CAETS

Engineering a better future .....

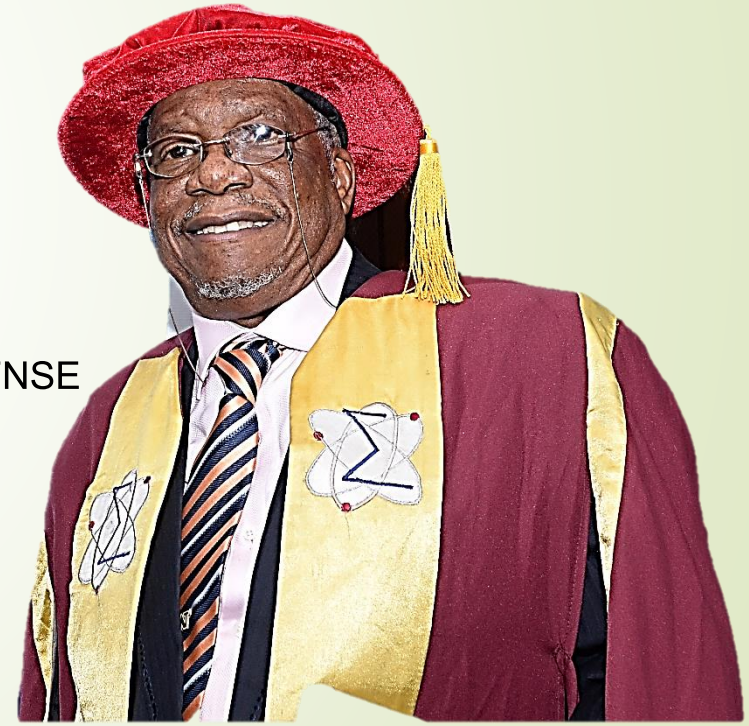
International Council of Academies of Engineering and Technological Sciences

CAETS 2019

Theme:
Innovation and Mentorship as critical factors in Engineering Education

by

Engr. Prof. FOLA LASISI FAEng, FNSE
President , Nigerian Academy of Engineering



OUTLINE

1. INTRODUCTION
2. MENTORSHIP and INNOVATION ANTECEDENTS
3. ENGINEERING EDUCATION and IMPLIED MENTORSHIP cum INNOVATION
4. BEST PRACTICES from TEACHING EXPERIENCE: MENTORSHIP and INNOVATION
5. CHALLENGES IN ENGINEERING EDUCATION: INNOVATION and MENTORSHIP
6. POTENTIAL REWARDS FOR MENTORING for INNOVATION
7. CONCLUDING REMARKS

INTRODUCTION

- It is a great honour and privilege to have been given this opportunity to give this special presentation at this congress of CAET (International Council of Academics of Engineering and Technological Sciences) holding in Stockholm, Sweden.

- The topic of my brief paper is a manifestation of my EXPERIENCE in recent years that we are not impacting enough on the young one who have selected to be our successors.

- It is not a new idea but a reawaking for us to be more focused on impacting on them the way we were raised many years ago.

- Innovative thinking is not totally new.
- We sometimes see this as a critical visionary thinking.
- In engineering, innovation is often seen as a new or better ways in the process of doing things or the production process that can safe time, labor and material. In the end it becomes more economical.

- Good mentors are the people who cross our paths at crucial moments, moments when we are ready to learn from their wisdom and experience.

- The best mentor may be the senior scholar who inspires you with his or her insight, the graduate student colleague who shares his classroom strategies, and/or the department assistant who takes the time to explain vital graduation paperwork.

- A good mentor - someone who possesses knowledge, experience, and the ability to explain both to novices in his or her field - is really only a small part of good mentoring.

- Nonetheless, I have chosen to primarily focus on two critical words that have continued to hunt my thinking for many years. MENTORSHIP and INNOVATION as an important parts of education have long been identified as an essential factors. Hence I have decided to devote my brief presentation on the topic: INNOVATION MENTORSHIP AS CRITICAL FACTORS IN ENGINEERING EDUCATION.

