Understanding the Current Work and Values of Professional Engineers: Implications for Engineering Education

Abstract

To better meet the needs of the 21st century workplace, engineering education must more fully understand the current work and values of professional engineers. However, little formal research has been done in this area. In this study we interviewed practicing engineers (n=45), surveyed engineers and individuals with engineering backgrounds (n=280), and conducted a case study of one engineering firm. We gained insights on 1. what engineers see as notable and as exemplifying in their work, 2. what aspects of their work they value most, and 3. what they would like to be different in their work. Specifically, we found that engineers see their work as using specialized knowledge to solve problems in a constantly evolving, local and/or global, business context.

Engineers value:
1. solving a problem to satisfy a client need,
2. creatively applying their knowledge,
3. making or saving money for their firm,
4. benefitting local or global communities, and
5. learning new skills and concepts.

Engineers expressed frustration that their work involves a greater focus on managerial and business processes than the tangible engineering of solutions, and that there is insufficient emphasis on developing new skills. These findings indicate that engineering education should ensure that students work in groups to creatively apply their knowledge to actual clients’ problems and develop significant business and communication skills.

Methodology

Surveys
- Survey of engineering managers (n = 70)
- Survey of “traditional” engineers (n = 80)
- Survey of those in another field w/ engr degree (n = 120)
- Follow up survey of engineering learning/thinking (n = 35)

Case Study of a large multinational firm
- 20 interviews, 7 hours of observations
- Interviews of other practicing engineers and managers (n = 30)

What do engineers do?
- “apply math and science to solve real-world problems”
- work to “improve objects” or “make new products”
- focus on “improving the lives of others”
- “turn dreams into a reality”
- consider constraints in solving problems

An engineer is really just a problem solver. It requires...taking action to make sure the product did not get shipped without being compliant.

What do engineers value in their work?

Why are these their values for selecting a project?
- Engineering is less about technical knowledge and more about satisfying your customers.
- Exercising creativity & inventing are why I became an engineer.
- Honorable goals such as ‘benefiting communities’ is great and important, but at the end of the day you still need to feed and clothe your family, which will not be possible if you do not take care of your customer and create products that succeed in the marketplace.
- It is more important in the business today to focus on non-technical issues such as time to market, lean manufacturing, product quality.
- The project must be interesting, but also something the customer wants and will be happy with.

What do engineers say about their education?
- Needed more hands-on, project-based work
- Need more practical, less theoretical
- Need more technical communication and presentation skills
- Need more business classes and client work

Define & Analyze Problems

Practice communication

Apply science & fulfill dreams

What skills do engineers see as “essential”?
- Need more business classes and client work
- Need more technical communication and presentation skills
- Need more practical, less theoretical
- Need more hands-on, project-based work

What are the initial implications for engineering education?
- Apply concepts and skills to real-world problems
- Focus on communication skills
- Work with clients, with monetary implications
- Work through realistic constraints (beyond the classroom)

What does it mean to think like an engineer?
- “To see things as ‘problems’ and naturally begin to conceptualize various ways to make things better.”
- “An engineer will think logically, theoretically, and most importantly, pragmatically.”
- “You need to look at each situation and determine the obvious and hidden constraints and basically do a risk management assessment on the trade offs.”
- “It’s more of a ‘vision’ capability then a way of thinking. You need to be able to see the ‘whole’ situation and take as many factors as possible into account before presenting your final solution.”

Data Analysis
- Identified the primary themes in the responses to each question and the frequency of those themes.
- Formulated educational implications based on the main answer to each question and commonalities among questions.

What do notable engineers see as “notable” in their work?
- Define & Analyze Problems
- Practice communication
- Apply science & fulfill dreams

Need more business classes and client work

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