

An Assessment of the Proposal
To Create a Department of Engineering
At Indiana University Bloomington

Anita Jones, University Professor Emerita, University of Virginia
Eric Grimson, Chancellor, Massachusetts Institute of Technology
James Duderstadt, President Emeritus, University of Michigan

March 3, 2015

The Charge

Responding to interests on the part of university faculty members and students, and strong encouragement from Indiana industry, Indiana University Bloomington commissioned an internal Task Force to consider the creation of a small engineering program that would align and collaborate with IUB's existing areas of strength in the physical sciences, environmental sciences, informatics and computing, and biological sciences. The IUB Task Force concluded that there was strong rationale for creating such a focused engineering program and recommended that such a program have the following characteristics:

- It would be launched as a small department (25 faculty members) within the School of Informatics and Computing.
- The early focus would be on research and doctoral education, and an undergraduate program offering a general engineering B.S. degree with concentrations in areas aligning with the existing strengths in informatics and computing, physical sciences, and biological sciences.
- This highly focused program would be designed both to complement and collaborate with existing engineering programs at Purdue University and IUPUI.

President Michael McRobbie sought additional external counsel to evaluate the IU Task Force recommendations, asking the three of us (University Professor Emerita Anita Jones of the University of Virginia, Chancellor Eric Grimson of MIT, and President Emeritus James Duderstadt of the University of Michigan) to visit campus for meetings with a broad selection of faculty, department chairs, deans, and executive officers. The particular charge to our group consisted of six elements:

1. What areas of engineering should an IUB engineering program emphasize? What opportunities will this offer for collaboration with existing programs/units at IUB and other campuses of IU?
2. What academic degrees should the engineering program offer, and what is the best starting point for these degrees (e.g., undergraduate or graduate)?
3. What programs at other universities serve as the best models for IUB to learn from in starting an engineering program, and what are the key lessons learned from them?
4. What resources will be required to start a new engineering program (e.g., faculty, staff, facilities, and equipment)?
5. Where will it make the most sense to house a new engineering program?
6. What rough timetable will be appropriate to begin a new engineering program?

We have considered each of these questions, and this brief report has been organized to present our major conclusions and advice.

The Importance of Launching an Engineering Program at IUB

We encountered very strong support for launching such a small engineering program from everyone we met at IUB, including faculty members, chairs, deans, and executive officers. In fact, many faculty members and program directors expressed concerns that it was increasingly difficult to conduct their education and research programs in the absence of engineering colleagues, in view of the increasingly interdisciplinary character of emerging technologies. In particular, several faculty members said in the strongest terms: “We desperately NEED engineering, for both our teaching and research activities at the UG and grad level, to sustain the strength of our own research programs, and to facilitate our collaboration with other universities”.

More generally, in an increasingly technology-driven world, a research university simply cannot be comprehensive without a significant engineering program, any more that it can meet contemporary needs without other professional schools such as law, business, and education. IUB remains the only AAU institution without engineering (with recent actions to add engineering programs by Harvard, Chicago, UCSC, and Georgia, as strong evidence of this trend.)

Moreover, the engineering discipline has joined the humanities and sciences as a “liberal art” for the 21st century. As such, engineering should influence university education in all disciplines since it focuses on “creating” and “making”, the key skills of our times. The absence of engineering students among the student body shortchanges the education of other IU students, since interactions among students with different intellectual perspectives play such an important role in university education.

The absence of both medicine and engineering at IUB seriously cripples its capacity to generate adequate grant support for its research activities (which, at \$117 M/y, ranks among the lowest of AAU institutions). Launching a program in engineering would boost sponsored research support very substantially even without medicine, as it has at the University of Illinois at Urbana Champaign. It also leaves open the opportunity to build programs in biomedical areas in collaboration with the IU School of Medicine in Indianapolis to further enhance IUB’s research activities.

Finally, it has become apparent to both industry and state government that Indiana faces a growing need for engineering graduates at all levels that simply cannot be met by existing engineering programs. This need is particularly great in the southwestern part of the state as is made clear in the recent Battelle report commissioned by the Lilly Endowment “Strategic Plan for Economic and Community Prosperity in Southwest Central Indiana”. In an increasingly technology-driven economy, Indiana will be unable to create adequate job growth and prosperity without additional STEM capacity, particularly in areas that engineering programs that align with the information, physical, and environmental sciences where IUB has established strength and potential. Such focused engineering education capacity will attract both additional human capital and economic activity from other states and nations, thereby multiplying the impact of the initial investment.

Collaboration

It is our belief that a strong case can be made for the positive impact that such a focused engineering program at IUB will have not only on other programs of Indiana University but also on existing engineering programs in sister institutions such as Purdue University and the IUPUI campus.

Here, it is important to understand that today major research universities set aside competition (other than on the football field and basketball court) and instead strive to build strong collaboration with other institutions to augment and leverage existing strengths. In fact, the success of the Committee on Institutional Cooperation over the past half-century in stimulating a spirit of collaboration among the "Big Ten" universities has become the envy of the world. This collaboration among many of the nation's leading research universities has created an unusually strong concentration of research and education excellence that today drives much of the commerce of the Great Lakes region.