INNOVATION ANTECEDENTS

- Innovation in its modern meaning is a "new idea, creative thoughts, new imaginations in form of device or method". Innovation is often also viewed as the application of better solutions that meet new requirements, unarticulated needs, or existing market needs.

- "Innovation is a new way of doing things. It's breaking tradition and taking a new approach to solving an old problem.

Significance of Innovation

- **Solving problems:** Most ideas are actually derived from attempts to solve existing problems.
- **Adapting to change:** This is especially evident in the technological world where there are rapid changes defining the business.
- **Evolving workplace dynamics:** The demographics in the work place are constantly changing.

Mentorship Antecedents

- "Mentorship is a personal developmental relationship in which a more experienced or more knowledgeable person helps to guide a less experienced or less knowledgeable person."

- "Mentoring as a process for the informal transmission of knowledge, social capital, and the psychosocial support perceived by the recipient as relevant to work, career, or professional development; mentoring entails informal communication, usually face – to – face and during a sustained period of time.

Mentoring Techniques

- The five most commonly used techniques among mentors were:

1. Accompanying:
2. Sowing:
3. Catalyzing:
4. Showing:
5. Harvesting:

Mentoring in Engineering Education

Purposely for;

1. Career development:
2. High potential mentoring:
3. Diversity mentoring:
4. Reverse mentoring:
5. Knowledge transfer mentoring:

Engineering Education And Implied Mentorship

- Generally, it is agreed that education helps us to prepare for tomorrow, but that does not mean that the present should be neglected, because it is even the present that helps us to live a better tomorrow.

- From different schools of thought, it is obvious, how difficult it is to separate man from education. Man continues to be the subject of education. It is man that receives and transmits education to his fellow man.

- To educate means to help someone understand the elements of reality in life. A good education is to be able to transform individuals and reach their heart.

- An educated person is someone who is sensitive to things and personally looks for solutions to his human needs and the needs of others. Therefore, anyone who has received education has the possibility of thinking logically and can communicate them by analysing critically his reasons and arguments.

Engineering Education

- Engineering education involves the trainers: lectures with technical staff; on one hand and the students who are being prepared for their critical roles in the very near future after appropriate training.

- Engineering contributions to national development are widespread and visible ranging from chemical engineering, civil engineering, electrical and electronic engineering, aeronautical etc. Consequently, engineers can serve as change agents not only for technical systems but also for many other societal changes.
- The technical nature of engineering education makes it unique in content and approach, thereby requiring special care and attention. The inputs of engineers are so visible to the extent that even the illiterate could see when 'failures' occur.

The philosophy of engineering programmes in Nigerian Universities is contained in National Universities Commission Handbook (NUC, 2007), they are:

- The development of a thorough practice in engineering and technology training.
- Broad-based training in general engineering and technology at the early stages of the programme
- Practical application of engineering, technology and manufacturing processes.

The philosophy of engineering programmes in Nigerian Universities is contained in National Universities Commission Cont'd,

- Adequate training in human and organizational behaviour management
- Introduction to entrepreneurial education and training.
- Close association of the programme with industries in the country.

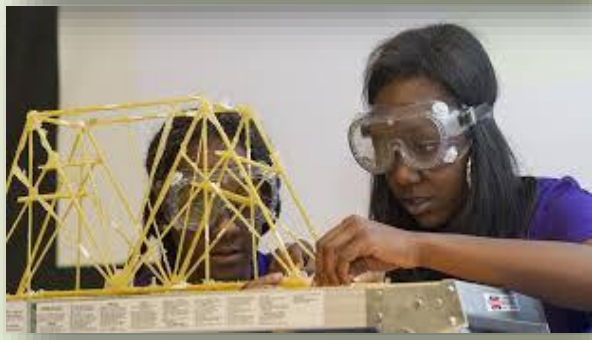
COMPARING NIGERIA, THE STRUCTURE OF ENGINEERING CURRICULA AND EXISTING STRUCTURE OF ENGINEERING CURRICULA IN U.S.A.

