

# College of Engineering Feasibility Study Viewpoint of a Theoretician Engineer

Leon van Dommelen

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*Note: The below suggestions did not seem to make it into the consultants report, except in part through the ME faculty response. So I am posting them here, for whoever might be interested.*

## 1 Introduction

I joined the newly established College of Engineering in 1984, as the second faculty member to be hired in its Department of Mechanical Engineering. Since then, I have spend most of the last 30 years at the College doing research, teaching classes, and advising students.

In view of the current College of Engineering Academic Feasibility Study, I felt that I should at least express my views of what can be done to arrive at a better College of Engineering. Not just as a long-time, relatively neutral, observer, but also because my viewpoint is maybe a bit different from other College faculty. While I have degrees in Aerospace Engineering, (ir., Delft University of Technology, and PhD, Cornell University), my work has always been in the areas of theoretical and numerical analysis. These areas are, at least on the academic level, really just areas of applied mathematics.

When I joined in 1984, it was widely understood that the College would not last more than a year or so. Either it would be disbanded or be broken up. In fact, I have been hearing rumors of plans for the College to be broken up for pretty much all these last 30 years. For one, FSU administrators have not kept their dislike for not having any budget control hidden. And there has always been at least some tension between quality teaching, most strongly promoted by FAMU, and quality research, most strongly promoted

by FSU. It is just that at the present, break up, or “differentiation,” seems maybe more realistic than ever before.

I believe most of us who were there in 1984 would have been astonished if they were told that the College would last over thirty years. Moreover, I know that at least Mechanical Engineering is a quite highly ranked program nationally. And we have over the years been among the very top departments in the nation in graduating quality women and minority engineers, in high demand by both industry and academia. Companies hire our graduates and come back for more.

In my eyes, the College owns this surprising success primarily to three key people: Joe Lanutti, Yulu Krothapalli, and Frederick Humphries. Joe Lanutti came up with the very idea of the shared College, along with Kidd at FAMU. He was strongly involved with its early stages. He stood up to considerable skepticism, especially at his own FSU, about the entire idea. Lanutti hired Yulu Krothapalli, a man who had tremendous energy and was afraid of nothing, as the first faculty member in Mechanical Engineering. Reputedly, at one time or the other Lanutti told a complaining administrator something along the lines, “Sure Yulu can be a bit of a pain. But he is also a go-getter, and that is what the College needs right now.” Yulu loved being in on the creation of a new college. His dream was to create a College that would both compete with the likes of MIT and Stanford in the visibility of its research and advance minorities through the dedicated teaching of classes of the highest quality. I think he has gotten quite close. Yulu also brought in the one Dean of the College that I really respected, Karamchetti, his former PhD advisor at Stanford University. Then there is Fred Humphries, former president of FAMU, who truly threw himself into the College’s mission to advance minorities through the production of high quality graduates. Humphries personally recruited a considerable number of top national black merit students, besting then number one, MIT, in the process. Also at the time, black PhDs in Mechanical Engineering (and in other areas of Engineering) were extremely rare. Humphries was right on top of us to do something about it, and we graduated a number of very high-quality black PhDs from our department.

Regrettably, this momentum did not carry forward. Even during Humphries time, signs of trouble started showing up. Black students may have started noticing that FSU students dealt with a noticeably more efficient administrative system. During my 30 years, I have routinely observed FAMU students (and others) not getting paid, or not getting paid on time. What

happened over time is that black students still kept coming to the College in large numbers, but they started enrolling through FSU instead of FAMU.

These students may also have recognized that the math program at FSU prepares the students far better for a career in engineering than the math program at FAMU. This, in any case, has been my long-term observation in routinely teaching relatively mathematically-oriented engineering classes, having lots of students, both FAMU and FSU, in my office with problems in these classes, and advising students.

## 2 Administrative Fixes and their Limitations

What I seem to hear from my faculty colleagues is that their biggest fear is much like mine; they do not worry that the College of Engineering is broken up, or not broken up, differentiated, or whatever. The big fear is that after all the smoke is gone, *nothing* effective will have been done to resolve the real problems that the College certainly has, given its unique status.

Maybe, if FSU gets, say, budgetary or hiring control of some departments, they will be more willing to invest in the future of these departments. Similarly, FAMU may be more involved with departments for which they have more unshared control.

Personally, however, I cannot see this as producing any dramatic changes over anything than the very long term. Unlike in 1984, we are not starting a new college from scratch. We are dealing with an existing shared College that while functional, has very significant weaknesses.

## 3 Targeted Functional Fixes

It is my belief that what needs to be done at this stage is to formulate targeted fixes for the specific problems that the College has. Hoping that if you just twiddle with the administrative structure, these problems will magically disappear is simply not realistic.

