The First Two Years of Engineering Technology: Systems or Components Approach?

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Abstract – There are significant differences between engineering science and engineering technology. The science undergraduate degree requires an abundance of theory while the technologist encounters a simpler and more hands-on approach. While there are similarities in the two curriculums, the science degree requires a much deeper approach to mathematics and leans towards the system approach. Accreditation in each program requires an evaluation of what the respective programs are providing to the graduate, value to the institution, and ultimately a contribution to a local economy and industrial workforce.

Keywords: ABET, Accreditation, TAC, IAC, IAB.

WHAT IS ENGINEERING TECHNOLOGY?

The following definition of engineering technology was established by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology [ABET, 1]. It was approved by the Engineering Technology Council of the American Society for Engineering Education. "*Engineering technology is the profession in which knowledge of mathematics and natural sciences gained by higher education, experience, and practice is devoted primarily to the implementation and extension of existing technology for the benefit of humanity"*.

It was through the recent accreditation process and remarks made by the evaluator of our program that was cause for this paper to be done. While no program at any two-year or four-year engineering institution is perfect, one must believe that every school is doing its best with available resources to provide a quality education for the student. Our department was told that we basically had a 'dinosaur' program because we were not teaching the 'system' approach. We did not agree with that specific assessment and this paper will attempt to provide proof that our program is indeed valid using the 'component' approach during the first two years of our undergraduate curriculum. To clarify our current program and probably many others elsewhere we need to look back a few years.

History of Engineering Technology

Engineering technology evolved from "engineering associate", a two-year certificate program established in many engineering schools after 1945 [Wolf, 3]. With a 'birthing' some sixty plus years ago, engineering technology has evolved and grown significantly. It was inevitable that engineering technology evolve to its present day status because of the enormous advances made in technology the last fifty years. Thanks to the transistor and Moore's Law, the number of institutions offering electrical/electronic and computer engineering technology degrees have increased significantly.

Curriculum Differences

Engineering technology is not engineering science. There are similarities in the curriculum topics of the science major versus the technology major during the freshman and sophomore years. The science student will go much deeper into theory while the technology student will get a more hands-on experience during the academic process. It is this difference between the two curriculums, coupled with enormous advances in technology, that resulted in the 'system' approach being primarily used on the science side and the 'component' approach used on the technology side. It is important to remember that many two-year programs exist to send their graduates directly into the workforce. Other two-year programs, through articulation, help improve attendance at four-year institutions through

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transfer of credits. The quality of curriculum is measured and then blessed through the accreditation process. It is worth mentioning that some companies will not hire a graduate unless he/she has come from an accredited institution. The differences in science and technology curriculum are quite clear. Schools work hard to prepare for accreditation. Achieving course outcomes and the ongoing assessment of those outcomes to further improve the quality of education is a continuous process.

'Dinosaur' Program Verification

The evaluator's remark prompted this author to do a survey of the engineering technology programs around the country. Was the 'dinosaur' remark justified? In all honesty, we were perplexed and not happy with the comment. The Engineering Technology ListServ was queried with four basic questions [Buchanan, 2]. The questions were designed to be answered with a 'Yes' or 'No' and to select choices of feedback to justify the initial answers. The four questions were:

- Are you a two-year or four-year institution?
- Do you have ABET accreditation?
- Do you teach the 'system' approach or the 'component' approach?
- Based on your answer to the third question, is your choice based on:
  1) Alumni feedback
  2) IAC/IAB feedback
  3) Local industry feedback
  4) Other (articulation, etc.)

Ninety responses were received. Forty-six were from two-year schools and forty-four were received from four-year schools. The following chart breaks down the responses in percentages between the two-year and four-year schools.

Two-year data: **46 colleges**		**Four-year data**: **44 colleges**	
ABET Accreditation	**20 or 43.5%**	**ABET Accreditation**	**42 or 95.5%**
Non-ABET	**26 or 56.5%**	**Non-ABET**	**2 or 4.5%**
System Approach	**15 or 32.6% ***	**System Approach**	**13 or 29.5% ***
Component Approach	**42 or 91.3% ***	**Component Approach**	**35 or 79.5% ***
IAC/IAB Feedback	**16 or 34.8%**	**IAC/IAB Feedback**	**22 or 50.0%**
Alumni Feedback	**22 or 47.8%**	**Alumni Feedback**	**18 or 40.9%**
Industry Feedback	**24 or 52.2%**	**Industry Feedback**	**22 or 50.0%**
Other (Articulation, etc.)	**22 or 47.8%**	**Other (Articulation, etc.)**	**10 or 22.7%**

NOTE: Some used multiple feedbacks *** Some teach both approaches**

Survey Response

Some of the responses politely asked for the reason of the survey or just asked for the numbers once they were compiled. This author replied to the listserv with the numbers and percentages above and briefly explained the reason for the survey. By averaging the two percentages of 'component' taught curriculum, it was noted also that 85.4% of the respondents were teaching 'dinosaur' programs based on the remarks of the ABET evaluator. Needless to say, a few responded to the author and did not have very nice remarks about their ABET experiences. Some who responded were asked for permission to quote them, but all but one requested to remain anonymous. It certainly made sense for them to not want to rock the boat. Listed next are a few of the 'I would prefer to remain anonymous' quotes that were received:

"I think it would be a disservice to teach from a systems approach when 2 year students need to learn the basics, including the basic math".

"Here's my take on electronics education - - first come the components, then comes the system. If the functions and properties of the individual components are not understood, the function and operation of the system can never be understood".

"I believe the ABET Criteria are indeed on target. However, I found the review process filled with personal opinion and bias".

Conclusion

This author is not trying to be vindictive toward the evaluator or ABET. The purpose of this paper is to show that no one is perfect and that 'standardization' is a very good thing to have and to follow. In a recent conversation with an experienced ABET evaluator, the author was left with these words - *"The post-2000 accreditation process is supposed to involve very minimal prescription of how you do something. It is supposed to focus on: 1) how are desired objectives and outcomes established, 2) is there an assessment process that measures the level of achievement of the objectives and outcomes, and 3) is there an evaluation of the assessment information that leads toward program improvement".*

Engineering and engineering technology may one day end up with a 'systems' approach in all of institutional curriculum. That would be when every printed circuit board or modular board contains nothing but 'integrated circuit' (IC) chips. But even when that day arrives, someone will still have to sit down and design the 'stuff' that is inside that chip.

REFERENCES

[1] ABET, Inc., 111 Market Place, Suite 1050, Baltimore, MD 21202, (401) 347-7700

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[3] Wolf, Lawrence, "The Emerging Identity of Engineering Technology", *Engineering Education, v 77,* 1987, pg 725-29.

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