

Rethinking the West African Engineering Ecosystem:

Solid Modeling, Simulation & Unilorin Design HUB

OA Fakinlede, Professor, University of Lagos; oafak@unilag.edu.ng; www.oafak.com

T Adegbola, Director Alt-I, Ibadan; tadegbola@alt-i.org

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Science to Products Africa Initiative; www.eds.s2pafrika.org

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The Problem & the Challenge

Even though we are a data-challenged nation, enough information comes out to demonstrate the dismal state of our technology. As Engineers, we make a big mistake if we sit to whine, complain and lament about our country. We must do something. Perhaps next to the political leadership, our failure reflects a failure to properly understand our role in the failure of our people and our challenge to reverse it. Patriotism and the concern for the future of our people are sufficient reasons to take the challenge; But, as engineers, we have other interests:

The proper attention to the challenges of creating goods and services will make us prosper, will make our society prosper also.

Breaking it down to the wire, technology begins and ends with the creation and modernization of Infrastructure with delivery of Goods and Services. A Technological Society is marked out by the quality, relevancy and effectiveness of the goods and services it produces and delivers, first, to its own people and, then, the world. A primitive people are known by their primitive technology. And by the level of our technology, we are, unfortunately, still a primitive people. We cannot be saved by the degrees and accolades we award to one another. We must be self-regarding on the one hand, and world regarding on the other. Understand the state of our technology and be prepared to make necessary changes for us to take our proper place in the world. Excuses will not suffice.

By this measure, it is arguable that, 60 years of tertiary engineering training of in Nigeria have not significantly altered the primitive nature of our society. A few examples may be in order:

1. In the 1950's and early 1960's, Nigerians, formally mobilized in Companies of Engineers, Technicians and labourers built, among other things, the Kano to Maiduguri section of our Railways. In 2017, Transport Minister, Rotimi Amechi announced to the world that Railways are beyond the competency of any Nigerian and that the Lagos-Port Harcourt Line will be built by Chinese manpower as a turn-key project!
2. Since the 14th century, metallurgists in the Benin Empire have been making carved masterpieces using techniques that Europeans had no clue about; in 2018, we have a posting online on the Saki metal smelters who use old tire rims, bridge railings and

other stolen metal scraps to make pots and utensils in the most primitive of ways garnering millions of views on YouTube as the state of Nigerian Technology – making us the ridicule of the world!

3. In 2012, as a member of the technical team to award national prizes by the NUC to the top engineering PhDs in the nation, we saw glaringly that Engineering PhDs in Nigeria are 80-90% focused on soft engineering: Social sciences, Operations management, etc. and similar things that can produce academic papers in the fastest ways rather than the hard engineering that can lead us to research, development and product making in the areas of energy supply efficiency, transportation innovation and infrastructural ingenuity to have anything important to give the world or improve the condition of our people. Let us be clear here: This is NOT a denigration of soft engineering itself. We are saying here that **soft engineering** only makes sense in the context of **hard engineering**. A society that has not developed hard engineering has no urgent need for soft engineering. The United States, Western Europe and, increasingly, Asian Economic Powerhouses can be talking about Human Factors Engineering; this is predicated on decades of industrial output and the need to make it more efficient. It is laughable if not entirely ridiculous that a nation with no history of industrial productivity begins to **simulate arbitrary improvements on imaginary industries and getting comical academic papers produced for self-congratulation, promotion and awards**.

Of course, the political leadership have a lot to do with these failings. Problems that make other peoples in the world to think deeply about solutions make our rulers think only about importation. The lack of confidence in ourselves, our people and our nation to offer anything of technological significance to our people (not to talk about the world) runs deep. It shows up in many ways and our conspicuous consumption of the latest toys from the Western world, and increasing from Asia, combined with the craze of our youth to go to live in the margins of other nations are debilitating facts we must try to address.

What we are doing today reconnects our engineering education delivery back to serious hard engineering and emphasizes the making of infrastructure with the development of goods and services. We begin with a brief description of the Regional Effort (West Africa) and Pilot Projects that encompass much of this effort before we situate the significance of the Design HUB being orchestrated by our Unilorin Engineering Alumni driving the process locally.

Pilots for Building Capacity in Research and Advanced Training

S2PAfrica organization is in a three-year sponsored project with the goal of researching into these failures; building capacity in upstream and downstream issues and leveraging these on the engineering ecosystem. The goal of rethinking the West African Engineering Ecosystem seeks to quantify the problems and create pilot solutions that can be tested in the effects on the ability of our engineering graduates to create useful products that are relevant to our region. Sponsors presently include:

- International Development Research Center, IDRC, Ottawa

- Autodesk
- University of Lagos

Conversations are at an advanced state for collaboration with the following:

1. **Google:** Natural Language Processing for localization in downstream interventions. This is designed to enhance access to the Global Information Infrastructure for Nigerians presently disadvantaged by Illiteracy (Graphical, Numerical, etc.) by present structure.
2. National Open University of Nigeria, **NOUN:** Development of Micro-Masters in the areas of 3D Solid Modeling, Simulation, Design and Machine Learning. The goal here is to address the large pool of desperate certificated unskilled university graduates that roam our streets.
3. StudioElle Inc.: Development of **MASC** Software for Automatic Testing for STEM, Immersive learning techniques, quantitative achievement evaluation and documentation.

