bironga C.H, Obiero Kenya Marine and Fisheries Research Institute, Turkana
			8.5**. THE BLUE ECONOMY IN THE OIL & GAS SECTOR IN KENYA: THE ROLE OF KISUMU OIL JETTY IN ACCELERATING ECONOMIC DEVELOPMENT WITHIN LAKE VICTORIA REGION.** Eng. Edwin Omolo and Eng Anthony Sang
1030 - 1100 HRS : TEA BREAK			
1100 – 1300 HRS	SESSION 9 Session Chair: Eng. Vincent Ochwo Co-chair: Prof. Eng. Simiyu Sitati	Port, shipping and Marine Surveillance	9.1. **INLAND WATER WAYS "THE GENTRIFICATION PROBLEM"** John K. Karuntimi, The Geo Roads Odessy Ltd
			9.2. **REMOTE POWER MONITORING OF MARINE SITES** Eng. Michael Wafula, Kenya Power
			9.3. **UTILIZATION OF NIGERIAN SATELLITE AUGMENTATION SYSTEM FOR OCEAN NAVIGATION, MARINE AND VESSEL SAFETY** Lawal L Salami Federal University of Technology, Minna Nigeria
			9.4. **EXTENDED ENDURANCE SURVEILLANCE & MONITORING USING REMOTE PILOTED AIRCRAFT SYSTEMS** Dr. Victor M. Mwongera, Kenyatta University
			9.5. **MARINE/MARITIME SAFETY NOT ACHIEVABLE WITHOUT ENGINEERING APPLICATIONS** Munyoki Mwendwa, Sunfire Kenya

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1300 - 1400 HRS: LUNCH BREAK			
1400 – 1415	**KEY NOTE SPEAKER –**	**ENG. JACOB Z. RUWA**	**EXECUTIVE DIRECTOR KENYA ROADS BOARD**
1415 – 1530 HRS	SESSION 10 Session Chair: Engr. Adekinle Mokuolu, FNSE Eng. Prof. Bancy Mati	Blue Economy	10.1. **AFRICA PASS: AFRO-EURASIA CONCEPT FOR ENERGY MANAGEMENT BY ACTIVATING POLITICAL ENGINEERING PROJECT COOPERATION** Aiman A. Rsheed, Nada University, *Egypt,*
			10.2 **ARISING CONTRIVANCES AROUND AFRICAN RIVERS A CASE STUDY OF RIVER NILE**, Medrine Naliaka, Lafemme Eng. Ltd
			10.3. **FUZZY LOGIC MODEL FOR OBSTACLES AVOIDANCE ROBOTIC CRANE IN STATIC UNKNOWN ENVIRONMENT** Aggrey Shitsukane, Technical University of Mombasa,
			10.4. **OFFSHORE GEOTHERMAL DRILLING: A RENEWABLE ENERGY SOURCE FOR AFRICA**. Eng. Fred S. Keny Geothermal Development Company
			10.5. **HIGH ALTITUDE PLATFORMS FOR SECURITY APPLICATIONS** Andrew Nyawade, Ministry of Defence
1530 – 1600 HRS : TEA BREAK			
1600 – 1730 HRS	SESSION 11 Session Chair: Eng. Joel Wanyoike Co-chair: Eng. Christine Ogut	Pollution Control & Water Catchment areas	11.1**. PATTERNS AND IMPACT OF INDIGENOUS AND MODERN SYSTEMS IN GOVERNANCE OF KAYA FORESTS IN KENYA: A CASE OF KAYA FORESTS AT THE COASTAL REGION OF KENYA.** Dr. Maundu Muli
			11.2. **CHALLENGES AND OPPORTUNITIES IN WASTE MANAGEMENT IN A BLUE ECONOMY** Eng. Stephen Nguli and Eng. Julius Ndirangu. Kenya Power.
			11.3. **MANAGEMENT AND DISPOSAL OF USED OIL - A CASE STUDY OF MENENGAI GEOTHERMAL FIELD** Eng. Collins Changole, Eng. Dominic Mutai Geothermal Development Company
			11.4. **REDUCTION OF POLLUTANT TOXICITY LEVELS IN PRODUCED WATER FROM CRUDE OIL PRODUCTION PROCESSES** Stanley Ngene and Kiran Tota-Maharaj University of the West of England, Bristol (UWE, Bristol),
			11.5. **IMPACT OF POLLUTION CONTROL ON BLUE ECONOMY** Maj (Eng.) Michael Mwangi Mucugia, Kenya Defence Force

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DAY 5(FIVE); FRIDAY 21ST SEPTEMBER 2018			
0815 – 0915 HRS	SESSION 12 Session Chair: Eng. Eric Ohaga Co-Chair- Eng. Wachira Kahoro	STUDENT PRESENTATION	12.1. **UNDERWATER TURBINES TO SUPPLY ENERGY IN THE COASTAL REGION** Phelister Nyanchama Bogonko, Bachelor of Science (Electrical and Electronic Engineering) Student.
			12.2. **AN INTEGRATION OF CLEAN ENVIRONMENT AND CLEAN ENERGY** Maina Kelvin Muriuki, Technical University of Mombasa Maina Patrick Kinyua, Technical University of Kenya
			12.3. **FEASIBILITY ANALYSIS ON HARNESSING OCEANIC RESOURCES FOR POWER GENERATION** Michael Curey Odero, Jomo Kenyatta University of Agriculture and Technology
			12.4. **USE OF REVERSE OSMOSIS MEMBRANE TECHNOLOGY IN THE DESALINATION OF SEA WATER FOR COUNTIES BORDERING THE OCEAN IN KENYA.** Lynette K. Bundi, and Samamba Amunga, University of Nairobi
0915 – 1045 HRS	CONFERENCE RESOLUTION/ CLOSING Session Chair: Eng. Erastus Mwongera CBS Co-chair: Eng. Margaret Ogai Rapporteurs: Faris Abdulraham and Victor Mungai		
1045 – 1115 HRS: TEA BREAK			
1115 – 1630 HRS	INDUSTRIAL VISITS Coordinator: IEK Coast Branch Eng. Roseline Jilo		SGR/ Dongo Kundu
			KPA
			Water and Sewerage Plants
			Power Plants
			SECO
1900 HRS	**GALA NIGHT & AWARDS**		**COORDINATOR ENG. MARGARET OGAI**

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Conference Abstracts

1. Marine Engineering

1.1 TOWARDS SUSTAINABLE BLUE GROWTH, THE ROLE OF PORT PROJECTS IN HARNESSING BLUE ECONOMY IN KENYA. THE CASE OF PORT EXPANSION PROJECT.

Author: Ryan O. Oremo I Email: roremo@kpa.co.ke

The Port of Mombasa serves as a vital link in the international trade between East Africa and the rest of the world. The position of Mombasa as one of the main ports and docking station for large vessels plays a catalytic role in national and regional development. Specifically, the Port of Mombasa serves as the main of entry of goods from other countries and an exit points for exports from Kenya and East Africa. Consequently, the port provides employment opportunities in logistics services and shipping. The initial design of the berths in the port provided for small vessels that primarily offloaded bulk cargo. However, there has been dynamic development in container transport and continued upward trends in container traffic. Globalization of the modern container traffic market and the current maritime trends in the world have led to an increase in the sizes of ship and containers that are involved in cargo business. Consequently, the large size of ships and the increased traffic calls for a redesign of the berths and other facilities to support the increased volumes. Upgrading the engineering structures and equipment at the port will improve the competitive edge of the port thereby increasing volume of trade, arrival of high-end tourists and growth of other sectors of the economy that rely on the port.

Upgrading the infrastructure at the port will include strengthening and straightening of berths as well as land reclamation to construct a new terminal. The engineering work will not only cater for the larger ships that call on the port annually but will also increase the cargo throughput that could be handled by the port. The port expansion project will allow the country to exploit Transshipment trade, opening doors to the new markets and providing greater economic value to countries partners the East African region. This paper argues that an expansion project at the port is not only timely but the only way for the port to keep its position as a premier entry point to East Africa. To support the opportunities availed by the expanded port, all stakeholders including the port managers, the cargo handlers and transport companies will have to work together to ensure security, efficiency and profitability of cargo handling and shipping at the port.

Keywords: Port expansion, Transshipment, Blue growth, Cargo handling, Blue economy

1.2 HARVESTING THE BLUE/OCEAN ECONOMY FOR ACCELERATED ECONOMIC GROWTH: THE ROLE OF THE ENGINEER IN MARINE CONSTRUCTION AND EQUIPMENT

AUTHOR: Eng. Festus Muema Wambua
Email: festusmuema7@gmail.com

ABSTRACT

The construction industry world over faces many challenges. In marine environments, the challenges are made worse due to the prevailing characteristics and difficulties of the sites which include presence of water, the need to conserve sensitive habitats and salination. In the developing countries, and more so those that border oceans and large water bodies, marine related difficulties are compounded by socio-economic stress, chronic resource shortages, institutional weaknesses and inadequate technical capacity and skills to address critical engineering questions. Regrettably, challenges within the marine environment that require urgent and sustainable engineering solutions have become regular, greater in extent and in severity in recent years. This is mainly due to the adverse effects of climate change and global warming that have led to erratic weather patterns, regular flooding and frequent seismic activity within and around water bodies. Consequently, incidences of flooding, erratic weather patterns and seismic activities have led to deterioration in the condition of engineering structures within marine environments and the need to build additional structures to facilitate water supply, access to renewable energy and the mobility of humans and goods.

This work considers a solution to the eminent threat of the increasing electricity demand in the sea port town of Lamu and environs in the face of degradation of water catchment areas, continued urbanization and unpredictable weather patterns.

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In particular, this author addresses the practical questions in energy transmission to ensure a sustainable, continuous and reliable supply of electricity in the sea port of Lamu from the newly constructed Rabai-Malindi-Garsen-Lamu 220kV transmission power line. Of immediate concern, is need to be adequately prepared for and anticipate the destructive effects of erratic weather patterns like the surge in flood waters that recently brought down a section of the power line in between April and May of the year 2018. In response to the unfortunate occurrence, there was need to redesign, re-engineer and reconstruct the transmission line at the section where it crosses the two major rivers of Sabaki. This paper therefore documents and discusses the lessons learnt from the re-engineering project on the power transmission line and highlights alternatives that can be adopted to provide sustainable procurement, design and engineering solutions for similar cases.
Keywords: Salination, seismic activities, marine environment, marine construction

1.3 STANDARD GAUGE RAILWAY DEVELOPMENT

SPEAKER: ENG. MATU

ABSTRACT

As Kenya Vision 2030 is being implemented in successive phases, one of the key areas of focus is **"Transport and Infrastructure Development"** and in particular **"Rail"** which is a vital service to global society and the transport backbone of a sustainable economy. By doing so, Rail will be able to respond to the expected growth in transport demand, both passenger and freight.

1.4.SEAMLESS CONNECTIVITY BETWEEN MOMBASA PORT AND THE NATIONAL IDGHWAY NETWORK

Director General
Kenya National Highways Authority

ABSTRACT

Mombasa is the main sea port for Kenya and hinterland countries including Uganda, Rwanda, South Sudan and Eastern Democratic Republic of Congo.

Rapid growth in port traffic at Mombasa has necessitated interventions to enhance the capacity of highways linking the port to the national highway network and thereby promote the blue economy.

The proposed presentation by KeNHA will give an overview of the nature, scope, cost and timelines of several ongoing and planned interventions in the vicinity of Mombasa Port including:

- Mombasa Port Area Road Development Project Package I (Miritini-Kipevu)
- Mombasa Port Area Road Development Project Package 2 (Mwache- Mteza)
- Mombasa Port Area Road Development Project Package 3 (Mtcza- Kibundani)
- Changamwe – Moi Airport/ Port Reitz Road Project
- Magongo Road Project
- Mombasa – Mariakani Road Project Lot I: Mombasa – Kwa Jomvu Road
- Mombasa – Mariakani Road Project Lot 2: Mombasa – Kwa Jomvu – MariakaniRoad
- Malindi – Lunga Lunga Road Phase 1: Nyali – Kwa Kadzengo

The proposed presentation will be 15 minutes long and will be in powerpoint format, thus requiring audio-visual faci liti es.

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1.5. NUCLEAR TECHNOLOGY A PATHWAY FOR CLIMATE CHANGE MITIGATION, PROVISION OF CLEAN AFFORDABLE AND RELIABLE ELECTRICITY

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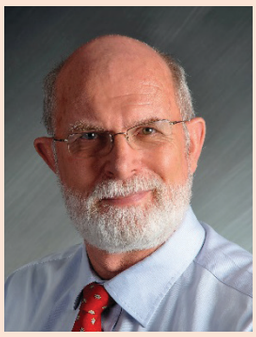
ABSTRACT.
In the recent years, energy demands in Kenya have risen steadily. This is directly attributed to the rapid industrial development, expansion of the manufacturing sector and demographic changes in Kenya. In the energy sector, the recent success of rural-electrification program has directly increased demand for clean and affordable energy creating an urgent need to diversify the country's energy sources to satisfy the growing demand. According to the country's Vision 2030 economic blueprint, energy has been identified as a critical pillar and an enabler of long-term socio-economic development of the country. It is therefore important to develop new energy sources to support economic growth and prosperity of the country. In choosing appropriate sources of energy to meet the high demand, climate change, safety and affordability of the new sources of energy must be considered. In the Least Cost Power Development Plan (LCPDP) for the 20 years between 2011-2031(LCPDP), Kenya factored nuclear power as a future component in Kenya's energy. Nuclear energy is preferred because of its marginal influence on global warming and ability to provide reliable and affordable electricity.

The paper analyses nuclear technology as a pathway to the provision of affordable and reliable electricity while mitigating climate change. In particular, with the growth of blue economy, nuclear power plants can be installed in the deep seas to reduce the chances of negative influence on the health and safety of people. The paper also addresses the potential challenges of desalination that must be considered when designing engineering structures to facilitate nuclear energy development, and transmission from the high seas. Further, the author proposes that the adoption of nuclear energy will require an inclusive discussion that should be led by engineers in order to address the fears that the country may be having in adopting the nuclear power program. Engineers occupy the enviable position of understanding the technical aspects of nuclear energy and also the skills and knowledge of designing enabling infrastructure that can promote safe, sustainable and affordable exploration of the rich resources.
Keywords: Nuclear Energy, Electricity, Climate change, Desalination, blue economy

2. Workshop Facilitators



Dr Martin van Veelen

Qualifications.