	NIGERIA		UNITED STATES OF AMERICA	
1	Basic Sciences	15%	Basic Sciences	25%
2	Engineering Sciences	25%	Engineering Sciences	25%
3	Technical Arts	8%	Technical Arts	2.8%
4	Applied and Design engineering	45%	Applied and Design engineering	22.2%
5	Miscellaneous subject	7%	Humanities and Social Sciences	22.2%
6	-	-	Thesis	2.8%
	Total	100%	Total	100%

- The overhauling of the curricula may not necessarily translate to the production of ready-made graduates for the industry except other components of training are of good quality, namely teachers: as critical agents [MENTORS]; prospective engineering students; physical facilities; funding; infrastructure and quality assurance.

Mentorship in Engineering Education

- Developing countries try to learn from developed ones as they develop their vision plans for development. In education this model has become significant. In USA lecturers are regularly honoured as great mentors. It is here proposed that in engineering the trainers must of necessity see themselves as mentors.



The elements of a mentoring relationship have various permutations.

1. Initiation:
2. Time frame:
3. Formality:
4. Intensity:
5. Reciprocity:
6. Agenda:
7. Medium:

Mentoring Settings

In relation to engineering education, such relationships can occur in one or more of the following settings.

1. Senior faculty with junior faculty.
2. Faculty with student.
3. Returning student with entering student.

Benefits Of Mentoring

The known benefits of mentoring include the following:

For the Mentor

- Enrichment through seeing someone else grow and succeed.
- Creativity generated by issues and ideas generated by someone younger and newer.
- Friendship.

For the Mentee

- Speedier adaptation to a new role and/or organization and reduced likelihood of frustration and failure.
- Increased exposure to ideas and connections
- Friendship.

For the Faculty or University

- Stronger individuals offering higher quality performance.
- Increased connectivity and caring. People enjoy working in caring and connected workplaces.
- Support to formal employee orientation and development programs.
- Greater spiritual protection for persons and the organization. spiritual protection

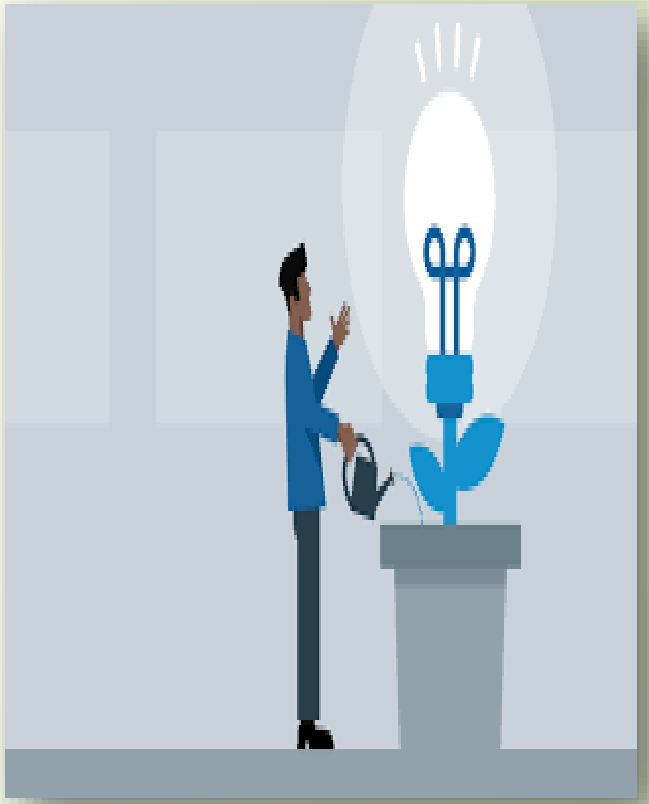
Scope of Innovation

- One of the greatest challenges facing engineering education is the need to educate engineers who can innovate successfully. With increasing calls for enhancing the level of innovation in the national economy, the role of innovation in engineering education is often underemphasized and poorly understood.