The absence of an engineering program at IUB hinders cooperation with leading universities such as Purdue University in areas critical to both institutions and to the state. Launching the proposed engineering program will significantly enhance collaborative activities between Purdue University and Indiana University in an array of areas in the physical, environmental, biological, and information sciences that are critical to the future of both institutions, to the state, and to the nation.

More specifically, it is our belief that the launch of a small engineering program initially focused in areas of IUB existing strength will have a major impact in stimulating collaborative activities in teaching and research that will significantly strengthen the teaching and research programs of both Purdue University and Indiana University.

Program Design

We accept and support the proposal to develop the IUB engineering program as a relatively small department (e.g., 25 faculty) in the School of Informatics and Computing, since much of the early faculty hiring and research activities are likely to be aligned with current activities of that School. We agree that the emphasis on the undergraduate program and the research and doctoral program needs to be equal and simultaneous, since the faculty being hired will be, to a great extent, motivated by the undergraduate program.

While we support the proposal for the early design and launch of an undergraduate program leading to a B.S. degree in general engineering, we strongly believe that eventually such a program must be designed by the new engineering faculty hired to staff the new department, working closely with existing IUB faculty in the basic and applied sciences. Hence, we recommend that the early design of the undergraduate program take advantage of established curriculum in these fields, including the use of standard textbooks, pedagogy, and laboratory design. This will be essential in any event to provide the new faculty with the opportunity to concentrate on the development of their graduate education and research programs. Furthermore, by building the undergraduate program on a well-established base, the graduates of the program will

enjoy well-defined career opportunities including possible licensure as professional engineers.

Although the undergraduate program will initially be modest, it should have at least two, and preferably three, areas of engineering concentration. Although it might appear simplest and least risky to start with a single concentration in computer engineering, this would not meet the needs in the physical sciences, and it would not be a broad enough basis for structuring and building the desired, more general engineering education program. Hence, several undergraduate concentrations should be developed within a relatively general engineering core that align with strengths both of the School of Informatics and Computing and other science programs at IUB, such as nanoscale systems engineering, environmental engineering, and bioengineering.

Although the M.S. degree was not viewed as an early priority by the IUB Task Force, we recommend instead that it be created at the same time as the B.S. and Ph.D. programs, since the M.S. is becoming the required degree for engineering practice. At the outset, one can simply follow the practice of most engineering doctorate programs, which utilize the M.S. as a stepping stone following the completion of coursework to transition to dissertation research for the PhD. However, as the engineering program matures, a parallel M.S. (or M.Eng.) could easily be introduced to focus on professional practice. From the beginning, we recommend that IUB involve part time as well as full time *Professors of Practice* in teaching the undergraduate program. Such individuals will bring knowledge based on deep, hands-on, engineering experience in industry.

The focus of the PhD program and research activities developed by the IUB engineering program will largely be determined by the new faculty members in the program. However, we believe it is likely that these will align well with both existing programs at IUB in the basic and applied sciences, as well with the opportunities afforded by strong collaboration with colleagues and programs at Purdue University and IUPUI.

Program Evaluation and Evolution

We believe it critical to design and implement a rigorous evaluation process to insure that the program has the highest chance of success. To this end, we suggest that both the evolution and evaluation of the program be based on the achievement of specific milestones rather than a projected timetable.

Since IUB has relatively little experience in this area, we strongly recommend the formation of a visiting committee consisting both of leading faculty in engineering education, as well as those with recent experience in building such programs (e.g., Harvard, Dartmouth, or Olin College).

Resource Requirements

In our limited time on campus, it was difficult to address the issue of resources at length. Here it is important to get realistic estimates of costs and how they will be met. Since IUB has a long tradition of responsibility center management with the authority for resource generation and expenditure accountability held by the deans, the launch of

an engineering department will require some resources from outside the host School of Informatics and Computing.

While there is a tendency to suggest private fund-raising as a key resource, the uncertainty in both magnitude and timing of such efforts makes this an uncertain source for core support of a new program. Certainly tuition for enrolled students will eventually be an important source, although this may require flexibility both in fee levels and the balance between in-state (low tuition) and out-of-state (high tuition) enrollments. It was noted that the hiring of new faculty will pose a particular challenge since the startup costs for even junior engineering faculty can amount to \$1M or more. The successful hiring of established faculty with strong externally supported research programs will be an important element in supporting students (as research assistants), faculty salaries, equipment, and facilities.

If successful, this program will eventually support most of its costs through its activities. But the startup phase must be adequately funded to achieve success. It is also important that the University create, in advance, reserve funds capable of sustaining the evolution and possible growth of the engineering program to sustain the momentum key to its success.

Concluding Remarks

In summary, we believe that there is a powerful rationale for creating an engineering program at the B.S., M.S., and Ph.D. level that will benefit not only the Indiana University but other established programs, including Purdue University and IUPUI, through the opportunity for collaborative efforts and through this collaboration, impact the state of Indiana. By placing the IUB program in the School of Informatics and Computing, the University can align its engineering program with existing IUB strengths and leadership in key areas of information and communications technology. In this way, these programs will complement, rather than compete with, other engineering programs in the state, while providing unique engineering expertise in areas of key importance to existing programs in the physical, environmental, and biological sciences.