The Use of Applied Engineering in an Engineering Dominant Culture

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Abstract
Following the National Association of Industrial Technology's (NAIT) name change to the Association of Technology, Management, and Applied Engineering (ATMAE), many associated accredited programs followed suit. These programs re-branded themselves using many variations of these terms. To date, seven ATMAE-accredited programs use the terms “Applied Engineering” in their program name. However, none of these programs exist at institutions with ABET-accredited (EAC) engineering programs. This has resulted in a gap in understanding the unique challenges in defining and defending what an “Applied Engineering” degree program is, how it is different than ABET-accredited engineering programs, and what value it holds for stakeholders. This research discusses efforts made, roadblocks encountered, lessons learned, and future recommendations for making one such program name change at a university already offering ABET-accredited (EAC) engineering programs. Considerations for the use of names such as “Applied Engineering”, “Engineering Technology”, and “Industrial Technology” are discussed.

Disciplines
Bioresource and Agricultural Engineering | Engineering Education

Comments
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Introduction
Applied Engineering is an emerging academic field. This is most notably illustrated by the forthcoming 2020 Classification of Instructional Programs (CIP), which will now include Applied Engineering under the 14.0103 engineering code listing (National Center for Education Statistics, n.d.). The Association of Technology, Management, and Applied Engineering (ATMAE, formally the National Association of Industrial Technology (NAIT)) was instrumental in creating this code. Started in 1966 as a professional society for faculty of Technology Teacher Education/Industrial Arts Teacher Education (CIP 13.1309) and Industrial Technology/Technician (CIP 15.0612) programs, NAIT was approved in 1973 to accredit baccalaureate degrees from the then-named National Commission on Accreditation (NCA). In 2009, NAIT changed its name to ATMAE and has continued to function as the professional society and accrediting body for the Applied Engineering field (ATMAE, 2016). On the heels of this name change, associated ATMAE-accredited programs also began to change their degree names to follow suit. While many name variations resulted, the use of “Applied Engineering” has been claimed by one associate and seven baccalaureate programs (see Figure 1). Even with the significant re-branding of ATMAE and the forthcoming Applied Engineering CIP code, limited inroads have been made at institutions with dominant ABET Engineering Accreditation Commission (EAC) cultures. Accordingly, a gap exists in understanding what Applied Engineering is.

Figure 1. Usage of Applied Engineering and Engineering Technology for ATMAE-accredited programs (as of November 2018).
This paper focuses on challenges encountered during the name-change proposal process of an ATMAE-accredited Bachelor of Science (BS) program to include “applied engineering” - specifically, changing a BS in Industrial Technology to a BS in Applied Engineering and Technology Management. The significance of this name change stems from the long history of the program’s home department, the Department of Agriculture and Biosystems Engineering (ABE) at Iowa State University (ISU), which offers an ABET-EAC-accredited Agricultural Engineering in addition to 11 other similarly accredited programs. To the authors’ knowledge, no other ATMAE-accredited “Applied Engineering” program exist at an institution with existing ABET-EAC-accredited programs. Therefore, the roadblocks, lessons learned, and recommendations offered by this case study are singularly noteworthy.

Background
Institutional and Programmatic Setting
To illustrate the unique efforts, roadblocks, and lessons learned while rebranding an ATMAE-accredited BS program to include “Applied Engineering”, the authors used the Industrial Technology degree, administered at ISU. This program is administered alongside three other BS degrees within the same department: two ATMAE-accredited programs (Agricultural Systems Technology and Industrial Technology programs), and two ABET-EAC-accredited programs (Agricultural Engineering and Biosystems Engineering). Additionally, the two ATMAE-accredited programs are administered from the university’s College of Agricultural and Life Sciences (CALS), while the ABET-accredited programs are administered from the College of Engineering (CoE). This nuance of home college and proximity to ABET-accredited engineering programs within the same home department and at the same institution are unique characteristics of this case study.

Name Change Rationale
Motivating the proposed name change was the perceived meaning of “Industrial Technology”, which has morphed over the past several decades. Based on the description of the Industrial Technology program at ISU, the ATMAE definition of Applied Engineering (and Technology Management) (ATMAE, 2019) was the most appropriate descriptor of skills and job responsibilities of graduates of this program. This was the primary reason for proposing the name change, as it would 1) clarify the competencies of the program, 2) more clearly market the program to prospective students, and 3) more effectively connect graduates with industry.