Project Deliverables

Instructional Materials

3D Solid Modelling can be learned by children and pupils in grade school. Ilorin is lucky to have interventionists such as ExtreMechanics: Promoted by members of Unilorin Engineering Alumni who are partly driving today's effort. At the regional end, our focus is particular to the training of Engineers. The first deliverable is a set of instructional materials including a multimedia and multimodal book titled "Continuum Mechanics for Modeling, Simulation and Design". It is between 500 – 600 pages long. There are seven chapters. It is developed for both undergraduates as well as graduate students. This method solves the problems of weakly prepared graduate students as they will have, in a single accessible system, materials that make minimal background requirements.

We emphasize here that, even though this book teaches design basics to our West-African students in their own cultural context, the fundamental idea goes beyond just "another book". It is connected to these other resources:

- Instructional videos – to obviate the necessity to be in class and to make the materials available for online learning,
- Slides to assist instructors.
- Animated Graphics: To assist student with imagination of real live systems that are not present in their everyday experience.
- MASC Automatic Tester: To automate testing, examination and evaluation. Can also be used by accrediting agencies to gain objective data in addition to the qualitative, impressionistic metrics presently used.

Design Competition. Engineering Design competition will begin in December 2019. There will be prizes for best designs as well as support for prototyping for selected projects. The call will be made in a matter of weeks. Prize sponsors already include the IDRC and Autodesk. We

seek more prize sponsors for Competition winners as well as Institutional winners to encourage institutions that give support and succor to students making headways in the product making mindset.

Science to Products The second part of our intervention has also started. We have started researching into the capstone projects strategy in conjunction with the Industrial attachment system aimed at helping university-trained engineers become product makers for our society. Our study will not only demonstrate/reveal, quantitatively, the gaps in the present system; it will go further to propose Solutions and Pilots that will bridge the gaps and be tested for viability within the life of our project.

Our main platform for 3-D solid modelling remains the Autodesk Fusion 360, whose business model is still the most accessible to our students and teachers. We have discussed further collaboration with Autodesk on a proposed Fabrications Laboratory.

The Design HUB

The Design HUB we are launching today is a vital step in realizing a revitalized Engineering Ecosystem. The emphasis is to inculcate infrastructural development and the product-making mindset into engineering students as the primary purpose of their training to address the failures highlighted on our present emphasis. The goal is to ensure that modern technology is brought to bear on this emphasis and connect it to several other instruments of engineering training such as SWEP, SIWES, Capstone Design Courses and the NYSC scheme

The major deliverable of the process for the student will be a connection of these instruments with the engineering science and theories they learn in the classroom. The absence of this reduces engineering education to craft training instead of the technical ingenuity that relies on the body of knowledge encapsulated in the science database and taught to engineers worldwide.

It is not a mean feat to get this done correctly. There will be a need to reorient practicing engineers, lecturers and other stakeholders in the engineering training and development process. Our people have long adopted the Western understanding of these concepts and it has made us able only to produce useful materials for them and our system has not improved in creating product builders for us. It is our responsibility to work in changing that narrative.

To do otherwise is to continue Nigeria's present waywardness in subsidizing engineering training of richer countries of Europe and America where those we have trained with the little resources we have go on to spend their productive lives, using the education we have given nearly freely with little benefits to our nation.

Disclaimer

Our effort is NOT for commercial gain. IDRC is presently our major supporter in their Development Intervention Initiative. Our recommendation of Autodesk Fusion 360 predated

their promise to be a competition award supporter. It is based on a business model that enables our students not only to gain access to top design software to create 3D Solid models, but also to animate, simulate and design. With present funding structure, our educational system could not otherwise afford software at this level of engineering design and deliverable solutions.

Autodesk also solves for us another problem. At this stage, we should be applying to University authorities and government for super computer access to run the ensuing Finite Element and post processing software. There is the ability to process the solutions by cloud computing. This will require cloud credits costing up to a thousand dollars per semester per student. Again, these are provided to the students for free.

We are not unaware of competing software such as Solid Edge, Solid Works, Pro Engineer and Catia that offer similar capabilities as Fusion 360. As at today, we are not aware of any other that offers the business model above. Furthermore, Fusion 360 directly offers Computer-Aided Manufacturing capabilities interface with additive and subtractive manufacturing hardware such as 3D printers and robotic Computer Numerically Controlled Machines (CNC) that make a single environment seamlessly integrate the entire design process from conception all the way to prototyping.

Conclusion

We offer thanks to the Unilorin Engineering Alumni that have done us proud in at least two ways: They have earned successful engineering professional lives despite all the challenges of present day Nigeria. Secondly, they have been patriotic in their ability to look back and see that their Alma Matter can be assisted to deliver modern engineering training to the younger ones trying to follow their steps in a more challenging Nigeria. This attitude, when replicated in other people is capable of moving this nation in the right direction. We say thank you for inviting us.

To university of Ilorin – a place where I raised my family and spent the most productive 18 years of my professional life, it is always a homecoming to visit here. We thank the Vice-Chancellor and the management for enabling this effort to gain the oxygen it needs to survive and thrive.

To other invited guests and facilitators, it is a privilege to be part of this success. Many thanks.