- Ph D in Aquatic Health from the University of Johannnesburg (2002).
- M Eng (Water Utilisation Engineering) from the University of Pretoria (1982).
- Bachelor of Engineering (Honours) (Water Utilisation Engineering) from the University of Pretoria (1977).
- Bachelor of Engineering (Civil engineering) from the University of Pretoria (1976).

Professional Registration

- Registered as a Professional Engineer (Reg No 800333) with the Engineering Council of South Africa.
- Certified as an Environmental Assessment Practitioner by the Interim certification Board for Environmental Assessment Practitioners of South Africa.

Professional Experience

Dr van Veelen has a total of 40 years of experience in engineering, environmental management and project management, mainly in water related projects. Extensive experience in water quality, especially water quality management, water quality monitoring and water quality assessment.

Dr van Veelen was responsible for the planning of various water supply schemes, including the Lower Fish River Government Water Scheme and the Mossel Bay Regional Water Scheme (Wolwedans Dam), for both of which a planning report and a White Paper were prepared. Preparation of a strategic water supply and sanitation plan for the Southern District Council,

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North-West Province. Optimisation of a Regional Waste Water Treatment Works for the Makwassie-Wolmaransstad area. Team Leader for a feasibility study and preliminary design for a 500 km, 2 m diameter water transfer pipeline in Botswana.

He was responsible for an environmental assessment of various options of power generation (mainly hydropower) in Ethiopia, a water supply and distribution scheme for Blantyre in Malawi, the Kampala Drainage Master Plan, a proposed oil pipeline from Kenya to Uganda, and water supply and sanitation for seven towns in Uganda. He was the team leader for the determination of the ecological flow requirements for the Orange River and Orange River Mouth. Project leader for the Environmental Impact Assessment of the Primkop International Airport and the Wonderboom Airport. Project leader for the determination of the ecological reserve for the Olifants River. Project leader for various environmental impact assessments for waste water treatment works, pumping stations, pipeline routes, reservoirs and water towers.

Dr van Veelen was instrumental in the investigation into the management of the Orange-Fish-Sundays Transfer Scheme to optimise water quality, planning of a National River Water Quality Assessment Programme, the development of a water quality management plan for the Jukskei River, an impact study on the Johannesburg Northern Sewage Treatment Works and the Kelvin Power Station, a project for setting new waste discharge standards for South Africa and the planning of a National Radio-activity Monitoring Programme for South Africa.

Service to Professional Bodies

Dr van Veelen has served in various committees since 1989 when he joined the committee of the SAICE Water Engineering Division. In 1992 he was the chairperson of that committee, after having served as the treasurer for a number of years. He has served on the Finance and Admin Committee of SAICE since 2000 and was the Chairperson from 2002 to 2005. In 2012 he was the President of SAICE and has continued to serve on the SAICE Council as a Past President. He is currently the Chairperson of the Finance and Admin Committee of SAICE.

Martin was elected as President of the Federation of African engineering Organisations (FAEO) in 2012, and served in that position for two years. He is currently a Past President of FAEO. During his term of office FAEO was recognised as representing the African Engineering Society by a number of international organisations, including the African Union, UNESCO, and the African Development Bank.

Dr van Veelen is a member of the WFEO/UN Relations Committee and the STC Support Group.
He is an Adjunct Professor at the Central University of Technology, Free State (Bloemfontein, South Africa).

Eng. Martin Manuhwa is the Vice President of the World Federation of Engineering organisations (WFEO). He chairs the WFEO Anticorruption Technical Committee. He is the incoming President of the Federation of African Engineering Organisations (FAEO) .He is a past Chairman of the Engineering Council of Zimbabwe (ECZ). He is the Past President of the Southern African Federation of Engineering Organisations (SAFEO), and also the Zimbabwe Institution of Engineers (ZIE). He has delivered various infrastructure papers at foras like World Energy Forum in China, OECD in London, World Engineering Conferences in Japan and Switzerland, the AU and the Royal Academy of Engineering, UK.

His research interest is in the use of Management Information Systems in construction and project management and he is currently a Doctoral Associate at the University of Cape Town where he is researching on the link of ICTs, the use of Big Data Analytics, Cybersecurity and Productivity in Engineering Projects. He has taught Management Information Systems for MBA graduate students at the University of Zimbabwe and at the Bindura University of Science Education.

He is a member of various boards in Zimbabwe and abroad. He is a Councilor with the Zimbabwe Higher Education Council (ZIMCHE). He sits in various engineering faculty advisory boards in Zimbabwe and SADC. Eng. Manuhwa was the chair of the Electrical and Mechanical Industry Sector Committee for NAMACO which he represented in the NAMACO Council. He has received numerous awards, including the SKF service to engineering award.

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He is Managing Consultant of the Zimbabwe Africa Infrastructure Development Group (ZAIDG), a company that specializes in engineering procurement and construction projects. ZAIDG works with Hatch Africa (Pty) Ltd in Zimbabwe to deliver infrastructure solutions in the power industry, mining and public arena. His company, ZAIDG were together with Hatch the technical advisors on the Kariba Extension (now successfully commissioned) and the $1.5 billion Hwange Power Station Expansion project. Martin is an electrical and energy consultant engineer. His engineering practice is in energy, construction projects, worksite project implementation and management.

Prof. Yashin Brijmohan is a South African who has a passion for the development of people. He is a Professional Engineer with his primary Engineering Degree from the University of KwaZulu Natal, Masters of Engineering from the University of Pretoria, and the Diploma in Engineering Business Management from the University of Warwick. He is currently employed at Monash South Africa (Higher Education Institution) as Executive Dean of Business, Engineering, and Technology managing the areas of Engineering, Commerce, Accountancy, Information Technology, and Law. He is the current Board member of the UNESCO International Centre for Engineering Education.

He also serves as the Vice President of the World Federation of Engineering Organisations (WFEO), Chairperson of the International Engineering Capacity Building Committee, and was former Chair of Chairs of the Standing Technical Committees at WFEO. He also serves as Executive Board Member of the African and Southern African Federations of Engineering Organisations.

He has held various positions in both Engineering and Education, and had the privilege to serve on various committees and councils both internationally and nationwide. He is commonly known for his expertise in Leadership, Strategy Development, Strategic Partnerships, Business Development and Planning, and Project Management. He serves as a thought leader in preparing various stakeholders (Industry, Society, and Business) for the Industrial and Technological Revolution.

His other notable portfolios include serving on Engineering Council of South Africa as a Council Member and Executive committee member, Head of School for Engineering at the Eskom Academy of Learning, Chairperson of the Strategic Advisory Committee for the Engineering Council of South Africa, Chairperson of The Tertiary Education Support Programme developing Science, Engineering Research and Educational centres in South Africa , Chairperson of The Science, Technology and Innovation Park at University of KwaZulu Natal, Chairperson of the Young Professional Development Committee (Eskom National), National Science and Technology Forum Adjudication panel member, Manager of South Africa's Black Researchers Academic Development Programme jointly with the National Research Foundation (NRF), and Chief Judge (Provincial Expo for Young Scientists).

In his private capacity, he was the Secretariat and National Committee member of a Meditation NGO, and he still spends much of his free time assisting communities, teaching the practice of Meditation and awareness of holistic medicine. He enjoys giving back to the community where he also served as Chairperson of a local Primary School Governing Body.

Eng. Grace Laura Apiyo Onyango is the **Director, Capacity Building & Accreditation** at the **Engineers Board of Kenya**

She boosts more than 14 years of experience in Electrical Engineering field with expertise in design, supervision, contracting and project management. She is a dedicated, hardworking individual with excellent intercommunication skills. She is an outstanding motivator and team builder. Eng. Onyango has received training in ISO 9001 Quality Management Systems.
Currently the director for capacity building and accreditation at the Engineers Board of Kenya, Eng. Onyango has previously served as a council member of the Institution of Engineers of Kenya. At

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the point of her registration as an Engineer, Eng. Onyango was the youngest registered Engineer in Kenya.

Alongside her Bachelor of Engineering (Hons.) in Electrical & Electronics Engineering degree awarded by Northumbria University United Kingdom, Eng. Onyango holds an MSc in Management – Strategy and Operations from Walden University, USA.
Before becoming a director at the Engineers board of Kenya, Eng. Onyango was a member of the board and also the Project Manager at TVET. She has also previously served as the Technical Manager at Ultimate Engineering Limited and an Electrical Engineer at the Ministry of Public Works.

3. The Infrastructure Report Card Guide

Three Past Presidents of SAICE combined their knowledge and experience to produce a Guide on how to prepare an Infrastructure Report Card. Dr Martin van Veelen, Sam Amod and Malcolm Pautz co-authored the Infrastructure Report Card Guide that will be used internationally to aid engineering organizations to produce score cards. The Guide has been submitted to the Independent Group of Scientists (IGS) who are preparing the 2019 Global Sustainable Development Report (GSDR).

The World Federation of Engineering Organisations (WFEO) represents the Engineering Industry at the United Nations (UN) by means of their participation in the Major Group for the Scientific and Technological Community. This Major Group, together with other Major Groups, forms the High Level Political Forum that has direct access to the General Assembly of the United Nations. This is the way that Civil Society can participate in global affairs. At a meeting of the WFEO/UN Relations Committee in Kyoto, it was resolved that WFEO would produce a report on the global state of infrastructure that can be used in conjunction with the UN report on achieving the sustainable development goals.

The United Nations' Sustainable Development Goals (SDGs) are international development goals that all 193 member states adopted at the UN Sustainable Development Summit September 25–27, 2015, in New York, USA, and agreed to achieve by the year 2030. 17 Sustainable Development Goals with 169 associated targets are integrated and indivisible, global in nature and universally applicable, taking into account different national realities, capacities and levels of development, and respecting national policies and priorities. Targets are defined as aspirational and global, with each government setting its own national targets guided by the global level of ambition, but taking into account national circumstances. Each government will also decide how these aspirational and global targets should be incorporated in national planning processes, policies and strategies.

Achieving the SDGs is almost entirely dependent on the presence of effective and fully operational infrastructure. Infrastructure is the assets that society develops, owns and utilises in order to improve the standard of living and the quality of life. It enables economic development and keeps society healthy. Infrastructure can only be an asset if it is maintained in optimum working condition. Governments have to report to what degree they achieve their set goals in terms of the SDGs, but they seldom report on the state of the infrastructure that is required to achieve these goals.

Infrastructure report cards have been used in various countries to report on the state of infrastructure. As long as this is done unemotionally, objectively and based on solid data, it serves the purpose of informing society whether or not they have the necessary infrastructure to achieve their aspirations. Engineering organisations are in the perfect position to produce infrastructure report cards, as they have access to a vast pool of knowledge and expertise, and can play the role of an honest broker between civil society and government.

The Infrastructure Report Card Guide was produced as a guideline for individual engineering organisations to produce their own infrastructure report cards. It is a guideline with suggested minimum requirements, but is not intended to be

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prescriptive. At the same time, if the minimum requirements are adhered to, it becomes possible to combine individual scorecards into a regional, continental and even global scorecard that can be submitted to the UN General Assembly through the High Level Political Forum. In this way engineering organisations can make a real contribution in achieving the SDGs by focusing attention on where infrastructure is lacking or dysfunctional. A course on how to use the Guide in producing a sound and credible Infrastructure Report Card will be offered during the Global Engineering Congress which will take place in London from 22 to 26 October 2018.

Course Outline

- Introduction to Infrastructure Report Cards
- Grading of Infrastructure
- Content Research
- The Africa Infrastructure Report App
- Main Objective for IRCs
- The Planning Process
- Sector Reports
- IRC Example
- Structure of IRCs
- Initiation of Process
- Organisation and Role Players

4. Renewable Energy

4.1. Renewable Energy in Blue Economy.

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Membership status: Graduate Mechanical Engineer-
Membership No.: G 5575

ABSTRACT.

The emergent paradigm of the ***Blue Economy*** is the result of applying ***Green Economy*** thinking to the oceans. The paradigm may offer a new dawn for the development of renewable energy (RE) in many developing countries whom were worst-hit by climate change and sea-level rise and are also dependent on the 'diesel economy'. These countries have also been slow to bounce back from their economic downturn. This paper therefore, consider the changing context of RE in Blue Economy. It briefly rehearses the vulnerabilities and constraints that most developing countries face in the transition to RE. It paints a distinction between aspirational commitments to RE at UN meetings over the last 20-plus years and the limited implementation of RE and energy efficiency measures. It illustrates some supporting institutional initiatives. It highlights some cross-national variations in performance, and the possibilities of having a "Hybrid Renewable Energy" sources to serve the country's power needs. Overall, the main focus will be on Kenya. If we consider RE in Blue Economy as part of the globalization of the energy transition, some key aspects of the transition become apparent. Kenya has shown moral courage and political will in taking a sustainable energy path, so enjoys the moral high ground in the discourse on international sustainable development.

The Blue Economy aims to reduce pollution, enhancing energy efficiency, reduce carbon emission and prevent loss of biodiversity and ecosystem services, (Steffen 2014). The Blue Economy is, thus, a development framework elaborated by and apply Green Economy thinking to the ocean and related resources.

In addition to their role as a food source, oceans have value as carbon sinks, for bio-prospecting, hydrocarbon sources, transport and tourism development. They also offer largely untapped opportunities for renewable energy exploitation, or "blue energy," from wind, wave, tidal, ocean thermal energy conversion (OTEC) and salinity gradients and biomass sources. Kenya, being among the countries most in need have RE sources and with the apparent availability to these ocean resources for RE, there is need to invest heavily in harvesting these RE either in one form or combined form as a "Hybrid Renewable Energy".