However, due to the prevailing ABET-EAC culture at ISU, questions of why “Industrial Technology” was not still applicable, or why “Engineering Technology” was not appropriate, were raised. The authors feel this was rooted in the significant philosophical difference in ATMAE- and ABET-EAC-accredited programs with only ABET-EAC-accredited programs ending in “engineering” (this is discussed in more detail in the Engineering: noun versus adjective section). While the National Center for Education Statistics (National Center for Education Statistics, n.d.) offers a CIP code and definition for Industrial Technology/Technician, in many instances this name is used for associates and/or vocational programs. This is assumed to stem from the phrase “…in support of industrial engineers and managers…” (emphasis added) in this definition, with engineers and managers having four-year bachelor degrees. Similarly, the National Center for Education Statistics’ (National Center for Education Statistics, n.d.) definition for Engineering Technology (15.0000) includes the phrase, “…in support of…”. These definitions imply a subservient role of industrial technology and engineering technology graduates to engineers or managers. This hierarchy of roles does not carry forward into professional careers as graduates of Industrial Technology at ISU have management roles, not support roles. Therefore, neither CIP code was philosophically nor practically appropriate.

Actions
The specifics of the process for changing the Industrial Technology name, while unique to the institution in question, are similar at most public institutions of higher education. To illustrate the formal process taken, Figure 2 is presented below. To continue the process, a majority vote in support of the name change was required at each step. While the voting record for all preceding steps was carried forward during the process, this record did not assume what subsequent voting would be. In essence, each step in the process had veto capability. In addition to the formal steps depicted in Figure 2, ABE solicited input from its External Advisory Council regarding the renaming of the Industrial Technology program to Applied Engineering and Technology Management. This input, which was overwhelmingly supportive, was a significant reference point during the Department’s discussions and subsequent faculty vote. Of special note, the Engineering Caucus (EC) of the Faculty Senate at ISU, while not procedurally responsible for input until a full Faculty Senate vote, exerted significant pushback to the use of “Engineering” in the new name. This input and its impact are discussed in more detail in the Discussion section below.
Figure 2. Formal procedural process followed for the academic name-change.

Results
As illustrated by Table 1, the majority of votes cast at each stage were in support of changing “Industrial Technology” to “Applied Engineering and Technology Management”. Even so, the process stalled halfway through the Faculty Senate step (a first reading was had, but not a second). At this point, the Senate’s EC raised concerns regarding the proposed use of “engineering” in the program name, ultimately resulting in a tabling of the proposal. A discussion of these roadblocks and what was learned is included in the following section.

Table 1. Voting record for the academic name change process at ISU.

<table>
<thead>
<tr>
<th>Venue</th>
<th>For</th>
<th>Against</th>
<th>Abstain</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABE Technology Curriculum Committee</td>
<td>5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>ABE Faculty</td>
<td>21</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>CALS Curriculum Committee</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CALS Faculty</td>
<td>146</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Faculty Senate Curriculum Committee</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Faculty Senate Academic Affairs Council</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Faculty Senate</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Board of Regents Approval</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Totals</td>
<td>194</td>
<td>13</td>
<td>4</td>
</tr>
</tbody>
</table>

Discussion

Effort
A timeline of major events in the name change process is included here to illustrate the effort required by the faculty pro-
posing the change. The overall process extended from the fall of 2017 into the summer of 2019. The initial conversations with the ABE Technology Curriculum Committee (TCC) and the full faculty during the fall, culminated in a TCC vote in April of 2018. This was followed by a full ABE faculty vote in May of the same year. The remaining votes outside the Department were completed by October of 2018, at which point a first reading was had at the Faculty Senate. At this reading, the EC raised concerns and lobbied to send the proposal back to the Faculty Senate Academic Affairs Council for repeated discussion. This effectively tabled the name change proposal, with the remainder of the spring involving discussions with curriculum committee, academic deans, and faculty from CALS and CoE. Through these discussions, four main issues arose (discussed below) and represented the major roadblocks of the name change proposal process.

Roadblocks and Lessons Learned

Risk to engineering college
The first main concern raised by the EC was that the CoE would not have curricular involvement for a program using “engineering” in its name (e.g., the proposed Applied Engineering and Technology Management program). On face value, this concern appears valid. Furthermore, it is a reasonable assumption that a program with the term “engineering” in its name would be administered from a college or school of engineering, which would have curricular input into this program. Interestingly, the program in question is housed in CALS and not CoE, resulting in no formal curricular input from CoE. This institutional structure is a result of the history of the Industrial Technology program, which evolved from an Industrial Education program previously administered by the School of Education. It was not until 2004 that this program moved to CALS. This situation is typical for many ATMAE-accredited programs that have grown from or alongside Technology Teacher Education/Industrial Arts Teacher Education programs (Dean & Hauer, 1969).