This presentation adopts a broad definition of different types of innovation to include the following:

- Product innovation – changes in products or services that an organisation offers.
- Process innovation – changes in the way that products or services are created and delivered.
- Position innovation – changes in the context in which products or services are introduced.
- Paradigm innovation – changes in the underlying mental models and technology which frame organisations' activities, as exemplified in the development of online retailing, hybrid cars and wind turbines.

- The focus of engineering education is typically upon innovations of product and process and then is constrained further by only considering the design or technical implementation of new products or services. This limited view of innovation provides a challenge for the profession to contribute towards developing the other types of innovation that contemporary society urgently requires.



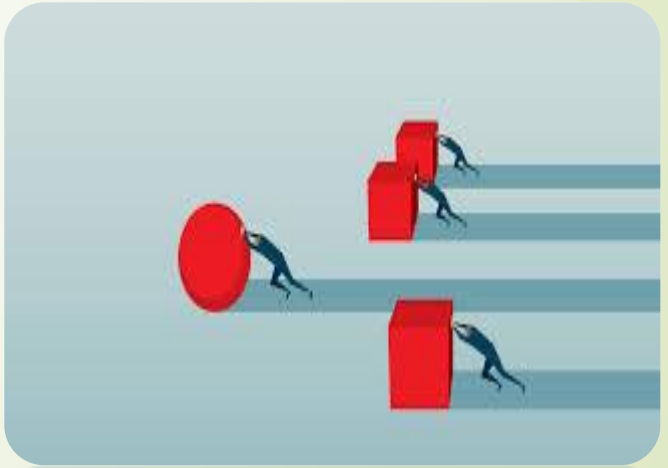
Engineering Education for innovation

- In a recent report, the League of European Research Universities has recognised that one of the main innovation roles of universities is in developing 'human capital'. At present, university-level education is geared towards incremental innovation; engineers do not have the opportunity to develop the skills and experience for the other types of innovation that society urgently requires.

Teaching innovation in Engineering Education

- Students need to be taught the principles of radical innovation, but it is important that they also build up practical experience through experiential learning by working on real-life projects. Just as reading a music score is not sufficient preparation for a musician to play in an orchestra, innovation cannot be taught from a book – it needs to be experienced, it needs immersion.

- It is important that innovation is not seen as an extracurricular activity – innovation is not an option. Practical innovation workshops either regularly scheduled or as intensive boot camps have to be presented as an integral part of the curriculum.



- Education needs to be based on experiential learning techniques with teams of students addressing real challenges from business or wider society. It is crucial that students work in multidisciplinary teams across departments and schools with engineering. Students need to be guided through their innovation experience and this defines the role of academic and industry tutors.

Role of Industry and Government Innovation and Engineering Education

- In order to ensure that the challenges that students address are real, industry and government need to be involved.

Methods of Assessing Students Innovative Capabilities

- It is important that students are assessed and get feedback on all aspects of their innovation capability, including their attitude, communication skills and ability to work in teams.

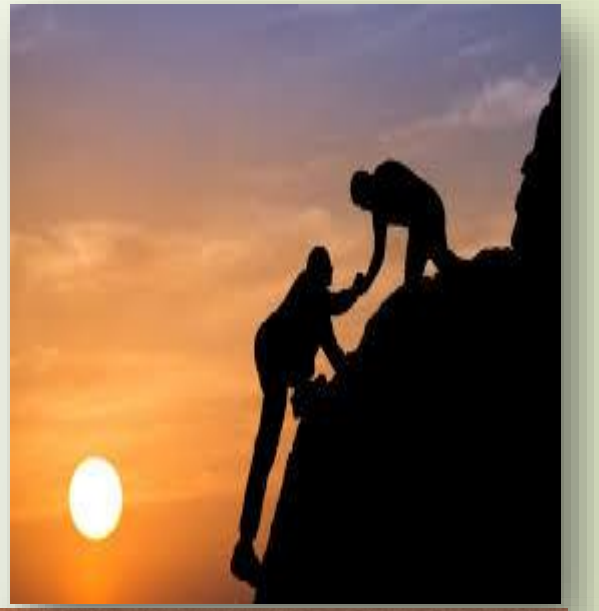
Best Practices from Teaching Experience: MENTORSHIP and INNOVATION