Key Words: Hybrid Renewable Energy, Blue Economy, energy efficiency, sustainable development, energy exploitation, carbon emission, biodiversity and ecosystem

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4.2 EXPLORING BLUE OCEAN ECONOMIC ACTIVITIES IN RENEWABLE ENERGY IN KENYA

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ABSTRACT

Kenya has made significant strides in the development of renewable energy resources in the country. Examples of renewable energy sources that have been developed and that are contributing to the energy supply in the country include hydroelectric power, wind and solar energy. A bulk of hydroelectric power is generated from the plants that are installed in the Seven Forks Dam, Turkwel River and Sondu-Miriu power stations. Other smaller power plants are installed in Tana, Wanjii and Mesco. For the wind generated energy sources, wind farms are installed in Ngong Hills and in the Lake Turkana Wind Power Farm which is scheduled for commissioning in September, 2018. In addition, there are solar power generation plants which are currently under development in the country. The largest of these is the 50MW in Garissa county. To complement these sources, there are geothermal power stations which are situated in Olkaria and Menengai Areas. It is worth noting that all this installed capacity is in the Kenyan mainland. The country is yet to invest in offshore renewable energy projects that can boost the supply of energy and contribute the economic growth and promote the quality of life of the citizens. Kenya is blessed with the Indian Ocean in the southeast border of the country. The Indian Ocean is a major source of livelihood for the communities around the coast and a major shipping line which serves the port of Mombasa. Unfortunately, the ocean has not been explored for its renewable energy potential.

This paper looks at the possibility of harnessing renewable energy from the massive resource that the Indian Ocean offers. In particular, the focus of this work is on the potential of wind and solar energy on the part of the Indian Ocean that is within the Kenyan territory. It is hoped that such energy will play a major role in accelerating economic of the country and the region. In particular, renewable energy from the Indian ocean can support the vibrant tourism in the coastal region and also complement the manufacturing industry which slowly is picking up in the region through the discovery of precious minerals like titanium and coal. In addition, renewable energy will also be able to support the well-established shipping industry.

Keywords: Renewable energy, offshore projects, Indian Ocean, economic growth

4.3 OPPORTUNITIES FOR PUMPED STORAGE HYDROPOWER PLANTS IN KENYA: UTILIZING HIGH HEADS IN RIFT VALLEY

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ABSTRACT

Hydroelectric power is one of the important sources of electricity in Kenya and accounts for nearly half of the installed capacity. The two main determinants of the amount of electricity generated by hydropower plants are the head, (the vertical height through which water drops) and the flow rate, (the average volume of water flowing through a section in a unit time step). High head power plants are the most preferred and utilize an elevated storage as a reservoir from which water falls onto the turbines. Most Alpine countries of Europe including Austria, Germany, France, Italy, Liechtenstein, Monaco, Slovenia and Switzerland have utilized high heads of over 1000m to develop pumped storage hydropower plants. This is because of their favourable topography, cheap coal, and nuclear power help to pump up water into elevated reservoirs.

This paper discusses opportunities of pumped storage hydropower plants that can be facilitated by the favourable topography particularly within the Rift Valley of Kenya. The sharp edges of the Rift Valley can be used to achieve high heads of up to 1000m. In addition, availability of rivers, lakes and geothermal brine within the Rift-Valley provides adequate water and affordable geothermal energy that can be utilized to heat and pump water into elevated reservoirs and to facilitate high head hydro power generation. Practical examples of existing projects that could be considered for potential implementation of this idea include the planned Arror Hydropower plant in Elgeyo-Marakwet County. Another example is the Suguta Valley/Lake Turkana site. Brine, which comprises concentrated and saline solutions could be pumped from Olkaria geothermal wells to nearby high hills and used for pumped storage hydropower generation. The paper is a documentation of observations from a study tour of hydroelectric power plants in Europe particularly the Alps of France owned by Electricite de France.

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The study tour was carried out in April 2018. In addition, the author shares lessons from the 2016 Hydro Conference in Montreux, Switzerland in which he presented a paper on using hydropower plants to enhance intermittent renewable energy in power grids. This proposed solution provides an integrated system of power generation in which geothermal and hydroelectric power sources could be harnessed into a form of Geo-Hydro power generation innovation. Such a solution could prove to be sustainable particularly in addressing the weaknesses and limitations of hydro-electric power sources that are heavily reliant on weather patterns.

Keywords: Hydropower, high-head power plans, geo-hydropower, sustainability, integrated power generation systems

4.4 CHALLENGES AND OPPORTUNITIES IN GRID INTEGRATION OF OFFSHORE WIND FARMS – A REVIEW

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ABSTRACT

Offshore wind farms are a promising renewable energy source in the blue economy. There is evidence that they can yield significantly higher energy production than onshore wind farms due to larger wind turbine ratings and stronger wind profiles in the oceans. In addition, offshore sites that are installed in deep sea away from human habitation are not restricted by environmental concerns that may hinder the establishment of wind farms in onshore sites. Furthermore, potential locations for offshore wind energy development within the sea are large hence ensuring abundant and consistent availability of clean wind energy resources in comparison to land-based wind energy resource. Since offshore wind farms have different characteristics from conventional land based power plants, their establishment and grid integration poses unique technical challenges. In addition, accessing the sites which are suitable for offshore wind generation also pose significant challenges that must be considered, particularly because, these affect the transmission of energy back to the mainland.

This paper reviews the challenges and opportunities in grid integration of offshore wind farms. In particular, this work focuses on the challenges that are presented by topologies of offshore wind turbines and the difficulties associated with the potential substation location. In addition, this work also looks at specific technical challenges that should be considering when considering the choice of equipment for offshore wind installations. The technical aspects include the capability of electric generators to stay connected in short periods of lower electric network voltage, voltage and frequency control mechanisms, protection and grid code compliance. The different aspects of their design and operation in terms of erection, installation of wind turbines, construction of platforms, laying of sea cables, maintenance and decommissioning are also highlighted. This article contributes to the body of knowledge on issues that engineers in Africa with an interest in offshore wind energy development should consider. In the discussion, the authors explore the weaknesses of onshore wind energy equipment that render them ineffective for offshore wind energy projects. As we prepare for the blue economy, the design of offshore wind energy equipment must be robust and be able to take advantage of the rich renewable energy resources in the oceans.

Keywords: Wind farms, converters, voltage, frequency, HVDC

4.5 MARINE CONSTRUCTION AND EQUIPMENT- CONNECTION OF ELECTRICAL POWER TO THE GRID FROM OFF-SHORE SOURCES

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ABSTRACT

The need to adopt renewable energy in a power system has been adopted by a number of African countries and is also recommended across the globe. Global attempts to promote renewable energy development include the United Nations Sustainable Development Goals number 7 (SDG 7) that advocates for investment and adoption of technologies that ensure access to affordable, reliable, sustainable and modern energy for all. Moreover, renewable energy is preferred because it has the potential of reducing over reliance on fossil fuel and hence can contribute to the reduction of carbon emissions, which lead to global warming. In Kenya, the Feed-in-Tariffs (FiT) policy which was introduced in 2012 to provide a framework

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for connecting renewable energy including wind, biomass, small hydroelectric power, geothermal, biogas and solar to the national grid has continued to encourage local foreign direct investment. This is particularly because, feeding the small energy sources to the national grid provides competitive prices and the enabling infrastructure for small-scale power generators. However, the FiT framework has not been without challenges.

This paper looks at the challenges facing the current FiT system with a view of addressing these challenges to promote exploration of onshore and offshore renewable energy sources by independent power generators. The hope is to increase the number of small energy sources that are connecting to the national grid and contributing to the rise in energy sources to meet the energy demand by Kenyans. Further, with the growth of blue economy, it will be important to come up with robust technologies and engineering solutions that can withstand the challenges of offshore environment while still offering compatibility for private power generators and the regulators in the government to streamline the operation of the feed-in-tariff program. In addition, this paper looks at how the FiT policy that can be enhanced to promote the participation of more private players who include engineers and investors as this will facilitate the success of the policy. The discussion focuses on the potential benefits, opportunities and challenges that must be addressed in anticipation of the blue economy.

Aspects that are considered include the existing infrastructure, the baseline potential and the expected potential in the onshore and offshore environment. Finally, this work looks at the existing potential locations that can be used for the construction and transmission lines to facilitate safe and affordable distribution of electricity to customers in the coastal area.
Keywords: Feed-in-Tariffs, offshore renewable energy, engineering solutions marine infrastructure, economic growth

5. Marine Administration and Tourism

5.1 AFRICAN CONSULTING ENGINEERS AND THE BLUE OCEAN ECONOMY IN AFRICA

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ABSTRACT

The Blue Economy aims at fostering a sustainable and integrated development of marine and maritime sectors. The holistic development of marine and maritime sectors has the potential of promoting socio-economic growth, innovation, creating jobs and investment opportunities and reducing poverty whilst safeguarding the healthy seas and their ecosystems. The development of an efficient Blue Economy Strategy relies essentially on the existing national maritime and coastal capital. The coastal capital is composed of natural capital, human capital and technical capital. The natural capital includes resources within the marine environments which include the water, sea plants, fish and animal species, minerals and other ecosystem services like provision of renewable energy and tourism products. The human capital refers to the knowledge, skills and capacity of different human actors in the marine environment. On the other hand, technical capital includes the equipment, technology and innovations that can facilitate sustainable exploration and use of the marine resources.

This work focuses on the contribution of the engineering industry to the blue economy. In particular, what value can engineering add to the marine capital? To address this question, the author highlights the potential application of engineering to the exploration of natural resources and in the development of maritime infrastructures in Africa. The discussion will expound on the multidisciplinary nature of the marine ecosystem and the different disciplines of engineering that can contribute to sustainable use of the resources to build the marine economy. The author will provide examples from around the world that demonstrate the significant role that engineers must play to reveal the potential of the blue economy in driving the progress of Africa. Recommendations will be made to enhance the involvement of the African consulting engineers to support the strategies for the development of blue economies in their nations. The role of the international and national associations of consulting engineers in this regard, will be also addressed. The marine ecosystem is complex in nature; national governments have sovereignty over specific territories while there are also shared international spaces that can only be harmoniously explored when there is agreeable enabling legislation. Part of the discussion will include comments on how engineers can be involved in developing the appropriate regulations to promote the practice of engineering in the marine environments.
Keywords: blue economy, consulting engineer, marine and maritime sectors

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5.2. DEVELOPMENT OF MARINE TOURISM IN AFRICA FOR SUSTAINABLE ECONOMIC GROWTH

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ABSTRACT

Global tourism industry has witnessed massive growth in the past 20 years. In 2012, total global tourist arrivals were approximately 1.035 billion, which was more than double the figure in 1990. The sustainability of tourism industry has a role to play in growing a sustainable economy. In many countries, coastal tourism provides the main tourism attractions. The strategies presented in this work were sourced through a systematic desk-based research. The main materials which provided the backbone of the data that is analysed here included publications of United Nations World Tourism Organization (UNWTO) and United Nations Environmental Program (UNEP).

In addition, interviews with tourism practitioners and agencies in both private and public sector, and a survey of developed coastal cities (Honolulu, USA) in comparison to coastal city of Lagos in Nigeria was carried out.

This study considers the inputs of public sector, private sector, international organizations, communities, individuals, tourism journalists and most importantly engineers in the development, improvement and maintenance of structures, strengthening policies, providing funds, relating information, and creating activities for the development of coastal tourism in Africa. Thus the need for a deliberate joint effort for the development and management of sustainable forms of tourism on the coast of Africa. Engineers play an important role in designing infrastructure and vessels that support the tourism industry. In addition, engineers also develop renewable energy sources which facilitate the mobility, entertainment and quality living conditions for the tourists. With the growth of the blue economy, engineers can promote the growth of tourism by designing the enabling engineering equipment to promote mobility within the oceans. In addition, engineering can also contribute to the products that are available to the tourists by building jetties and other structures that can support deep sea diving and fishing. In particular, an observation of the practice in the USA reveals that players in the tourism industry in the country are using available technological and engineering advances in shipping and water transport to promote marine tourisms. For instance, long distance cruise ship tourism is common in the west because of the advances in engineering that have provided the enabling infrastructure. Engineers in Africa can also seize the opportunities that is provided by the African waters to support tourism through engineering profession.

Keywords: Tourism, sustainable growth, coastal tourism, engineering for tourism, marine tourism

5.3. THE INVESTMENT IN CONNECTING MARINE PORTS BY RAILWAYS IS THE KEY TO UNLOCKING AFRICA'S TOURISM POTENTIAL TO ACTIVATE THE CONCEPT OF AFRICAN COOPERATION

AUTHOR: Aiman A. Rsheed Mechanical Engineering, lecture at Basic Sciences Department, Faculty of Engineering, Nada University, Beni Suif, Egypt, I Email: aiman.rsheed@nub.edu.eg

ABSTRACT

Tourism is one of the most important economic and social sectors in the world. Tourism industry is a major source of income for the national economies of many countries. A vibrant tourism industry increases the gross domestic product while also raising the share of a country's foreign exchange earnings. Furthermore, a well-managed tourisms sector creates employment for different service providers in the sector and reduces the rate of unemployment that is so prevalent in Africa. In Africa, tourism is mostly vibrant in the coastal regions. Consequently, a boom in the tourism industry has the potential of creating more employment opportunities particularly among those living within coastal regions.

This paper discusses the concept of a master plan of an integrated infrastructure development between Salloum plateau and the Sidi Barani area with its deep extension into the Western Sahara. Such a plan will transform Western Sahara to a world tourist port. Successful investment and development of a vibrant tourism industry around this port will create a focal

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point for a number of major maritime tourism companies, logistic and educational users. In addition, an efficient port can promote the development of a vibrant tourist corridor for tourists to enjoy a voyage of five 5 African countries including Egypt, Sudan, South Sudan, Uganda and Kenya. This concept is designed to carter for an additional 30 million who will be attracted by the infrastructure development that will include an efficient railway system, affordable shelter and reliable electricity. To achieve this goal, the plan proposes for an efficient electricity transmission line to be built within the Western Sahara to connect the country with her neighbours, especially those that have a unified electrical network. In effect, the project will reduce the economic marginalization of Western Sahara and improve the flow of resources through the railway. The sustainability of the DESERTEC as it is known will depend on the large tourism industry, and vibrant commercial and manufacturing sectors.