In light of the norms and history described above, the authors argue the question of risk to CoE is unfounded. Is CoE truly at risk from a proposed Applied Engineering and Technology Management program, while this program is administered by CALS? Answering “yes” would logically lead to the statement that CALS is also at risk from the Agricultural Engineering program administered by CoE. This risk to CALS, is undocumented, which significantly questions the validity and reasonableness of CoE’s concerns of risk. While the authors dispute a risk to CoE from the program in question, they also hold that this response is to be expected from ABET EAC accredited program faculty.

Applied Engineering is an emerging field of study - the CIP code 14.0103 goes into effect in 2020. Furthermore, in predominantly non-ATMAE-accredited academic environments, Applied Engineering is largely unknown. Therefore, the authors encourage faculty and administrators at these institutions to expect significant time and discussion related to the inclusion of “Engineering” in Applied Engineering, especially if it is to be used for a non-ABET-accredited program. These discussions are expected to uncover philosophically different definitions of engineering that are not anticipated to be easily or quickly reconciled.

Perceived curricular overlap
Another concern raised by the University’s EC was that the proposed name change of “Industrial Technology” to “Applied Engineering and Technology Management” would imply curricular overlap with existing programs, namely an Industrial Engineering (IE) program. Specifically, the perceived overlap came from the ATMAE definitions and CIP code 14.0103 (ATMAE, 2019) given for “Applied Engineering”, which uses similar verbiage to the IE program description at ISU (see Table 2 below). Specifically, the use of the phrases “design and integration of systems,” “execution of new product designs,” and “improvement of manufacturing processes” were highlighted as overlapping with the existing IE program description at ISU.

At first pass, this concern of overlap appears reasonable. However, the perceptive reader will ascertain the difference in the level of analysis used to manage industrial systems between the two definitions. While both include systems design, process improvement, and quality control, the IE description extends to the “…analysis, optimization, and modeling…” of these systems. While the Applied Engineering definition does imply systems analysis (e.g., quality control and process improvement), the level of analysis here does not imply systems modeling, simulation, and optimization as IE does. This is a key difference between the definitions and illustrates the practical divergence in these curricula.

Table 2. Descriptions of Applied Engineering and Industrial Engineering.

www.ATMAE.org
Applied Engineering

A program that generally prepares individuals to apply mathematical and scientific principles inherent to engineering to the management and design of systems, execution of new product designs, improvement of manufacturing processes, and the management and direction of the physical or technical functions of an organization. Includes instruction in basic engineering principles, project management, industrial processes, production and operations management, systems integration and control, quality control, and statistics.

Industrial Engineering

Industrial engineers are employed to design, analyze, and improve systems and processes found in manufacturing, consulting, and service industries. Professional responsibilities are typically in design, management, analysis, optimization, and modeling of industrial systems. An industrial engineer is focused on human factors, operations research, engineering management, manufacturing engineering, and quality. Industrial engineers are typically found in organizations responsible for operations management, process engineering, automation, logistics, supply chain management, scheduling, plant engineering, quality control, and technical sales.

In the final analysis, the authors contend there is no substantive overlap of the Applied Engineering field of study (as defined by ATMAE) with other engineering fields of study (as supported by 2020 CIP code 14.0103). However, based on the concerns raised of curricular overlap, the authors encourage clear and substantive delineation of Applied Engineering curricula from similar Industrial Engineering, Engineering Management, Systems Engineering, and/or Manufacturing Engineering curricula.

No similar accredited programs

Another concern raised was that no similarly accredited programs exist. Specifically, opponents of the name change contended that no other institutions exist with both ABET engineering and ATMAE Applied Engineering accredited programs. If the definition of an “ABET-accredited” is to mean “ABET-EAC-accredited”, ISU would be the sole institution where this is true. Related concerns were voiced that an unwise precedent would be set if ISU were to hold this title. Further concern was raised that no other peer or peer-plus institutions had accredited Applied Engineering programs with this name. Again, this is technically true. However, the University is not the only national institution with both ABET and ATMAE accredited programs. When broadening the definition of “ABET-accredited program” to include all of ABET’s commissions (i.e., Engineering Accreditation Commission (EAC), Engineering Technology Accreditation Commission (ETAC), Computing Accreditation Commission (CAC), and Applied and Natural Science Accreditation Commission (ANSAC)) (ABET, n.d.), five institutions exist: four with bachelor’s degrees and one with an associate’s degree (see Table 3).

The authors maintain that defining ABET accreditation to only include EAC criteria is unfair. It discredits ABET’s ETEC, CAC, and ANSEC criteria. It also discredits the achievements attained by programs accredited by these commissions. If the goal of this debate is to highlight the singular uniqueness of a program, the only prerequisite is to choose acute categorical criteria. While this is a common tactic, it is often an unreasonable and counterproductive stance to take and devalues innovation.