- The role of a mentor includes directing and advocating, evaluating and rewarding, celebrating successes and guiding through adversity and disappointment.

- Some basic underlying principles to keep in mind in developing one's own approach to mentoring include:
- 1. Credibility:
- 2. Integrity:
- 3. Confidence:
- 4. Cooperation:
- 5. Chores and citizenship:
- 6. Communication skills:
- 7. Professional Activity:
- 8. Credit:
- 9. Sharks:

Formal Responsibilities of Mentors

- Mentoring is an important role that every engineer has to assume, formally or informally, sooner or later in their professional life. The experience can help many engineers to identify areas of progress and decide their future course of action, for example to pursue a career as an engineer educator, engineer practitioner or engineer manager.



- While considering mentorship as a way of progression in the profession, it is important for the engineer to think critically and objectively about what this role entails.

- Engineers who are considering becoming involved in student supervision and mentorship in any technical setting should have knowledge of the importance of mentorship, its process and basic principles.

Role of Mentorship on Engineering Professional Practice

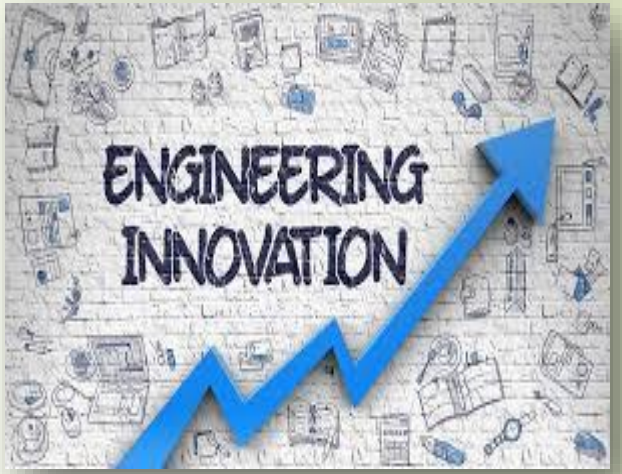
Some of the most important roles include the following:

1. Adviser:
2. Role model:
3. Coach:
4. Problem solver:
5. Teacher:

Engineers as innovation leaders

- In many cases, engineers innovate ‘silently’, inside their own microcosm. This can be at a lower level (the actual design and implementation) or at a higher level (components and system’s architecture).

- But, engineers can play a more important role in leading innovation. In fact, they have a great advantage in driving innovation efforts. They are the ones with deep understanding of technology and they are often passionate about it. This allows engineers to easily spot both the opportunities and the underlying constraints of technology.



- Moreover, engineers are expected to understand the principles of experimentation and be ready to take risks following a ‘fail fast, fail-safe’ approach. Either as part of wider multidisciplinary team or as an independent software development unit, skilful engineers can thrive in leading real innovation, beyond the hype. What is needed is the right culture and steering—the key signals and a clear direction from the leadership.

Enabling Innovation

- Innovation happens at many levels: technical, organisational, and societal. Innovation is not R&D – it spans from ideation through to adoption, implementation and value creation. Not all innovation is good for society; there is destructive innovation – this is why engineers need a deep ethical and reflective dimension. Innovation and technological change are a combination of technology, social and cultural dimensions – they are inseparable.

- Over 50 per cent of the new engineer role is managing change. If engineers are to be more than technical specialists in the 21st century, there is a need to provide young engineers with an understanding of innovation within the social context in which they will work, together with skills in critical analysis, ethical judgment, and an ability to assess the long-term consequences of their work.