In addition, the project will rely on renewable energy including solar and wind which can be generated in the Sahara Desert to complement other energy sources. The result of this study will help in addressing the challenge of interrupted travel between countries, which inhibits the flow of tourisms, trade and economic progress.

Keywords: DESERTEC, Marine tourism, Salloum plateau, Sidi Barani, Western Sahara

5.4. TOURISM IN COASTAL AREAS: IMPACT ON SHORELINE CHANGES

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ABSTRACT

Population growth, infrastructure development and climate change have adversely affected the ecosystems and biodiversity in the shores along the Kenyan coast. The influence of humans has particularly been significant in the construction of infrastructure and property to support the tourism industry. The hotels at the coast and their enabling infrastructure constitute a significant financial investment and are major drivers of the local economy. However, lack of enforcement and adherence to planning regulations and poor coordination between different stakeholders in the coastal economy has contributed the harmful effects of tourism development on the shoreline ecosystem.

This paper addresses the impact of marine tourism on shoreline change. Shoreline change is an ongoing issue affecting communities, their livelihoods and tourism development along the coast. In addition, deterioration of the shoreline impacts negatively the biodiversity and the ecosystem services that the shores provide. Many counties along the coast have authorized the construction of tourism infrastructure on the shoreline or even into the marine environment. The threat of coastal erosion that is associated with the development of tourism infrastructure has been of great concern to the environment, safety of tourists and long-term effects on climate change. Other concerns include habitat loss and the degradation of coastal amenities. The potential economic and livelihood losses that are attributable to shoreline change should be considered when siting a tourist facility along the coast. In conclusion, the author provides proposals that can enhance sustainability of the construction of tourist hotels, residential buildings and recreational facilities along the coastline and in coastal islands. In particular, developments within the coast should adopt an integrated planning and development strategy. Such an integrated development strategy should advocate for the collaboration of different stakeholders and ensure that interests of the multiple users of the coastal ecosystem are considered. An integrated planning model for projects in the coastal shorelines can promote the sustainability of the blue economy by for example facilitating proper water, energy and waste management, and assigning dedicated zones for different activities that support the marine economy. In addition, an integrated approach can reduce the cost of engineering projects through economies of scale that allow different projects to benefit from common enabling infrastructure.

Keywords: Shoreline ecosystem, integrated development planning, sustainability

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5.5. Blue economy
Sub-theme: Marine construction and equipment

By Maj Jane Bengat Kirgen

ABSTRACT

The country has rolled out several projects along its coast line amongst them being the Lamu Port. The strategic location of the port, the maritime transportation of crude oil and other increased maritime activities in the new port are likely result in the increase in the number of naval vessels on the Kenya coast. The increased number of naval vessels will increase demand for associated activities such as ship maintenance, repairs and construction. The existing companies ie. SECOL and AMGECO are expected to have in increase in number of clientele and may have to diversify into other activities such as ship construction to meet the increasing market demand. Their limiting factor may be space.

With this in mind and the Kenya Navy having been one of the clienteles, are looking at setting up our own Dry dock to enable us service our own ships and probably later look into providing services to partner institutions at a reasonable fee.

6. Marine Construction Equipment

6.1 CHALLENGES OF CORROSION ON MARINE STRUCTURES AND THEIR EFFECTS ON THE CONSTRUCTION OF MARINE STRUCTURES IN KENYA

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ABSTRACT

As engineers prepare for the growth of the blue economy, corrosion is one challenge that engineers and corrosion prevention specialists will have to tackle together. Corrosion is a natural process that is responsible for the failure of many engineering systems and structures. Specifically, corrosion entails a reaction between a metallic material and its environment. Through exposure to chemicals in the surrounding environment, the structure of the metallic materials assumes a new state, which is different from the known pure state of the metal. While many metallic materials are susceptible to corrosion, the process can be managed and reversed.

There are a variety of ways of controlling and preventing corrosion of metallic materials. Commonly, corrosion depends on the electro-chemical characteristics of the specific material. An understanding of the electrochemistry of materials is therefore an important consideration when designing engineering equipment for use in sensitive settings like the marine environment. In engineering projects, corrosion leads to gradual changes in the geometry of structures or changes in specific components of the engineering structures leading to a loss of engineering function. For instance, corrosion may cause general wastage that leads to a decrease in a section of an engineering structure hence reducing contact for engineering processes that depend on conduction. Similarly, corrosion may also lead to pitting which manifests as small holes or perforations on a metallic surface or cause cracks and fractures which ultimately destroy the equipment or structure. Rusting of ordinary steel is the most common form of corrosion and generally contributes to a large proportion of corrosion of engineering structures. General corrosion, in which the whole of the exposed metallic surface is attacked, may lead to complete failure of engineering structures.

This paper discusses remedies that can be used to reduce the effects of corrosion such as applying suitable control measures. With prior knowledge of the environments and conditions in which engineering structures may eventually be used, appropriate metals that can withstand potential corrosion can be selected. Finally, to reduce the risk of corrosion, the authors recommend that engineers should work hand in hand with corrosion prevention specialists to minimize corrosion of marine structures.

Keywords: Corrosion prevention. marine structures, corrosion susceptibility, pitting

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6.2. DURABILITY OF STEEL REINFORCED STRUCTURES IN THE MARINE ENVIRONMENT-WHAT IS THE WAY FORWARD?

Keywords: reinforced concrete, corrosion, chloride-induced corrosion, durability design, quantitative quality test
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ABSTRACT
Engineering designs for marine environment faces many challenges. One long-standing challenge particularly for engineering constructions within the marine environment involves chloride-induced corrosion of steel structures. Chloride-induced corrosion of steel is the major cause of premature deterioration of reinforced concrete structures in the marine environment. This is mainly due to lack of durability design of the reinforced concrete structures to withstand chloride infection. In a majority of cases, the as-built concrete is deemed to meet durability requirements. However, this assumption is not based on quantitative quality testing before or after construction. Consequently, even the engineering structures that may have been considered to have durability characteristics at the point of design are still susceptible to chloride-induced corrosion. Furthermore, most of the current design codes are prescriptive in nature. The prescriptive nature of the design is meant to limit for instance the cement content, water-to-cement ratio etc. While such prescriptive codes are replicable in conventional engineering sites in dry land, they at times fail when adopted for marine construction sites. The descriptive codes are now slowly being replaced by the performance-based concrete durability design methods, which takes into account not only the concrete quality but also its service exposure environment in assessing the concrete's potential durability performance. Recently developed codes such as the EN 206-1 have been a major step towards implementing performance-based concrete design.

This paper argues that for the durable (and sustainable) construction of reinforced concrete structures in Africa at large, engineers need to quickly embrace durability design in their day to day concrete-related works. This will reduce the need for regular maintenance and reduced the overall cost of maintaining marine engineering projects. Reinforced concrete that are built based on the flexible durability design criteria can potentially last for intended service life of the engineering structure. These kind of engineering designs will ensure that the limited resources that are available in Africa are spent on more demanding sectors such as health and education instead of being used in repairing deteriorated reinforced concrete structures. In addition, such designs are also likely to promote the sustainability of engineering projects in the marine environment while facilitating proper marine ecosystem management.

6.3. IN PURSUIT OF DURABLE MARINE STRUCTURES

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ABSTRACT.
Marine structures are essential for the sustainable exploration and use of abundant natural resources in the open sea. With the emerging interest in blue economy, marine structures may include platforms for offshore oil and gas exploration, piers and jetties for fish landing, offshore tourism and marine sports, harbours for shipping, maritime defence facilities and affordable accommodation in small islands within the seas. In construction of marine structures, it is important to have durable structures that do not require regular maintenance and replacement within a short period, these structures are usually costly to construct since they require special engineering skills and materials that can withstand the often-salty water. Marine structures constructed from reinforced concrete often deteriorate as a result of the corrosion of embedded steel. This process is known as rebar corrosion and is characterized by rusting of the embedded steel due to chloride ions in the seawater. As the steel rusts and deteriorates, the pressure around the rebar increases and the concrete around the rebar is delaminated exposing the concrete to corrosion. As corrosion intensifies, the concrete quickly loses its structural integrity.

This paper proposes that the production of special reinforced concrete with higher durability can promote the construction of durable engineering structures to ensure sustainable exploration and use of marine resources. Moreover, such structures

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can reduce the cost of regular maintenance of the marine engineering structures. In order to produce the improved concrete, the choice of concrete binder and the design of the concrete mix should be considered. The author proposes for rapid construction between tides, high early strength for fast construction and high durability of the construction material to minimize the cost of maintenance. Further, to promote the local manufacturing industries, the author proposes for local sourcing of products to grow the local economy, ensure accessibility of materials and ensure engineering designs are easily replicable in other scenarios. In the discussion, the paper considers the cost-benefits of this new approach of concrete design. In conclusion, the paper asserts that engineering projects should not only be durable but must also be able to promote the sustainability of the blue economy.

Keywords: concrete binder, rebar corrosion, Marine structures, blue economy durability, sustainability)

6.4. MARINE CONSTRUCTION AND EQUIPMENT

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ABSTRACT

The concept of the blue economy is anchored in Kenya's Vision 2030 which is a long-term economic blueprint whose aim is to transform Kenya into a globally competitive country by the year 2030. Pillars of Vision 2030 that support the concepts of blue economy include agriculture, energy, tourism, infrastructure, trade, science, technology and innovation. In addition, as a signatory to the United Nations Sustainable Development Goals (SDG), Kenya works towards the development of blue economy through SDG 14, which advocates for conservation and sustainable use of ocean resources to spur sustainable development. Further, the national government in Kenya is currently implementing a five-year 4-pillar agenda that is dubbed Big Four Agenda. One of the targets of the agenda is to expand manufacturing sector with a special emphasis on the blue economy. Finally, the country has other enabling legislation which include the Kenya Maritime Authority Act of 2012, regulations, government circulars, the East African Treaty of 2007 and other commitments to international agencies including the European Union (EU), Africa Growth and Opportunity Act (AGOA).

This paper explores the physical infrastructure and equipment in the marine environment as enablers of accelerated economic growth within the Kenyan. In particular, the paper links development of marine infrastructure and equipment to the country's economic plans including Big 4 and Vision 2030 economic blueprint. The engineering construction works including jetties, berths, breakwaters, quays, retaining and diaphragm walls, boat ramps, dolphins, sheet piles, marinas and pontoons fall within the infrastructure that can promote the blue economy. On the hand, equipment include the necessary contrivances engineered to enhance performance of the blue economy for accelerated economic growth. In the discussion, the paper explores aspects that can promote the design and development of appropriate engineering infrastructure and equipment to facilitate sustainable development of the blue economy.

Keywords: Kenya Vision 2030, marine infrastructure, 4 pillar agenda, economic growth

6.5. STRUCTURAL DESIGN CONSIDERATIONS OF OFFSHORE WIND TURBINES

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ABSTRACT

The East African Region which includes Kenya, Tanzania, Uganda, Rwanda, and Burundi will become home to approximately 387 million inhabitants by 2050. Of this population, 43% are expected to live in cities with half of the urban population expected to live in coastal cities. This means that the countries in Eastern Africa must plan and be prepared to host more than 80 million of their citizens in these cities. Such a plan must include the provision of clear, reliable and affordable of energy. In addition, the governments in Eastern Africa should make include the provision of safe transport infrastructure and affordable shelter that can promote the quality of life of the people. Unfortunately, the energy profile of sub-Saharan Africa remains the lowest with the region accounting for only 4% of the world's installed energy capacity. By targeting only, the

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section of citizens and users who can afford to pay for energy, on average only 18% of sub-Saharan Africans have access to electricity. There is a deficit of 10,000 GWh/year which is expected to grow twofold to 23,0000 GWh/year by 2050. The per capita deficit in the East African countries is estimated to be approximately 500kwh/year. With the aim of having 'Renewable energy in the blue economy,' It is surprising that only 1% of the total energy production in the East African region comes from renewables. With the current trend of investments, this value will only reach 2% by 2040.

In this paper, the authors provide a brief review the economics of wind farming and its advantages over other forms of renewables. The technical aspect of this paper revisit the environmental considerations and the models for designing blades, the support (tower), and the foundation for offshore wind turbines. The highlighted design models analyse stochastic loading conditions and response effects of wind turbines. In addition, the models consider only the frequency domain instead of the time domain. The hope is that the design consideration and the challenges highlighted in this work can contribute towards accelerating adoption of renewable energy and prepare the countries in Eastern Africa for the expected rise in demand for electricity.

Keywords: Wind farming, offshore wind energy farming, renewable energy, sustainable wind turbines

7. Desalination

7.1. DESALINATION: A SOLUTION TO WATER SHORTAGE PROBLEMS IN THE KENYAN COAST

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Water Desalination Plants in the Kenyan Coast I Email: mainafmuriithi@gmail.com

ABSTRACT

Rural to urban migration has led to a rise in the population of people within cities and urban areas in Kenya. The demographic changes have resulted from the quest by young Kenyans to find better opportunities in employment, education, health services, technology and fashion in urban areas. Consequently, there is need to provide additional housing, reliable energy sources, adequate water supply, sustainable waste management systems and reliable public transport. The surge in population in urban areas is causing a strain on essential amenities such as water, electricity, housing, waste disposal, transport, education and medical services. There is also a need for additional investment to ensure that there are adequate educational and vocational institutions, and accessibility to affordable and efficient health facilities.