Table 3. Institutions with both ATMAE-accredited Applied Engineering and ABET-accredited programs.
<table>
<thead>
<tr>
<th>Institution Name</th>
<th>ATMAE Accredited Program</th>
<th>ABET Accredited Programs</th>
<th>Degree Designation</th>
</tr>
</thead>
</table>
| Eastern Kentucky University              | Applied Engineering Management                  | Fire Protection and Safety Engineering Technology (ETAC)  
Computer Science (CAC)                  | Bachelor                                      |
| Southeast Missouri State University     | Technology Management                           | Computer Science (CAC), Engineering Technology (ETAC) | Bachelor          |
| Kent State University                    | Applied Engineering                             | Aeronautical Systems Engineering Technology (ETAC) | Bachelor          |
| Millersville University of Pennsylvania | Applied Engineering & Technology Management    | Computer Science (CAC), Occupational Safety & Environmental Health (ANSAC) | Bachelor          |
| Delgado Community College               | Civil & Construction Applied Engineering Technology | Electrical Electronic(s) Engineering Technology (ETAC) | Associates        |

**Engineering as the last term**

At the beginning of the name change process, it was argued that “engineering” is a noun, when used in conjunction with an adjective (e.g., Mechanical Engineering). Implicit to this perspective is the stance that “engineering” as a noun can only be applied to an ABET-EAC-accredited program that prepares graduates for engineering careers culminating in professional licensure. Furthermore, for technical programs not accredited by ABET EAC criteria, and assumed to be accredited by ABET ETAC, “engineering” becomes an adjective the describes the noun “technology” (e.g., Mechanical Engineering Technology). Simply stated, if “engineering” is a noun, it should be accredited by ABET EAC, if not, by ETAC. The view of engineering as a noun (i.e. profession) is not universally held. Pawley (2009) illustrates a strong emphasis on problem-solving and making things as the distinguishing marks of engineering, not accreditation criteria. Spinden (2014), while persuasively arguing for tighter regulation of professional engineering and licensure, presents many inconsistencies in the engineering profession across the United States. Additionally, as indicated by Figure 1, ABET is not the sole accreditor of Engineering and Engineering Technology programs - ATMAE accredits 3 programs ending in “Engineering” and 18 ending with “Engineering Technology”.

Further compounding the issue was the emerging nature of the Applied Engineering field of study. This called its educational and professional scope into question. While the ATMAE description of Applied Engineering (ATMAE, 2019) was included in the name change proposal, it did not align with all ABE and ISU faculty’s philosophical perspectives of the field of engineering. Unfortunately, at the time of the initial proposal process, there was no CIP definition of Applied Engineering to support the name change rationale and the engineering tradition of ABET-accreditation outweighed the emerging ATMAE defined field of Applied Engineering. The authors feel that having the 2020 CIP code 14.0103 will provide an objective arbitrator in this matter and significantly strengthen the efficacy of naming a non-ABET-accredited Applied Engineering program alongside ABET-EAC-accredited engineering programs.

**Future recommendations**

Even though the authors expected pushback for the use of the name “Applied Engineering” as part of a degree name from ABET EAC espousing engineering faculty, they did not anticipate the vigor with which issues were raised. At the heart of this confrontation was the stark difference in philosophical perspectives of what engineering is and how it should be used. This appeared to flavor all issues raised during the name change proposal process. As such, the authors provide four recommendations for similar future efforts,

1. Expect negative emotional response (initially) to “applied engineering” terminology, as this is an emerging field and has not garnered full acceptance by the traditional engineering profession or academy.
2. Plan to spend significant time managing expectations and allaying concerns related to the definition of Applied Engineering as a field of study.
3. Keep discussions focused on what Applied Engineering is and do not stray to philosophical debate regarding terminologies and definitions of the engineering profession.
4. Use the 2020 CIP code 14.0103 of Applied Engineering to describe this emerging field and delineate it from other engineering disciplines.

Conclusion
In this paper, the authors presented issues encountered during a name change proposal to include “Applied Engineering” at an institution with existing ABET EAC accredited engineering programs. It was shown that this example institution is unique as the only to have both ABET-EAC- and ATMAE-accredited programs within the same department and university. A brief rationale was also provided for the use of “Applied Engineering” versus “Engineering Technology” vs. “Industrial Technology” at the institution in question. Furthermore, the authors discussed roadblocks and lessons learned during this process. Finally, recommendations for future efforts were provided. The authors hope that others will benefit from the lessons learned and recommendations included in this paper.

References