Technology development and implementation is a social activity

1. Engineering work is clearly a social and political activity, although this has been ignored in engineering education.

2. The public image of engineers and engineering is poor in some countries and very high in others

3. the image and status of the engineering profession is declining as the public identifies engineers with controversial and environmentally damaging technologies.

4. And in other instances engineers are labeled as ‘fixit’ skilled trades, with little expectation of thinking at the strategic or policy level.

5. If students have a poor or non-existing image of engineering then they are hardly likely to choose it as a career and this is leading to a shortage of engineers and even a decline in engineering standards.

Engineering Education and Innovations: The role of the engineer

1. Professional engineers play a central role in developing, operating and managing technological enterprises, systems and projects;

2. Engineers must be expected to lead and drive change across the total innovation spectrum from setting policy to implementation and ongoing operations;

3. Engineers as currently educated aren't capable of doing this – they are weak at 'engineering' social and cultural change – their education is deep but in very narrow technical domains – add-on business or humanities courses are not enough;

4. Many universities have drifted to become ivory tower research institutions divorced from industry practice and societal challenges – many university professors have never practised real engineering;

5. We need an integration of the old rigorous five-year apprenticeship model tied to an engineer's degree

CHALLENGES IN ENGINEERING EDUCATION: INNOVATION and MENTORSHIP

- In the USA most universities now have Engineering Education outfits housed in the Faculties of Engineering. The research capabilities of these outfits are providing needed impetus for moving the training of future engineers ahead of their peers with an added edge for competitiveness.

The Challenges can be summarised in the following areas: - Mentorship

- The need to incorporate mentoring space in the curriculum in our educational policy;
- It is critical to develop special training programmes for academics in engineering;
- The follow up in industrial attachment programmes must be well supervised;

- Outfits for research in engineering education must become part of the forward planning in our tertiary educational establishment; and

- Funding in direct control of departments can be an effective way in addition to some get students' assessment of staff mentoring effectiveness.

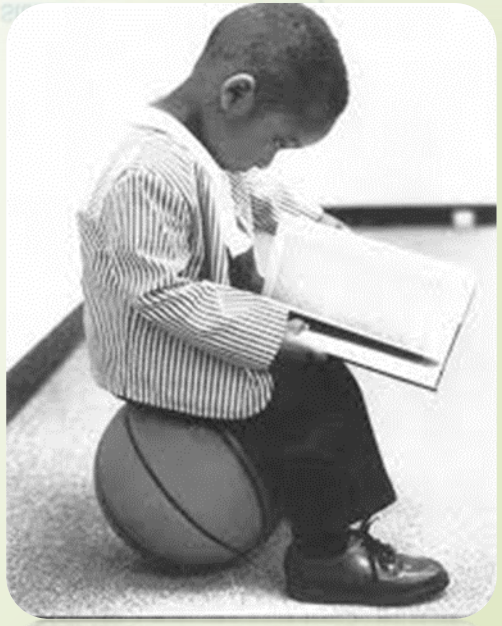
The Challenges can be summarised in the following areas: - Innovation

These are the common challenges of Innovation in Engineering Education and how to solve them:

1. Young Engineers aren't empowered to innovate
2. Young Engineers aren't motivated to innovate
3. Missing an innovation strategy
4. Innovation is centralized to one functional group

The Challenges Cont'd

5. Lack of collaboration
6. Lack of diversity
7. Current product offerings are successful
8. Missed connections with customers
9. Measuring innovation incorrectly



POTENTIAL REWARDS FOR MENTORING for INNOVATION

- The most effective mentors, irrespective of their field of study and /or concentration, share similar attributes. What they have are the abilities to listen, question, challenge, and offer feedback and support. These are the qualities central to lecturers' roles as mentors.