The focus of this paper is to contribute to finding a solution to water shortage problems in urban areas with the aim of improving water supply to cater for the rise in demand of the essential commodity. In particular, this work proposes the introduction of water desalination plants in the coastal towns of Mombasa, Diani, Mtwapa, Kilifi and Malindi, which have been the most affected by rural to urban migration in the coastal region of Kenya. Specifically, the process of desalination will be achieved through Reverse Osmosis (RO) in water desalination plants to be established in different beaches within the Kenyan part of the Indian Ocean. To actualize the process of desalination, water from the ocean will be pumped to the plants for processing. The processed water will then be stored in elevated water tanks, which will be constructed for each treatment plant. The elevated tanks will facilitate the distribution of the treated water to the surrounding towns through gravity. In order to supervise, monitor, control and manage the water supply, consumption, pressure levels and address any leakages in the system, a Supervisory Control and Data Acquisition (SCADA) system will be deployed. The water treatment plants will be connected to the Kenya Power and Lighting Company (KPLC) electricity grid to ensure that there is a consistent and reliable supply of electricity to the plants. Finally, the sludge from the water treatment plants will be deposited back into the ocean. This will reduce the need for additional waste management site. In the end, the water desalination plants and the distribution system will ensure that there is an integrated water management system that can sustainably meet the needs of all the major towns within the Kenyan coast.

Keywords: Desalination, water treatment plants, waste management

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7.2. HARVESTING FRESH WATER FROM OCEANS USING SOLAR POWERED DESALINATION SYSTEMS

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ABSTRACT

The economy of Kenya relies heavily on rain fed agriculture. The overreliance on rainfall exposes the country to food insecurity particularly with erratic rainfall patterns as have lately been experienced due to climate change. Sustainable water supply is one of the agenda of the government in developing the blue economy. To achieve this goal, focus must be placed on the adoption of technology for harvesting water from the Indian Ocean for agricultural purposes. This paper explores the methods that can be applied to harvest water from oceans to meet agricultural and domestic demands. The method must be able to affordably achieve mass desalination of the ocean waters with minimal impact on the environment. Motivation for this work is derived from countries like Israel that rely on seawater to meet most of her domestic, agricultural and industrial demand. Today 60% of Israel's domestic water demand is met through desalination – a process through which salt and other impurities are removed from seawater to produce fresh water that can be used for domestic and agricultural purposes. Desalination plants commonly use the process of reverse osmosis. In reverse osmosis, seawater is forced through ultra-fine membranes that filter out salt molecules. Unfortunately, conventional reverse osmosis requires expensive infrastructure and large amount of electricity. These plants also release large amount of concentrated saltwater and other pollutants back into the ocean hence creating problems for marine environment. Hence, a new method that is affordable, eco-friendly and more energy efficient is urgently needed. In this contribution, the author proposes a solar-powered desalination involving a two-step desalination process. The first step involves filtering the liquid through a polymeric membrane, while the second step requires vaporizing and collecting the condensed water. The heat required during vaporization stage can be generated by the solar panels. Such a solution uses renewable energy to reduce the cost of energy that is required for desalination. The water from the system can then be used to promote agriculture and improve food security in the country. In addition, the salt which results from desalination can be further processed for domestic, industrial and in animal feeds.

Keywords: Desalination, Reverse Osmosis, Water harvesting, Sustainable water supply

7.3. DESALINATION; ALTERNATIVE TO MEETING DEMAND OF FRESH WATER

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ABSTRACT

There is a growing body of evidence and global consensus that oceans and seas are vital for sustainable development. The oceans cover two thirds of the earth's surface area and contribute to the life on earth. In particular, fish from the oceans feed billions of people while different industries depend on the oceans to provide employment opportunities for millions of workers in various sectors thereby generating trillions of dollars in the world economy. Furthermore, the oceans regulate the global weather and climate patterns. In spite of the large volume of water that is stored in the oceans, the amount of salt and chemicals in the waters hinder its use for domestic and agricultural purposes. Securing adequate quantities of clean and safe water to meet the needs of a growing population is one of the greatest challenges and obstacles to development of the blue economy.

Meeting the demand for freshwater is expected to become increasingly difficult in the context of climate change. The extraction and use of water from oceans can provide an effective solution to the demand of fresh water. Extracting fresh water from the ocean relies on effectiveness of the process of desalination which removes the excessive salt and harmful chemicals from the water. To date, only a limited number of desalination plants have been built along the coast. A major hindrance to the adoption of large-scale desalination is the cost of installation and the large amount of energy that is required to power the desalination plans and large. With the increasing incidences of drought and the ever present challenge of climate change that continue to reduce the fresh water supplies, desalination remains the only alternative to meeting demand of fresh water. In order to develop the appropriate technology that can support large-scale, research should focus of how to improve the current methods of desalination. Apart from reverse osmosis, other methods should be developed which would be less energy demanding. In addition, continued developments in clean and cheap energy can also contribute to reducing the cost of desalination.

Keywords: desalination, ocean economy, fresh water

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7.4. SYSTEMS ENGINEERING APPROACH TO SELECTION OF BMSMR FOR POWER GENERATION AND DESALINATION

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ABSTRACT

Kenya's vision 2030 economic blueprint has identified energy as a key enabler for the realization of economic growth and prosperity of the country by the year 2030. The plans for accelerated infrastructure development and economic growth at the national and county levels require reliable, safe, and adequate power supply. Despite the noble ambition, many counties in the country continue to experience low accessibility to electricity. In addition, the cost of electricity is beyond reach for many citizens, resulting in low rates of installation and use particularly in the rural areas. Barge Mounted Small Modular Reactors (BMSMRs) are ideal for spurring the development of the coastal regions through simultaneous generation of power and provision of clean drinking water which can be processed from sea water through desalination process. Small and modular reactors are easy to deploy and can be used without connecting them to the main grid hence making them suitable for use in remote locations without elaborate transmission network. BMSMR was particularly introduced as favourite for developing countries based on its plug and play capabilities, affordability, and incremental development. In addition, mounting the reactors on mobile barges make the solution suitable for applications in the ocean economy including in marine fisheries and tourism.

This paper presents a conceptual framework for barge (boat) mounted modular reactors. The systems engineering approach is proposed for selecting an appropriate BMSMR system. In particular, the systems engineering approach considers a number of characteristics including barge mobility, systems safety, power output, desalination capabilities, and construction duration. The holistic approach to system development was evaluated by considering product life cycle of the candidate BMSMR systems. Specifically, the authors incorporated a trade-matrix analysis to evaluate the system. The parameters to the matrix included needs analysis (NA), concept exploration (CE), and eventual concept definition (CD). As on output, the system selected the candidate BMSMR with the desired specifications for power generation and desalination capabilities. A system like the one presented in this work could be applied during the procurement for energy solutions in remote locations.
Keywords: Systems Engineering, Power generation, Desalination, Barge, Small Modular Reactor, Trade off matrix method.

8. Marine Fisheries and Aquaculture

8.1. FADS FISHERY ALONG THE KENYAN COAST: SOCIO-ECONOMIC PROBLEMS AND PROSPECT

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Existing fishing methods and traditional vessels used by artisanal fishermen in the Kenyan coast are not efficient for harvesting scattered resources. These inadequacies force fishermen to be confined to overfished sheltered reef areas. For this reason, Fish Aggregation Devices (FADs) have been proposed as a new technological frontier with better prospects for capturing high value fish species like tuna and improve incomes of coastal fishermen. In spite of the benefits that FADs promise, and deployment of experimental FADs, the uptake of this technology still remains low.

This study provides a socio-economics lens with which to view the current status of Kenya's FADs fishery in the Kenyan coast. In particular, the authors highlight the prospects and challenges that are hindering the uptake of the FAD technology by coastal artisanal fishermen. Survey data for this work was collected through a combination of questionnaires and participant observations. Results reveal that fishing activities by the artisans are restricted to the shallow protected waters of the barrier reef. Moreover, the artisans operate small non-mechanized crafts during the fishing trips. The fishing duration is relatively high and on average lasts for about 7 hours in a single day. The study also revealed that the traditional basket traps are the most preferred fishing gear with about 43% of the fishermen using basket traps. On the contrary, only 13% of the fishermen were aware of the FADs. The shortcomings that hinder the adoption of FADs included risk of theft and vandalism of equipment, the likelihood of attracting illegal fishermen and also the increased likelihood of conflict between fishermen who adopt FADs and those who stick to the conventional methods of fishing. Although 72% of fishermen who were introduced to the FADs thought they were highly effective, fishermen generally considered the gadgets unsustainable

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due to their high costs and lack of special expertise to effectively use the gadgets. In conclusion, the authors recommend that to promote the adoption of FADs, fishermen should be equipped with modern fishing vessels that can guarantee fishing beyond the reef where FADs are most effective. Further, FADs should be fabricated from locally available materials in order to enable fishermen to learn and improvise by using materials at their disposal.

Keywords: Marine fishing, fish aggregation devices (FAD), innovation, adoption

8.2. BLUE VICTORIA: THE POTENTIAL FOR RECREATIONAL FISHING INDUSTRY IN LAKE VICTORIA TOWARDS PROMOTING BLUE GROWTH

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ABSTRACT

The fishing industry in Lake Victoria provides employment opportunities to more than 220,000 people who are involved in fish production. In addition, the industry supports many informal employment opportunities in fish trade and artisanal processing. The lake is the largest source of fish products in the country, accounting for more than 90% of the annual production. In 2015, it was estimated that annual fish production from Lake Victoria was approximately 118,145 metric tonnes with a value of 9.3 billion Kenya shillings. However, recent studies indicate that in spite of the declining fish stocks, there is a marked increase in fishing activities. Addressing the challenge of overfishing in Lake Victoria calls for diversification of the fishing industry in the country. In particular, the diversification should include a shift of focus from commercial and subsistence fishing to recreational fishing. This shift can promote marine tourism in the region and contribute to environmental conservation.

Currently, conventional recreational fishing equipment which include long-line and hard-lines are not categorized as recreational equipment in Kenya even though they account for about 15% of the fishing equipment used by fishers. The ready availability of recreational fishing equipment is an indication of the resource capacity that can be adopted for recreational angling. An expansion of recreational fishing will provide economic opportunities for the local manufacturing industry around the lake. In particular, local manufacturers will be able to find opportunities for designing and producing fishing gears and building recreational boats to facilitate the angling activities around the lake. In addition, players in the tourism industry will also find opportunities for managing recreational boats that could be chartered for recreational angling and for guided fishing trips. This paper argues that the envisaged recreational fishing industry will provide local communities with an alternative source of income and employment opportunities. In addition, a shift to recreational fishing will help in improving the fish stock and open up avenues for exploration of marine life beyond consumption and fish trade, thereby promoting sustainability of the lake ecosystem.

Key words: Recreational, Fishing, Blue growth, Victoria, Potential, Sustainability

8.3. BOUNTIES OF LAKE VICTORIA: A CASE FOR BLUE ECONOMIC INVESTMENT.

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ABSTRACT

Located in East Africa, Lake Victoria is iconic in both its size and function. With a surface area of approximately 68,000 km^2, it is the largest freshwater lake in the tropics and only the second in the world. The lake is of immense ecological and socio-economic signi□cance for the riparian communities. Whether it is for food, transportation, water for domestic and industrial uses, recreation or regulation of climate and aquatic ecosystems, Lake Victoria has always been an integral part of survival and wellbeing of lake-edge communities. To underscore its importance, the lake's □sheries annual catch of close to 1 million tonnes accounts for between 1-8% of the world's total inland fish production. The lake provides employment opportunities for 1 million people in the areas of fish harvesting, processing and trade. In addition, the lake serves as a significant tourist attraction in the Great Lakes region thereby contributing the economic growth of the region. Lake Victoria Basin is also recognized for its high levels of freshwater species diversity, which are of critical importance to local livelihoods and national economies within the basin

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In this paper, the authors quantify the various ecosystem services offered by Lake Victoria. Specifically, the authors highlight the true contribution of the lake to the wellbeing of the region, a dimension that has largely been ignored. This attention is motivated by the backdrop of human induced pressures such as over□shing, introduction of alien species and increased pollution that threaten sustainability of ecosystem services offered the lake. Apart from highlighting the ecological significance of the lake, the authors provide suggestions on practical steps that can be adopted to promote sustainability of the lake as a way of safeguarding the biodiversity in the lake and the livelihoods of the people that rely on the lake. Specifically, diversification of investments to unexploited niches of the resource and value addition opportunities for potential blue economic growth are highlighted. Practical examples include developing tourism products and research centres around the lake to highlight different aspects of the ecosystem of the Lake Victoria basin. Such products will not only provide alternative opportunities and resources but also help in educating the different stakeholders on the significance of the lake and basin.
Keywords: Lake Victoria, blue growth, lake ecosystem, ecosystem services, diversification

8.2. BLUE VICTORIA: THE POTENTIAL FOR RECREATIONAL FISHING INDUSTRY IN LAKE VICTORIA TOWARDS PROMOTING BLUE GROWTH

Authors: Nyaboke H.*1, Nyaundi J.,1 Owili M.,1 Nyamweya C.,1 Aura C.,1 Gichuru N.,1 Okechi J.,1,3 Owiti H.,1 Mwanzala F.,1 Sudoi V.2 and Liti D.2 | Email address: nyabokehilda@gmail.com

ABSTRACT

The fishing industry in Lake Victoria provides employment opportunities to more than 220,000 people who are involved in fish production. In addition, the industry supports many informal employment opportunities in fish trade and artisanal processing. The lake is the largest source of fish products in the country, accounting for more than 90% of the annual production. In 2015, it was estimated that annual fish production from Lake Victoria was approximately 118,145 metric tonnes with a value of 9.3 billion Kenya shillings. However, recent studies indicate that in spite of the declining fish stocks, there is a marked increase in fishing activities. Addressing the challenge of overfishing in Lake Victoria calls for diversification of the fishing industry in the country. In particular, the diversification should include a shift of focus from commercial and subsistence fishing to recreational fishing. This shift can promote marine tourism in the region and contribute to environmental conservation.

