A Research Agenda for the Engineering Management Division

Paul Kauffmann
Old Dominion University

Abstract
A widespread issue in engineering management programs is establishing relevancy in the college of engineering curricular program both at the graduate and undergraduate level. For example, traditional engineering faculty who do not possess industry experience do not understand the program value. Similarly, potential students with engineering backgrounds do not understand the differences in engineering management and business programs. Even many employers do not fully appreciate the potential engineering management programs present for significant organizational change. Even within the discipline, the focus varies between an emphasis on soft skills and quantitative skills. This paper proposes a research agenda for the engineering management division that targets examination of these issues and long-term definition of the discipline by using educational assessment and effectiveness measures and also by study of skills necessary for student success in the work place.

The Issue

This paper proposes that the primary issue facing engineering management educators and the broader field of engineering management practice is identification of the case for engineering management as a defined, identifiable field of study with a specified content boundary that is appropriate for this field. This issue then can relate to identification of why such a field of study is useful to graduates, how it is differentiated from or similar to related fields, and the potential impact on career opportunities. This endeavor requires a research agenda that is discussed in detail in following sections.

The ASEE Engineering Management Division (EMD) is the organization that spans education and educational research and its members are best suited, equipped, and credible to pursue this agenda. Consequently, proposal of and discussion of the research agenda with the members of this group is an essential first step in pursuing the general goal of a research agenda. The result of this process over several years should be the development of a focus that serves to crystallize the educational research efforts of the group and gradually answers the identified issues.

This last point raises an important point: a research agenda is not a static set of goals and objectives. Consequently, the EMD should envision that developing a research agenda is an evolutionary process. For example, if the first generation agenda focuses on developing the defined field of engineering management and how it is differentiated, the following generation will need to track how this definition changes as the world of business and technology evolves over time. The next section proposes a starting point for the EMD research agenda.

Before the paper continues, it is important to note that it is written primarily to serve as a seminal lightening rod for this issue and a tool to begin identifying research hypotheses. Due to the fact that many of the issues it raises have not been sufficiently researched, it does not contain the usual list of references to substantiate its main points and this is precisely the issue it attempts to identify.

The Issue Within the Academy

A particularly complicating element is the lack of understanding and appreciation by rank and file engineering faculty related to what engineering management can or should mean in particular to work place success of graduates. Anecdotal examples abound that relate how traditional engineering programs have eliminated credit hours related to engineering management oriented topical areas such as engineering economy or project management in lieu of subject matter that has been outdated by the simple digital computer and commonly available software.

This issue can be clearly seen by a cursory review of the well known "a-k" outcomes contained in ABET accreditation criteria in Exhibit 1. A comparison of the course titles in many engineering programs with these outcomes will quickly reveal a disjoint in being able to tie several of them to any of the titles. Although these schools are currently accredited, it is not clear how this accreditation occurred based on this issue.

Exhibit 1 ABET Outcome Criteria

	Desired Outcomes for Engineering and Engineering Technology Programs
	The Programs attempt to instill the following attributes in its graduates as outcomes of the education provided:
a.	An appropriate mastery of the knowledge, techniques, skills, and modern tools of their disciplines
b.	An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology
c.	An ability to conduct, analyze, and interpret experiments and apply results to improve processes,
d.	An ability to apply creativity in the design of systems, components, or processes appropriate to program objectives,
e.	An ability to function effectively on teams,
f.	An ability to identify, analyze, and solve technical problems
g.	An ability to communicate effectively,
h.	A recognition of the need for, and an ability to engage in lifelong learning,
i.	An ability to understand professional, ethical, and social responsibilities,
j.	Respect for diversity and a knowledge of contemporary professional, societal, and global issues,
k.	A commitment to quality, timeliness and continuous improvement.

On a deeper plane, these outcomes imply a significant knowledge of the work place. They imply that the traditional program faculty is sufficiently familiar with the engineering work place to map these criteria to these skills. Surveys of recent graduates may be a tool to measure this issue. But once again, the issue is whether these graduates realize the skills that they could have had to be

more successful. It is impossible for them to know the things they do not know and this is a similar issue for the faculty.

Advisory committees are supposed to bridge some of this gap. However, many advisory committee members fall into the same category as the students- unaware of the deficiencies in what can be taught. This issue has been substantiated numerous times by student surveys related to graduate engineering management courses. Students who have been practicing engineering managers and practicing engineers continually indicate that they wish they had received this information in their earlier education.

A Proposed Agenda

The previous discussion has highlighted the point that the first area for the EMD research agenda must be, for both the short and long term, a consistent focus on the world of engineering practice and the specific skill sets needed for meeting the needs of business and industry. This is no simple task due to the variety and complexity of the range of areas in which engineers practice.

Current approaches commonly employed to fill this gap include alumni surveys, anecdotal discussion by opinionated faculty, and advisory committees. In this author's opinion, this system often fails primarily because it does not stand the test of investigative rigor. For example, how many of us have been to advisory committee meetings where a vocal industry representative is pushing for curricular change that may be based on the last problem he/she experienced on the job. Even more frustrating is the possibility that the issue that is supposed to be solved by improved education is an organizational problem within the specific business environment ranging from poor management, loose goals, or inadequate direction.

It should be the purview of the EMD to focus the attention of its members, in a consistent and penetrating manner, on describing and documenting the engineering workplace from the entry level to the boardroom. The result should be information that is actionable, for a wide range of engineering career alternatives, from an academic curriculum development viewpoint. It should provide statistical and quantitative data rather than qualitative opinion that is more related to a specific company or work environment.

Building on this basis, other issues can be developed ranging to the body of knowledge represented by engineering management, the differentiating factors for an engineering management degree (from for example the MBA), and how EMD can contribute to improvement of engineering education in general.

Summary and Recommendations

This paper expresses one person's opinion and is based on a single experience. Its purpose is to crystallize opinion and provide a position for discussion. Specifically, the EMD should take the lead in putting flesh on this skeleton by developing a specific committee to examine research issues and formulate a statement of interest that describes issues that have been defined based on broader discussion and participation.

This group can also explore ways to execute the agenda and these may include:

- Exploration of NSF funding for a significant longitudinal study of engineering management graduates and involving a consortium of EMD members and their institutions.
- Coordination of EMD members and use of their advisory committees to study actual industry environments with the support of the advisory committee members.
- Use of student project papers, master's theses, and dissertations directed to areas of interest.
- Continued long term, consistent focus on this issue, the elimination of fuzzy thinking, and focus on management by fact.

Over time, this effort will result in significant improvement in the quality and productivity of the engineering profession, enhancement of performance of American industry, and continuous improvement of the curricular focus of the EMD and engineering education in general.

Biographical Information

Paul Kauffmann is Professor and Chair in the Department of Engineering Technology at Old Dominion University. His previous position at ODU was in the Department of Engineering Management. Prior to his academic career, he worked in industry where he held positions as Plant Manager and Engineering Director. Dr. Kauffmann received a BS degree in Electrical Engineering and MENG in Mechanical Engineering from Virginia Tech. He received his Ph.D. in Industrial Engineering from Penn State and is a registered Professional Engineer.