The Qualities Expected of the Engineering Mentor Must include;

1. Approachable and welcoming in the office and outside.
2. Shares information, knowledge and experience openly.
3. Has good communication and listening skills.
4. Understands the field of engineering and related areas.

- Has a network of contacts within the college, university and industry.
- Is motivating, encouraging, positive and empowering.
- Is willing to set aside /commit time to mentor someone.
- Is committed to making a difference, one individual at a time.
- Does not wait to be asked, approaches mentees when he/she feels there is need.

Mentor and Mentee Relationship

- Unfortunately, the advising system in most universities is not ideal and may force a student to accept an advisor without mutual consent, or changing student's field of study may force a change in advisors, or the faculty member may leave the university or go on leave, thus forcing a change in advisors.

- An incompetent and/or an impatient advisor is often the cause of dropping out, or failure of students to accomplish their goals in engineering programs.

Mentoring Process and Rewards

- Identify two to three students or young professionals who could benefit from your insights and experiences. Ask them if they have questions about the scope of engineering and how they might fit in?

- Help your students evaluate employment opportunities that they might not otherwise consider. . Encourage them to think about many facets within the profession, and help them secure rewarding summer break experiences, or take a semester off and join a company as a trainee.

- Encourage students to become involved with local, regional, and national professional associations. Membership and involvement in such organizations provides students with priceless leadership opportunities and helps students develop a variety of valuable workplace skills.

- Remember that a student or young engineer may have a different or even a better idea in solving a problem. The young engineer may well bring a perspective that is much more than fresh - t may well be of the "why didn't we think of that" variety.

- Seek out students where they exist. Get involved with local high schools and help them establish an engineering club. Seek involvement with community organizations such as Big Brothers and Big Sisters or Habitat for Humanity.
- There is little if any magic in all of this. And, we won't be successful with every student we mentor. But our efforts will be one hundred percent worthwhile as we strive to help make our profession more robust and vibrant for these complex and challenging times.

Role of University in Promoting Mentorship

1. The university, in general, and the college in particular, should devise policies that would allow students to have the option of selecting advisors, even if not all parties want this choice. The mentoring relationship is best fostered with sound advice and in a mutually comfortable environment.

2. The university is, by all measures, the sole organizer for improving advising in all colleges. Training programs, short courses, seminars, etc. should be established and maintained on a college basis.

3. The university should recognize faculty participation in an advisor training program, and encourage young faculty, in particular, to participate in such programs.

- 4. The college and the respective department should establish lines of communications with advisees at all levels, asking for their opinions and views on their relations with their advisors, and how may advisor /advisee relations be improved? Such feedback would help all parties involved.

- 5. The university should establish a reward system for exemplary mentoring, based on feedback from mentees coupled with a statement from the nominee stating his or her philosophy on mentoring.

Innovation in Engineering Education – Organization's Benefits

1. Improved productivity & reduced costs:
2. Better quality:
3. Building a product range:
4. To handle legal and environmental issues:
5. More added value:
6. Improved staff retention, motivation and easier recruitment:

The link between Engineering Education and Innovation

How does Nigeria rank on the engineering and innovation scale?

- Overall, Nigeria sits in lowest position for the NICI, also ranked very low for proportion of engineers and scientists, 68th for Innovation Policy, 41st for Cluster Innovation Environment and 59th for Linkages.

- The country was not elevated in the innovation rankings due to its lowest result for linkages. Given the often lamented lack of venture capital in Nigeria, it is safe to conclude that if necessary attention is given to our universities and students especially science and engineering education, there will be high score for the innovation index in the country.

- It is essential for our engineers to pay more attention to both training and retaining engineers to be innovative. Engineers will be retained in Nigeria when vibrant, innovative companies working at the leading edge of technology are allowed to develop and prosper.