Currently, conventional recreational fishing equipment which include long-line and hard-lines are not categorized as recreational equipment in Kenya even though they account for about 15% of the fishing equipment used by fishers. The ready availability of recreational fishing equipment is an indication of the resource capacity that can be adopted for recreational angling. An expansion of recreational fishing will provide economic opportunities for the local manufacturing industry around the lake. In particular, local manufacturers will be able to find opportunities for designing and producing fishing gears and building recreational boats to facilitate the angling activities around the lake. In addition, players in the tourism industry will also find opportunities for managing recreational boats that could be chartered for recreational angling and for guided fishing trips. This paper argues that the envisaged recreational fishing industry will provide local communities with an alternative source of income and employment opportunities. In addition, a shift to recreational fishing will help in improving the fish stock and open up avenues for exploration of marine life beyond consumption and fish trade, thereby promoting sustainability of the lake ecosystem.
Key words: Recreational, Fishing, Blue growth, Victoria, Potential, Sustainability

8.3. BOUNTIES OF LAKE VICTORIA: A CASE FOR BLUE ECONOMIC INVESTMENT.

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ABSTRACT

Located in East Africa, Lake Victoria is iconic in both its size and function. With a surface area of approximately 68,000 km^2, it is the largest freshwater lake in the tropics and only the second in the world. The lake is of immense ecological and

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socio-economic signi□cance for the riparian communities. Whether it is for food, transportation, water for domestic and industrial uses, recreation or regulation of climate and aquatic ecosystems, Lake Victoria has always been an integral part of survival and wellbeing of lake-edge communities. To underscore its importance, the lake's □sheries annual catch of close to 1 million tonnes accounts for between 1-8% of the world's total inland fish production. The lake provides employment opportunities for 1 million people in the areas of fish harvesting, processing and trade. In addition, the lake serves as a significant tourist attraction in the Great Lakes region thereby contributing the economic growth of the region. Lake Victoria Basin is also recognized for its high levels of freshwater species diversity, which are of critical importance to local livelihoods and national economies within the basin

In this paper, the authors quantify the various ecosystem services offered by Lake Victoria. Specifically, the authors highlight the true contribution of the lake to the wellbeing of the region, a dimension that has largely been ignored. This attention is motivated by the backdrop of human induced pressures such as over□shing, introduction of alien species and increased pollution that threaten sustainability of ecosystem services offered the lake. Apart from highlighting the ecological significance of the lake, the authors provide suggestions on practical steps that can be adopted to promote sustainability of the lake as a way of safeguarding the biodiversity in the lake and the livelihoods of the people that rely on the lake. Specifically, diversification of investments to unexploited niches of the resource and value addition opportunities for potential blue economic growth are highlighted. Practical examples include developing tourism products and research centres around the lake to highlight different aspects of the ecosystem of the Lake Victoria basin. Such products will not only provide alternative opportunities and resources but also help in educating the different stakeholders on the significance of the lake and basin.
Keywords: Lake Victoria, blue growth, lake ecosystem, ecosystem services, diversification

8.4. HAVE INNOVATIVE TECHNOLOGIES REDUCED FISH POST HARVEST LOSSES ALONG LAKE TURKANA? CASE STUDY OF THE POLYETHYLENE SOLAR DRYER

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ABSTRACT

Lake Turkana is the second largest lake in Kenya. The geographical location of the lake in the northern semi-arid section of the country positions it as a major contributor to the economic development and a source of livelihood for the communities in the arid area. The fish from the lake provide an important source of proteins for the communities around the lake. Unfortunately, there are no large-scale fish processing industries in the area thus leading to post-harvest losses. Consequently, there is a need for urgent measures to improve the fishing industry and develop innovative technologies to reduce fish post-harvest losses. To address the gap, polyethylene solar dryers have been built around the lake as a way of reducing post-harvest losses.

This study investigated the effectiveness of the solar dryers at Nariokotome Beach Management Unit (BMU) which are situated on the north western side of Lake Turkana. Data was collected through questionnaires, fish drying trials, shelf life trials and physical count of solar dryers. When the fish was weighed after 44 hours of drying, the samples, which were dried on solar dryers, lost 55.98% of their weight while the samples, which were dried on stones lost 61.3% of their weight. Physical observations on status of the dryers found that 54% of the dryers were in good working condition while the remaining 46% of the dryers were dilapidated. The study also revealed that Kenya Marine and Fisheries Research Institute (KMFRI) was the largest donor of solar dryers along Lake Turkana having constructed 51% of all the solar dryers. This study revealed that polyethylene solar dryers are not effective for the reduction of post-harvest fish loss in Lake Turkana. The fishers were actually using only 30% of the solar dryers even though 54% of the dryers were in good working condition. Furthermore, there was no evidence on improvement in income of fishermen or uptake of solar dryers by fish processors along Lake Turkana despite massive investment in their construction by various donors. The main weakness of the solar dryers was the long duration that they took to dry fish and the drastic reduction of weight after drying. The authors recommend that alternative innovation for drying fish along Lake Turkana should be developed and should factor in the challenges encountered in uptake of polyethylene solar dryers.
Keywords: polyethylene fish solar dryer, Lake Turkana, post-harvest losses.

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8.5. THE BLUE OCEAN ECONOMY IN THE OIL & GAS SECTOR IN KENYA: THE ROLE OF KISUMU OIL JETTY IN ACCELERATING ECONOMIC DEVELOPMENT WITHIN LAKE VICTORIA REGION.

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ABSTRACT

Water transport of people and goods in Lake Victoria and in the Great Lakes region remains largely underdeveloped. This is in spite of the large water mass that is shared by the three countries of Kenya, Uganda and Tanzania in addition to numerous rivers that can be developed to provide cheap and affordably movement of people and goods in the East African region. Water transportation is comparatively faster, efficient and more affordably than the commonly overused road transport. Water transportation relies on direct shipping lines linking port towns on the shores of the lake. The direct links reduce the amount of fuel and time that is used for transportation. In addition, lake-based transportation of goods can reduce long durations that are used for clearance of multiple road users at border crossings. Transportation across the lake would also substantially reduce the pressure on the road infrastructure in the region thereby reducing maintenance costs. The Kisumu Oil Jetty project that aims to transport in excess of 8 million litres of petroleum products between Kisumu in Kenya and Bugiri near Entebbe in Uganda in two weekly trips will enhance the oil industry in East and Central Africa. Other benefits of water transportation of oil products include the elimination of the risk of adulteration and theft of fuel products along roads. In addition, lake transport will guarantee the security and safety of the cargo.

The authors argue that the Kisumu Oil Jetty will go a long way in opening up the navigation channels to much more traffic both between the East African countries and also within the individual countries. Apart from serving the ports on Lake Victoria, a vibrant oil jetty at Kisumu and efficient transport in the lake will attract trade from other ports within Kenya. The success of the project will thereby contribute to economic development along Lake Victoria and an increase of economic opportunities in the region. In addition, the success of transport in Lake Victoria will promote the development of other industries in the area. For instance, fishing industry could be expanded to meet the rising demand for fish that will come with improved economy in the region.

Keywords: Water transport, oil jetty, Lake Victoria, regional trade

9. Port, Shipping and Marine Surveillance

9.1. INLAND WATERWAYS “THE GENTRIFICATION PROBLEM”

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ABSTRACT

The Government of Kenya through the Ministry of Transport and Infrastructure launched the Low Volume Roads (LVR) framework in July 2014. In the framework, firms from private sector enter into financing agreements with the government for roads projects. It was anticipated that a total of 10,000 km roads would be upgraded to bitumen standard by the year 2017.The roads implemented under this framework had been classified into three phases with the first phase targeting 2,000 km, second phase 3,000 km and the third and last phase 5000km.

This paper presents the findings of an Environmental and Social Impacts Assessment (ESIA) study which was undertaken to investigate the gentrification problems as an integral part of the designs of LVR scheme. The framework which was adopted in the study was based on the requirements of Environmental Management and Coordination Act 1999 and the Legal Notice 101 of June 2003. In addition, the study addressed client expectations as stipulated in the terms of reference. The main objective of this work was to identify environmental and social impacts associated LVR projects and to recommend appropriate mitigation measures for integration in all phases of project development. Moreover, this work intended to lay the groundwork for detailed ESIA studies leading to development of permanent solution for environmental and socio-economic management plans for all the projects. Baseline data was generated through discussion with the client and a review of

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previous projects documentations. Opinions from the baseline data were validated through field work which entailed site interviews with residents in potentially affected areas and with secondary stakeholders. To identify and evaluate potential impacts that may emanate from the problem, diverse study methods and tools including use of checklists, matrices, expert opinions and observations were employed. An Environmental, Economic and Social Management Plan comprising of an impact mitigation plan and modalities for monitoring and evaluation was developed to guide environmental, economic and social management during all phases of projects developments in future. In conclusion, the result of this study are not only applicable on LVR projects but can also find application in construction of engineering infrastructure to serves the blue economy particularly as these may include road construction to serve coastal communities.

Keywords: Low Volume Roads. environmental impact, gentrification problems

9.2. REMOTE POWER MONITORING OF MARINE SITES

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ABSTRACT

Power monitoring is essential in ensuring continuous operation of electrical equipment in a given setting. Apart from guaranteeing the continued operation of the electrical equipment, power monitoring ensures the safety of the equipment and facilities that rely on power or are in the vicinity of the power transmission infrastructure. In addition, power monitoring reduces the chances of unexplained resetting of control devices and can also improve the costing system to ensure that power consumers are getting value for their money while the power provider is not incurring avoidable losses. Many remote sites are prone to unattended power losses. Such unintentional power losses can adversely affect economic activity and have catastrophic consequences when the power is intended for critical areas of application. With the growth of the blue economy, vital sectors of the economy and critical infrastructure are likely to be built within the deep sea. There are opportunities to construct sensitive renewable energy plants, fishing jetties and tourist attraction sites and products within the ocean. Such services require around the clock power supply and fast intervention in case of power losses. Unintended power loss can manifest in the form of loss of power supply, faults and drained back-up battery.

This paper focuses on the different techniques that rely on Global System of Mobile Communication (GSM) and highlights the advantages that automated power monitoring systems may present to the blue economy. The effectiveness of real time power monitoring systems in remote marine sites will play a critical role in ensuring that the power supply, both traditional and alternative sources are monitored and information about them is relayed to relevant personnel in near real time. The monitoring capability should also provide expert insight that can help in decision making and facilitate quick restoration of power in the affected areas. A good monitoring system should give an indication of the potential cause of unintended interruption, the exact location, the time and any other auxiliary information that may aid in the mitigation. In other cases, the monitoring system should also be able to rectify the problem through remote assistance of the operator.

Keywords: Global Systems of Mobile Communication (GSM), power losses, power monitoring

9.3. UTILIZATION OF NIGERIAN SATELLITE AUGMENTATION SYSTEM FOR OCEAN NAVIGATION, MARINE AND VESSEL SAFETY.

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ABSTRACT

Nigerian Satellite-based Augmentation System (NBAS) arose from the need to provide continuous and accurate Global Navigation Satellite Systems (GNSS) signals for African users. Such a system could act as an alternative to eliminate the discrepancies associated with Global Positioning Systems (GPS) and other navigation systems. Satellite images from NBAS were meant to provide a Navigation Overlay Services to fill the gaps that are overlooked by other GNSS when capturing images of the African continent. Having a complete and regular satellite images can meet requirements of aviation, defense, maritime security, and provide effective location based services to support disaster management. Maritime navigation and accurate determination of position at sea provided the impetus to create systems that are capable of providing accurate and precise locations. The ability to accurately determine the longitude and latitude of a place is important for land surveying,

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tracking of vehicles and navigation. In addition, accurate satellite navigation systems can support ground based reference systems and provide a means of correcting and validating land surveying data. Apart from South Africa, most countries in sub-Saharan Africa have not invested heavily in satellite navigation. As a result, the African continent is heavily reliant on US, Europe and the Asian giants of China and Japan to provide it with satellite imagery about the continent.

The paper describes various applications of satellite navigation systems in the maritime environment. Examples of the applications include navigation in restricted inland waterways, safe docking at harbours, and monitoring of movements of vessel. The authors describe how precise location data can be used to monitor changes in engineering structures to detect deformations and distortions. Such a system can be useful for monitoring bridges to ensure safe passage of marine vessels. In addition, advances in positioning systems can be used to monitor sea surface characteristics and provide a warning systems particularly during earthquakes and hurricanes.

Keywords: Communications Satellite, GNSS, Global Position System, Location Based Services

9.4. EXTENDED ENDURANCE SURVEILLANCE & MONITORING USING REMOTE PILOTED AIRCRAFT SYSTEMS

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The coastline of any country is an area of interest and importance to a country's economy and environmental health. Traditionally, coastal ports have been a major gateway for entry and exit of goods and passengers. Even with the invention and growth of the airline industry, sea ports remain the most preferred trade route, especially for bulky non-perishable and semi-perishable goods. For Kenya, the coastal region with its scenic white sand beaches and warm climate, provide an additional source of income in terms of tourism. This, combined with the fishing industry, means that there is need for large scale monitoring and surveillance of the coastal region to protect the vital resources. The vast waters of the Indian Ocean avail an arena for monitoring the national and international waters to ensure the safety of trade routes, provide security and enforce sustainable environmental practices to safeguard the oceans. The large expanse of the ocean however reduces the effectiveness of contemporary manual monitoring methods. To facilitate effective monitoring of the seas, other countries have adopted modern technology including satellite-based systems and sensors that are installed in various locations with the ocean.

This paper examines the feasibility of using a remote piloted aircraft system to perform surveillance and monitoring of the coastal region of Kenya. Different designs and configurations were explored to find a system that can be employed for effective surveillance and monitoring. Based on an extensive evaluation which considered different factors including cost, safety, challenges of the area of interest, and regulatory constraints, a fixed wing system was found as the most suitable solution for this task. In conclusion, the author proposes the engineering designs that can be considered for this system and observes that, apart from building the marine ecosystems, engineers have a role to play in ensuring safe and sustainable use of marine sectors. This can only be achieved by developing appropriate engineering solutions and adopting innovative strategies that can promote safe and non-intrusive monitoring of coastal waters and the ecosystem. Solutions must consider different factors and challenges that are inherent in marine environment. The solution discussed here addresses these factors in order to provide a system that can be adopted for marine monitoring.