My primary concern is my long term observation that students who did their pre-engineering science classes at FAMU cannot compete with those who did them at FSU. Our 120 student graduating class has 3 (sic) FAMU students in it. (I ignore 3 students who, while this year formally enrolled at FAMU, are merely visiting students from Nigeria. They did not go through

the FAMU program.) How can you have a “joint” College, with *whatever* administrative changes, if the students of one of the Universities do not enroll enough and cannot survive if they do?

I have never had any doubt of the reason for the problem either. I have many times observed that my FAMU students, charged with the same mathematically inclined question as my FSU students, greatly underperform the FSU ones. I even vaguely remember a few instances of actually collecting statistics, like checking FAMU and FSU Calculus grades of the students. While the FAMU students had on average higher Calculus grades, they performed far worse on the question on average than the FSU students. While I understand that FAMU has a tradition of caring, there is also a real need for truly challenging the students so that they can compete with others in their career.

Not that I am the only one who has observed this. The College has always been abuzz with stories of students who failed a math class a few times at FSU, then took the same class at FAMU (a legal procedure) and suddenly got an A. A few of my own advisees did this sort of thing.

It has also been my observation that FAMU students do not tend to noticeably underperform the FSU students in the *new* math that I teach them. The big problem is with the mathematics that I assume they already know. I consider them not less talented students, but less prepared students.

Even the College has recognized the problem. At some time there was a drive to move the teaching of the Engineering Math classes to the Engineering campus. But like so many things the College has set out to do over the thirty years, there was no follow-through and it petered out.

Now the language of engineering is mathematics. Even relatively low level engineering tasks require math. An engineer cannot say, “Well, this airplane sure looks strong enough to me.” or “Now lets just make these bridge pillars this thick and see whether they withstand the water in a storm.” Pretty much everything you teach in engineering is phrased in the language of mathematics. Now if I took some courses and they taught it in Chinese, I can safely tell you that I would not learn much in these courses. And I have no doubt this is the real problem that FAMU students face: *They do not understand the language well enough.* So how can they compete which students who do?

In my opinion, the only solution to this problem that has a real chance of being successful is to move the mathematics classes that engineering students take into Engineering. This is not at all an unusual thing. There are lots

of high quality programs that teach their own “Mathematics for Engineers” type classes. By making all students, FAMU and FSU taking the same math classes, we eliminate the fundamental inequality of preparation in the most important area.

In addition, all students will be exposed to the same requirements for the amount of work it takes to pass science and engineering classes. There will not be a “culture shock” like FAMU students telling me that they never had to work as much in their FAMU classes as in mine. I might also mention, since during our meeting with CBT, it was pointed out that promoting “separate but equal” would be illegal, that I am proposing just the opposite. My proposal is instead that we should replace the critical “separate but equal” math preparations by “shared and really equal.”

Note that I am not suggesting we move, say, physics into Engineering. Physics is not so much a “language,” but a set of observations organized by mathematics. You can “fake” physics to a considerable extent by giving the mathematics, but you cannot “fake” mathematics using physics except maybe by very limited analogues.

Trying to make small tweaks within the individual math departments is not going to make a difference for more than a semester, if even that much. Within the FAMU math department there is a culture that math is not really that important to engineers. I, and every other mathematically inclined engineer that I have spoken to, are simply incredulous that you would give multiple choice tests as finals in an engineering math class. And the culture in the FSU math department is not that great either, from an engineering point of view. For example, the math department is not really that happy to teach Engineering Mathematics I, which is supposed to cover both “ordinary differential equations” and “linear algebra.” The FSU math department would really greatly prefer to just teach “ordinary differential equations.” That is not that unexpected: mathematicians like to teach depth. However, engineers do a variety of things, requiring a variety of mathematical techniques, so they care more about breadth rather than depth. As I mentioned, many engineering colleges teach their own mathematics: well, there is a reason.

Based on the above considerations, I strongly recommend the following steps:

1. Move the equivalent of the current Calculus and Engineering Mathematics classes within engineering.
2. Increase their breadth and make sure enough practice in solving real-life

engineering problems is included.

3. Make sure that they are taught by real, capable faculty, and that graduate students need not apply.
4. Name the classes whatever you want, but make sure that they have engineering numbers. In that case they should fall under serious scrutiny of ABET, the national accreditation board for engineering programs. The reason I strongly recommend this is because 30 years at the College of Engineering has given me a very poor opinion about its higher level administration. I would have very little confidence in the College standing tall for long-term high-quality teaching of these classes unless there was a big stick behind the door. And ABET is as big a stick as you can get. At their sight, all but the likes of MIT and Stanford tremble.

Yes, the above will require some resources. However, I cannot imagine how you could possibly hope to make a significant positive change at the College without spending some resources. Administrative changes be damned.

Yes the CBT is not charged with making recommendations. But my recommendation is your data.