FUTURE INNOVATION LEADERS

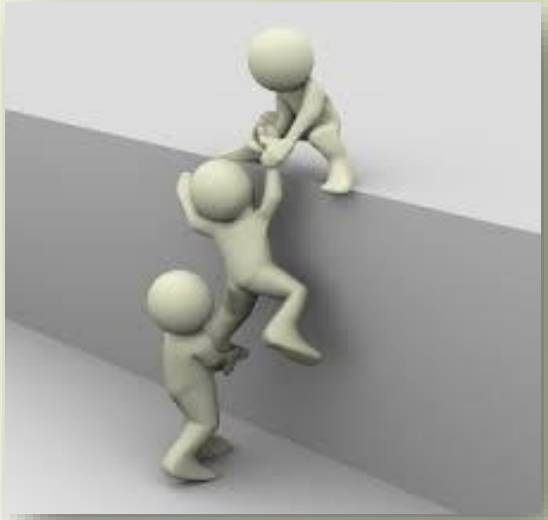
This can be achieved by:

- Creating a more favourable public policy framework including tax incentives to invest in R&D
- Developing private sector companies that aim to create unique products and processes rather than relying on natural resources
- Moving beyond technology licensing and beyond setting up new ventures with the sole intention of selling them off – shore - so that home – grown scientific and engineering advances can be developed in Nigeria more quickly than they disperse to other countries.

- Increased private sector focus on building own brands, controlling international distribution and selling globally.
- Engaging in extensive training of employees and making greater use of incentive compensation.
- Making seed capital (from both the private and public sectors) more readily available for innovative higher risk ventures, but linking its supply to the existence of the above factors.
- Strengthening the bonds between our tertiary institutes and industry

CONCLUDING REMARKS

- The main thrust of this lecture has been to contribute to the need for mentorship and innovation in our educational set up, and especially for engineering to take the deserved leadership role in the promotion of the national development in the work efficient way through engineering and technology.



- It is hereby noted that in the Nigerian Academy of ENGINEERING, a select team of our fellows in Nigeria and the Diaspora has recently concluded a study commissioned by the Royal Academy of Engineering of United Kingdom aimed at improving Engineering Education in Africa. We are bound to know more about this in the nearest future.

- It is in my habit to use selected quotations as a concluding aspect in order to learn from others:

1. Leadership and Mentorship:

- "The biggest difference is in the leadership. It was better for us. We had more coaches and mentors to help us. A lot of the younger players today suffer from a lack of direction."

--- Isaiah Thomas

2. College Experience:

- "Mentors provide professional networks, outlets for frustration, college and career counseling, general life advice, and most importantly, an extra voice telling a student they are smart enough and capable enough to cross the stage at graduation and land their first paycheck from a career pathway job."

---Gerald Chertavian

3. Lucky to have Mentors:

- "I was lucky that I met the right mentors and teachers at the right moment."

--- James Levine

4. Dreams and Ambition:

"Never give up on what you really want to do. The person with BIG DREAMS is more powerful than the one with all fact,"

--- Jackson Brown

5. Successful People:

- "I've seen that phenomenally successful people believe they can learn something from everybody. I call them 'mavericks with mentors.' Richard Branson, for instance, is a total maverick but he surrounds himself with incredibly successful, smart people and he listens to them."

--- Brendon Burchard

6. Teacher and Eternity:

- "A teacher affects Eternity, he can never tell where his influence stops."

--- Henry Brooks Adam

7. Curiosity and Learning Process:

"You can teach a student for a lesson for a day, but if you can teach him to learn by creating CURIOSITY, he will continue the LEARNING PROCESS as long as he live,"

--- Clay P. Bedford

8. Innovation and Success

"LEARNING and INNOVATION go hand in hand. The arrogance of success is to think that what you did yesterday will be sufficient for tomorrow."

----- William Pollard

9. Self Improvement for Collective good

- You cannot hope to build a better world without improving the individuals. To that end, each of us must work for his own improvement and, at the same time, share a general responsibility for all humanity, our particular duty being to aid those to whom we think we can be most useful.

--------Marie Curie

I thank everyone for your attention and patience.

Engr. Prof. Fola LASISI
President, Nigerian Academy of Engineering