Keywords: Marine surveillance and monitoring, aircraft monitoring

10.1. AFRICA PASS: AFRO-EURASIA CONCEPT FOR ENERGY MANAGEMENT BY ACTIVATING POLITICAL ENGINEERING PROJECT COOPERATION.

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ABSTRACT.

Egypt occupies an important position in Africa as the gateway between the continent and Mediterranean seas and the Middle East. However, lack of modern infrastructure connecting Egypt to other countries in sub-Saharan Africa has prevented the continent from gaining from trade, tourism and cultural exchanges that could be derived from the connection.

This paper discusses the primary master plan of the Africa Pass project, which will depend on Egypt's distinct geographic

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location, human capital, natural resources, and advances in renewable energy development to guide massive infrastructure development. Specifically, Africa Pass project proposes to develop large-scale transport, energy and manufacturing infrastructure in the western desert of Egypt that will pass through 15 countries in the first two phases. Further phases could also include more countries in the northern and eastern African region.

The general idea of the project considers approximately 2 million people who will gain directly from employment opportunities in infrastructure development, food production, logistics and other service industries. In addition, more than 100 million people in the interior of the African continent will gain from the infrastructure that will pass through different countries. Further, the project is expected to contribute to the mobility of people and goods between the connected countries thereby promoting trade and mutual exchanges between people. Moreover, the project will facilitate the development of industries in the logistical services and food production. To support food production, the African Pass project proposes to concentrate agricultural activities around Qattara Depression. Food production and processing will rely heavily on renewable energy including solar and wind which will be harnessed from the western desert of Egypt. In this concept paper, the author introduces a hope to Africa by proposing large-scale urban and regional infrastructure planning master plan that will positively influence the lives of many Africans. From a regional planning perspective, the Africa Pass project will distribute population of Egypt from the narrow Nile valley to the western desert thereby reducing overreliance on the Nile river. The diversification of water and food sources will promote peace and equitable use of the resources of the Nile resources among all the countries that depend on the Nile. The project will also revolutionize the economies of Sub-Saharan and North Africa and relations within the continent and across the Mediterranean into Europe.

Keywords: Africa Pass, regional planning, infrastructure development

10.2. ARISING CONTROVERSIES AROUND AFRICAN RIVER WATERS: A CASE OF RIVER NILE.

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ABSTRACT:

River Nile is arguably the most significant river water resource on the African continent. It cuts across Uganda, South Sudan, Sudan, Ethiopia and Egypt. Residents of each of these countries are highly reliant on the water from the river and this has fueled water related wars. The most significant 'war' resulting from the use of the Nile waters is the ongoing feud between Egypt and Ethiopia. This came about as a result of Ethiopia's ambitious plan to set up the 1.7 Km long Grand Renaissance Dam across the Blue Nile.

The Controversial project has strained relationship between the two nations. Egypt has long held the majority rights to the Nile and relies almost entirely on the river for its water needs. "Construction has never stopped, and will never stop, until the project is completed [...] We are not concerned by what Egypt thinks - Ethiopia is committed to benefitting from its water resources without causing harm to anyone," Ethiopia's Minister of Irrigation, Water and Electricity, Seleshi Bekele, is quoted to have said. (Aljazeera News, 28 November 2017)

Important to note is that before the initiation of the project construction phase, the three main countries that share the Nile River's waters moved toward an agreement to study whether the Ethiopian dam would disrupt flows to downstream countries, water ministers of Ethiopia, Sudan and Egypt came together for this meeting (Africa Business Central, October 20, 2014). Ethiopia however insists that its main concern is to exploit its water resources for the benefit of the Ethiopian people without affecting any of their neighbors. The Ethiopians have chosen to continue with the construction of the dam as they continue with the negotiations as Egyptians continue to cry foul.

The conflicts around the Nile River's waters is one of the several water related conflicts that are currently existent within the African continent. In West Africa, there continues to be controversies around the rivers Volta and Niger. In Southern Africa, there continues to also exist conflicts around the use of water in River Limpopo. Most of the problems arise from colonial treaties that were signed during the colonial times and have since not been altered to fit the dynamic growth and development that the continent has been experiencing since Independence.

This therefore brings about the need for African Engineers to come on board and be part of evading the possibility of the

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third World War, resulting from Water conflicts within our continent. As stakeholders in the Blue economy, we have no option but to embrace a comprehensive monitoring and evaluation approach, which will go a long way in helping up develop Water projects that are not only beneficial to the communities but are also sustainable. By doing this, the continent shall experience a decrease in water related wars and an increase in development of projects that embrace sustainable use of water resources.

10. Blue Economy

10.3. FUZZY LOGIC MODEL FOR OBSTACLES AVOIDANCE ROBOTIC CRANE IN STATIC UNKNOWN ENVIRONMENT. - SUB THEME. PORTS SHIPPING AND MARINE SURVEILLANCE.

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ABSTRACT

Cargo handling is a major part of the maritime industry. Cargo handlers face risk of accidents from loading and unloading assignments during their work and even worse accidents from the equipment that are used in the shipping industry. Repetitive motion injuries, joint damages and injuries from falls are common accidents particularly for people who move cargo by hand. Furthermore, even when cranes are used, accidents from mechanical faults or operator errors are also common. In order to reduce accidents in the maritime industry, automation of cargo handling processes is recommended. In particular, the use of robotics for cargo handling has been tested and implemented with huge success. Autonomous mobile robots have been used to automate some aspects of the shipping industry. A reliable collision avoidance methodology is needed for robotics to navigate effectively in seaports. Conventionally, robots are fitted with sensors for detecting their environment and transducers for communicating with other robots and the central control system. However, the sensing, communication and coordination mechanism are still unreliable for achieving faultless navigation in complex environment like those in seaports. In particular, the robots have to overcome pertinent problem of dealing with vagueness in their surroundings. Fuzzy logic is a mathematical method that is appropriate for handling uncertainty emerging from imprecise knowledge.

In this work a fusion of Mamdani Fuzzy Inference model which is an advanced version of the fuzzy logic is presented. Specifically, the model uses eight input ultrasonic sensors, two output variables and twenty-seven fuzzy rules to solve the navigation problem. The study investigated the possibility of modelling and handling uncertainty by tuning controller and applying sensor data to achieve efficient results for mobile crane navigation in seaports. Multiple simulations were performed to validate and to check the feasibility and efficacy of proposed model. The implementation was performed in V-REP and MATLAB software. The result of this work provide a promising solution that will find application in the marine industry for automating cargo handling. Large-scale automation will improve the efficiency of the seaports and contribute to an increase in the volume of trade thereby leading to economic growth.

Keywords: Fuzzy logic, Autonomous robot, Proximity sensors, Cargo handling

10.4. OFFSHORE GEOTHERMAL DRILLING: A RENEWABLE ENERGY SOURCE FOR AFRICA

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ABSTRACT

Geothermal energy emanates from thinned out layers of the earth's surface particularly in regions where rift tectonism accompanied by intense volcanism has taken place. In Africa, the rift system runs from Afar triple junction in the north of Ethiopia to Beira, Mozambique in the southern African region. The rift system is an intracontinental divergence zone that hosts extensive geothermal systems. Exploration of the geothermal resource is done by drilling of wells that reach the steam, at temperatures as high as 300°C. The compressed steam can then be used to generate power by using it to turn turbines or by pumping the hot steam to pump water to high head hydroelectric power generation systems. All of Africa's geothermal exploration and development is done onshore in sites along the African rift. Offshore geothermal energy has

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not been considered as a feasible option. With the continuous rise in the cost of electricity and the emergence of blue economy that is reliant on the ocean ecosystem, this may be the time to consider offshore geothermal development to provide the much needed energy to support the blue economies. It has been estimated that in the oceans, tens of terawatts of geothermal energy is dissipated through hydrothermal vents. Unfortunately, this rich resource has not been explored conclusively to as a source of clean and affordable energy. The only examples of offshore geothermal drilling are in Marsili Italy, the hydrothermal vent project in the Gulf of California and Reykjanes ridge in Iceland.

This paper looks at the prospects of offshore geothermal drilling as an alternative source of renewable energy for the African economy. Specifically, the paper outlines the methods for mapping out the geographic and temporal variation of temperature fields in the African seas. In addition, out from the mapping exercise is augmented with other scientific data and validated with sample data from on-field exploration. In the discussion, the paper highlights the technical potential of geothermal energy in Africa. The results of this work contribute the diversification of energy sources to meet the growing demand and contribute to economic and prosperity of Africa.

Key words: Geothermal energy, offshore drilling, renewable energy

10.5. High Altitude Platforms for Security Applications

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High Altitude Platforms (HAPs) are airships or planes that operate in the stratosphere at altitudes of 17 – 30 km, depending on the latitude, where wind speeds are lower. These include manned planes, unmanned hydrogen powered planes, and unmanned solar powered planes and airships. Airships use aerostatic lift to remain airborne instead of aerodynamic lift and are filled with an inert gas such as Helium which expands as it rises through the air to achieve buoyancy. They operate above the controlled airspace under the command of a manned ground station.

The airship essentially operates in a geostationary position and can deliver persistent station keeping as a surveillance platform, telecommunications relay, or a weather observer. It can also provide security agencies affordable, ever-present intelligence, surveillance and reconnaissance, and rapid communications connectivity over their areas of responsibility. Satellites on the other hand are quite expensive, require long development time and are difficult to replace. HAPs therefore offer advantages such as persistent around the clock capability, low cost, rapid reconstitution of capabilities, incremental deployment, low inherent risk of being detected, multi-mission exchangeable/ repairable/ upgradeable payloads, and limited environmental impacts (solar power and propulsion system).

11. Polution Control and Water Catchment Areas

11.1. PATTERNS AND IMPACT OF INDIGENOUS AND MODERN SYSTEMS IN GOVERNANCE OF KAYA FORESTS IN KENYA: A CASE OF KAYA FORESTS AT THE COASTAL REGION OF KENYA

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ABSTRACT

The changing times, attitudes and practices have necessitated re-evaluation of indigenous practices and the adoption of modern systems of governance and management of sacred forests. It is evident from observation and from a research studies that the status of many sacred forests is changing. It is therefore necessary to define the appropriate and broad based governance of the sacred forests through evaluation of the strengths and weakness of traditional indigenous regimes and the benefit of modern governance systems. The aim of this study was to explore opportunities and challenges facing both indigenous and modern environmental governance systems which have been applied in traditional sacred forests with aim of restoring and maintaining the sacred forests to their expected standards. The research was undertaken in four Kaya forests in the Kenyan coast. The four forests include Kaya Kinondo, Kaya Fungo (Giriama), the Duruma Kayas and Kaya Jibana. The sample of the four Kaya forest was based on the state of conservation of the Kaya forests which was characterized by minimal human interference. Primary data for this work was obtained from observation, in-depth discussion with key informants and group interviews. Secondary data was incorporated through a review of legislation on sacred

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forests, and from published work in journals and from grey literature. Literature review focused on environmental regulatory frameworks, socio-economic and environment aspects of indigenous forest management, and documented knowledge on local versus global perspectives of governance of sacred forests.

From the research findings, the author proposes a hybrid system that integrates indigenous and modern governance system and adopts a multi-scalar action oriented pointers of environmental governance. These pointers include the principles of effective governance namely: Integration, Involvement, Collaboration and Accountability. The hybrid and multi-scalar nature of the proposed governance system of sacred forests involves the engagement of the four levels of authority. The four levels of governance include supranational, national, sub-national and local, each with a role to play in the conservation of the Kayas. The new governance system which is proposed from this study provides a potential direction for future management and governance of sacred forests. The hybrid form of governance system ensures that sacred forests are sustainably governed while also adhering to modern trends. In addition, the hybrid model balances economic interest and sustainability aspect of the sacred forests.

Keywords: Sacred forests, Kaya forests. Multi-scalar, environmental governance

11.2. CHALLENGES AND OPPORTUNITIES IN WASTE MANAGEMENT IN A BLUE ECONOMY

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ABSTRACT

The population of many towns in the coast is expected to rise with the growth of the blue economy around the Indian Ocean coupled with the development of various infrastructure to connect the Kenyan coast to the inland destinations. With the rise in population, the municipal solid waste (MSW) is expected to rise significantly. In addition to this, population increase in urban centres will also place a huge burden on current energy resources available in the coastal towns. The situation is made worse by the current state of waste management in most of the towns and urban centres. Unless waste is properly managed, it will to negatively impact on health and quality of life of residents living in urban centres. Managing the twin issues of waste management and affordable energy requires an integrated plan that will use the waste as a source of energy. Solid waste is an important source of energy that should not be lost by inefficient and unsustainable disposal methods. With this in mind, turning them into electricity should be considered as a way of recovering the energy and using it to tame the twin problem of municipal solid waste disposal and meeting the energy deficit. This paper examines the potential of municipal solid waste (MSW) generated for use in a modern Ultra High Temperature Gasification (UHTG) to generate electrical energy as an alternative to landfills. Such a system will reduce the demand for land to meet the current need of waste disposal sites. In addition, using the waste to directly generate electricity plays a role in a zero-emission waste-to-energy (ZEWTE) process. This solution has the potential of contributing to meeting the electrical energy demand, diversifying the sources of green energy while also guaranteeing a green environment in a blue economy. In conclusion, this integrated solution will help in addressing the two issues that bedevil most of the urban areas in Africa, the issues of proper waste management and affordable energy for the residents. This model can also provide a good example that can be adopted by other upcoming urban centres in Kenya.

Keywords: Municipal Waste Management, waste-to-energy, solid waste management, Ultra High Temperature Gasification

11.3. MANAGEMENT AND DISPOSAL OF USED OIL - A CASE STUDY OF MENENGAI GEOTHERMAL FIELD

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ABSTRACT

For a long time, used oil has been reused or disposed using methods that contaminated the environment. Rarely is used oil recycled to maintain its resource value. Used oil does not get won out, it just gets dirty because of being exposed to smoke, soot and dust. Recycling is the process that reduces the impurities in the oil and restores its resource value. It is

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estimated that in Kenya, annually 200 million gallons of used oil is poorly disposed by pouring it on the ground, taken to dumpsites or poured down sewers and storm drains. This is despite the fact that one gallon of used oil can contaminate up to one million gallons of clean water. Poorly disposed oil also end up in lakes, rivers and streams where they threaten the aquatic life and pose a risk to human and animal health. In addition, when used oil is disposed in landfills, it kills the vital organisms in the soil, changes the characteristics of the soil thereby making the soil ineffectual for agricultural production. Proper disposal of used oil could save wastage of thousands of gallons each day in Kenya. Used oil can be processed into fuel oil, re-refined into lubricants or used as raw materials in petrochemical industries. Large-scale recycling can support environmental conservation efforts.

This study sought to identify the current uses and disposal methods of used oils and to propose environmentally friendly methods for the disposal of used oil. The case study was undertaken at Menengai Geothermal Field and aimed at exploring the methods for handling, management and disposal of used oil. The data for this study was sourced from well costing reports and company disposal records. The result of this work confirmed that used oil can still be recycled and reused in the industrial processes. In addition, there is a need to sensitize Kenyan on proper methods of disposing used oil in order to conserve the environment. As oil exploration and manufacturing moves to the marine environment, proper management of used oil and other by-products from the energy sector is one of the considerations that must be made to ensure the safety of marine ecosystems. The oceans provide valuable resources, however improper handling of used oil and incidences of oil spill in the marine environment can ruin the potential benefits of the oceans.

Keywords: Geothermal, used oil, disposal, recycling

11.4. REDUCTION OF POLLUTANT TOXICITY LEVELS IN PRODUCED WATER FROM CRUDE OIL PRODUCTION PROCESSES

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Abstract:

Water produced from crude oil processing is saturated with various contaminants making it unsafe for discharge into the environment without adequate treatment. The weight fractions of these contaminants vary from one well to another depending on the nature of the well, its age and production conditions. The discharge of produced water is subject to treatment which is usually aimed at reducing pollutants to a level that is considered safe for the environment by the regulator. The cost of treatment of produced water is prohibitive and surges as the age of the well increases and the reservoir characteristics change. The contaminated water has a concentration of pollutants such as Benzene, Toluene, Phenol, and Ammonia among others. This contamination could be altered by adjusting the temperature, pressure, residence time and flow rate during oil processing.

This research tested for effectiveness of reducing the concentration of pollutants by adjusting various characteristic during oil processing. In particular, the authors tested the variation in the amount of pollutants in produced water during crude oil production process by varying temperature, pressure, residence time and flow rate at various points along the production process. This was implemented using HYSYS simulator. HYSYS is process engineering simulator that can be used to mathematically model chemical processes. The HYSYS system was configured to recording periodic results. The result of the simulation process showed that combination of some production variables including temperature and pressure decreased the concentration of the selected pollutants in the produced water. This outcome is very important in oil and gas production in meeting regulatory limits for discharge of produced water and in the reduction of the cost of treatment of produced water. The significance of this research is in the demonstration of the role of simulation models in engineering and chemical processes. As we think about offshore oil and gas exploration, the actual exploration will be costly. However, prior to committing resources, well specified and validated mathematical models could be used to test for various engineering scenarios. Models can produce accurate results and reduce the cost of carrying out the actual on-field exploration. In a situation like the one presented here, the mathematical model provided a computational laboratory to test for an effective way of reducing pollutants in produced water.

Keywords: Produced water, pollutants, toxicity, production process, crude oil, production variables.

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11.5. IMPACT OF POLLUTION CONTROL ON BLUE ECONOMY

A PRESENTATION OF THE KENYA DEFENCE FORCES (KDF)
BY MAJ (ENG) MICHAEL MWANGI MUCUGIA

ABSTRACT
Industrial waste, sewage and domestic waste have been flowing into rivers and other water masses polluting and making it unsuitable for use. Particulate matter emission from manufacturing sites, automobile exhaust, smokes or fugitive dust emissions have been a major air pollutant. Domestic waste has been the largest contributor to the urban centres Landfill menace in the country.

Pharmaceuticals and agricultural chemicals have had their pollution impact, either while undergoing processing or in use.

All these streams of pollution do pose serious health risks on human, animals, plants and more operating systems key in supporting our ecosystems. This lead to specific negative effects of; reduced visibility, machinery fouling, environmental damage (Deposition) and Aesthetic damage.

12. Student Presentation

12.1. UNDERWATER TURBINES TO SUPPLY ENERGY IN THE COASTAL REGION

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ABSTRACT
Renewable energy is one of the most promising energy sectors around the world. The ocean covers about 70% of the earth's surface and with it stands a very huge potential in the supply of renewable energy. Ocean energy has many forms from tides, surface waves, ocean circulation, salinity and thermal gradients. Out of these forms is tidal energy which has the ability to offer a long term solution by providing clean and renewable energy to the coastal region. This energy could be tapped from building underwater turbines. This paper underlines a feasibility assessment on this type of innovation in Kenya and also looks at the different aspects that could be considered for underwater tidal current turbines deployment on the coastline.

12.2. A vision for Africa: An Integration of clean environment and clean energy

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ABSTRACT
This paper provides an overview on the future of our energy sources in Africa focussing on an idea of a possible solution to improve solid waste management. An approach on how to improve solid waste management by taking advantage of the waste energy (heat) from Power plants is taken into consideration.
Today the major source of power is hydro –power, geothermal, solar, wind and fossil fuels. The focus of geothermal and thermal power plants has been production of electricity only and heat energy as a by-product which majorly ends in the cooling towers.
Our thought! -Instead of letting heat escape uselessly up to cooling towers, we suggest an economical approach of harnessing the excess heat for use in gasification process.
The idea is setting up combined heat and power (CHP) cogeneration systems in our current power plants and future power stations.
For solar, hydro, wind energy, tide energy etc. which fluctuates the system can be modified to enable harvest of excess

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electricity produced during peak time. This can be stored in large scale heat pumps and thermal storage facilities for use in electricity production by gasification to supplement the main energy sources at times of low production.

12.3. FEASIBILITY ANALYSIS ON HARNESSING OCEANIC RESOURCES FOR POWER GENERATION

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Abstract:
Island towns and countries have greatly relied on fossil fuels as a source of energy. The fossil fuel is sourced from oil producing countries that are often thousands of miles away. Over reliance on fossil fuels contributes to the vulnerability of the economies of island towns and countries to the turbulence of the petroleum market. In addition, the reliance on petroleum products poses a threat to the ocean ecosystem through pollution by the shipping vessels and emission of carbon fumes when electricity is generated through fossil fuels. There is huge potential in the ocean ecosystem for clean and renewable energy. Unfortunately, many developing countries are yet to commercially explore these resources. The low investment in renewable energy in the marine environment is mainly due lack of human and resource capital. In addition, most island coastal countries in the developing world had initially not embraced the concept of the blue economy. Consequently, ocean power generation in developing countries is mainly in experimental stage making the venture very expensive to commercialize for domestic and commercial purposes in the mainland of the hosting countries. The current focus on the blue economy will increase investment in ocean generated energy and thereby result in the reduction in the overall cost of energy. In addition, establishment of companies in the developing world to manufacture parts of the energy production and transmission equipment will reduce the cost of the necessary equipment hence reducing the cost of installation, generation, and transmission of energy. Different technologies have been developed to harvest ocean energy. Renewable energy is harnessed from various sources in the marine environment. The sources include solar, tides, wind, ocean waves and also the use of variation of temperature of ocean current to build electric currents. However, not all the sources are suitable for each country. This paper analysed the various technologies used in ocean and offshore power generation and highlights the suitable technologies that can be adopted to generate power that is clean and friendly to the ocean ecosystem. Specifically, this work investigated the technological feasibility of different renewable energy productions methods. The results contribute to the state-of-art of the relevant, feasible and cost-effective technologies that can be adopted to improve renewable energy development for the benefit of coastal communities and economies of developing countries.
Keywords: fossils, islands, power generation, solar, tides, wind, waves, salinity, offshore, ecosystem.

12.4. Use of Reverse Osmosis membrane technology in the desalination of sea water for counties bordering the Ocean in Kenya.

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Abstract
Potable water scarcity remains a major challenge in Kenya. Reverse osmosis has been considered as an emerging source of portable water from water desalination, due its operation simplicity and lower capital cost. The effect of feed water temperature, salinity and recovery ratio on the efficiency of the whole RO system was investigated for a wide range of design considerations. The design for this application was optimised and economic assessment carried out. RO has been applied to variety of salty water resources using tailored pretreatment and membrane system design. This article brings to light key parameters of a reverse osmosis process as applied in desalination and innovative plant design and how it can be used in Kenyan coastal regions.
Keywords: Reverse osmosis, membrane filters, desalination, permeate, reject, saline water, fresh water, osmotic pressure.

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JANDU, Rajinder Singh	14005-Nairobi
KANGURU S.P	60295 Nairobi
KARIUKI, Peter David	494 - 10100 Nyeri
KIMWERE, Bernard Antony	99469 - 80104 Mombasa
KING'ORI Anthony	4849 - 00200
KINUTHIA, H.B	
KINUTHIA, Hiram Brere	56498 Nairobi
KISILU, Joseph Muoki	23805 - 00100 Nairobi
KONDITI, Dominic Bernard Onyango	493 Kalimoni
LUBONDI, Nicholas Okumu	P.O BOX 5625-00100 NAIROBI
MAINA, Chrispin Mwangi	67880-00200

MATHARU, Ravinder Singh	43099 Nairobi
MBINGA, Gabriel Wafula	35189 00200 Nairobi
MIANO, David Gituto	34403 Nairobi
MOCHAMA, Enoch Nyangate Josia	702-02006
MUCKOYA, George Carrol	P.O BOX 54859 - 00200 Nairobi
MUIA, Benjamin Kilonzo	104 Nakuru
MUTAHI, Julius Maina	2712-00200 Nairobi
OCHIENG, Stephen David	785 - 20117 Naivasha
OKETCH, Peter Ohola	69245-00622 Nairobi
OMOL, Dickson Oyoo Willington	78299 Nairobi
ONGALO, Churchil	102508-00101 Jamii
ONYANGO, Sammy Otieno	1722-50100 Kakamega
ONZERE, James Jas	1444 - 40200 Nairobi
OWALA, Jacob Roberts Malala	45042 Nairobi
OYWAKO, Gliday	332-40502 nyansiongo
SAMUEL Chandago kuri	93231 - 80102 Mombasa
SEWE, Fredrick OdhiambO	4849-00200 Nairobi
SHETH, Varjivandas Hematlal	45112 Nirobi
WADAYUA, Joseph Munda	25494-00603 Nairobi
WAINAINA, Charles Mburu	2288-20100 Nairobi
WALUME, Darius Edward	20723 Nairobi
WASILWA, F.M	
WILLS, Leonard Makokha	8083, 00100 Nairobi
MECHANICAL	
BARMI, Nirkal Singh	17572 Nairobi
CHEGE, Charles	1912 Naivasha
DHADIALLA, K.S	47188 Nairobi
GULAM-HUSSEIN, Amjid	81038 Mombasa
GUPTA, Subhash Chander	18042 Nairobi
JENKINS, David Leuan	39253 Nairobi
KIMOTHO, Isaac Miringu Elija	505 Kalimoni
KIOMA , Samuel Kiarii	15585 - 00100 Nairobi
LAD, Manilal Laxmanbhai	44132 Nairobi
LIROVAS, Cliff Simon Mudasia	95013 - Mombasa
MACOWENGA, Clatus Odhiambo	63574 Nairobi
MUCHIRI, Edward Wanee	800 Njoro
MUTAHI, Peter M	215-10103 Mukurweiini
MWACHOFI, Oliver Mwashighadi	90202 Mombasa
MWANGI, David Ngarachu	31687 Nairobi
NGETHE, Paul Ngima	5611 - 00200 Nairobi
OKUMU, Michael Francis	525-40400 Suna
WAFULA, Christantus Agapitius	34969 Nairobi
WAMALWA, Gerald Reuben	78102 - 00507 Nairobi
WANJOHI, Daniel Maina	31394 Nairobi
Gill L.J.	
SHINGADIA, Devji Meraman	14444 - nairobi

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KENYA NUCLEAR ELECTRICITY BOARD

KENYA'S NUCLEAR DATELINE 2010-2018

2010
The Nuclear Electricity Project Committee is formed

2011
Prefeasibility Study commences.

2012
Transformation into the Kenya Nuclear Electricity Board.

2013
Prefeasibility Study is completed.

2014
First National Nuclear Stakeholders Conference held in Nairobi.

2015
The International Atomic Energy Agency conducts an assessment of the progress of Kenya's Nuclear Power Programme, a process known as the Integrated Nuclear Infrastructure Review.
KNEB and other government agencies conduct a grid study to gauge the preparedness of the transmission network for nuclear power.
Kenya hosts the African Conference on Nuclear Energy held in Diani, Kwale County.

2016
Government receives scorecard report of Kenya's Nuclear Power Programme from the International Atomic Energy Agency.

2017
KNEB commences the Strategic Environmental Assessment for the Nuclear Power Programme.
KNEB hosts the Nuclear Energy Week: Conference and Exhibition in Nairobi.
KNEB commences siting studies to identify potential sites for nuclear power plants in Kenya

2018
KNEB attains ISO 9001:2015 certification Cabinet approves the draft Nuclear Regulatory Bill.

Vision

Safe, efficient and reliable nuclear technology for electricity generation

Mission

To promote safe and secure application of nuclear technology for sustainable electricity generation and distribution in Kenya

Core Values

Safety and Security
Clean Environment
Integrity
Professionalism
Transparency and Accountability
Innovation
Efficiency

KEY FACTS

13% - Percentage of the World's total electricity generation from nuclear energy.
1800MW: The electricity generated by South Africa's Koeberg Nuclear Power Plant's two reactors.
2027 – The year Kenya aims to commission its 1st 1000MW Nuclear Power Plant.
30 – The number of countries that generate nuclear electricity worldwide.

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KENYA VISION 2030
Towards a globally competitive and prosperous nation.

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