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OPINION: Why EM? The Potential Benefits of Instilling an Entrepreneurial Mindset

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ABSTRACT

Entrepreneurship is always challenging the status quo; it's an engine of human progress. We view Entrepreneurial Mindset (EM) as a pathway to improve upon the status quo and improve individuals, organizations, and communities and promote health, education, and prosperity. In this brief paper, we lay out the case for why EM is beneficial for engineering students as individuals, their communities, their companies, and their nations. We also address the case for systemic change by embedding EM in the undergraduate engineering curriculum. This vision sets the stage for cultivation of the specific attributes developed in the subsequent "What" volume, enacted in the "How" volume of this same series.

Key words: Entrepreneurship, Professional Skills, Active Learning



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INTRODUCTION

What is at stake in national debates about engineering education? Faculty, administrators, employers, and other stakeholders appear to agree that improving technical education should be a top priority. U.S. technical competitiveness depends on the quality of engineering education that is offered at the undergraduate and graduate levels. And while about 28% of undergraduates declare a major in a science, technology, engineering, or math (STEM) field, nearly half of them leave those majors before graduating (Chen, 2014). Achievement and retention can be boosted by adoption of approaches such as active learning (Freeman et al, 2014). It is important, therefore, that we make engineering education more engaging, more hands-on, more accessible to women and underrepresented groups, more relevant to current social and environmental problems. In these conversations regarding how engineering education should change, entrepreneurship may seem a mere distraction. Those unfamiliar with entrepreneurial education may not see its relevance outside of schools of business. They may ask, how is entrepreneurship, with its supposedly focused on starting a business and making a profit, relevant in the discussion regarding engineering education?

We would argue that entrepreneurship, more specifically “entrepreneurial mindset” (or EM, the term of art that we will employ in this piece), is key to changing engineering education and should be considered as a positive disruptive force on par with efforts to increase diversity and to make engineering education more hands-on. In this piece, we are outlining the context for entrepreneurial mindset in engineering education by posing a series of important questions:

1. How does EM benefit individuals?
2. How does EM provide benefits for communities?
3. How does EM provide benefits for industry and corporations?
4. How does EM benefit the United States?
5. How can we support systemic change towards EM?

What Do We Mean By “Entrepreneurial Mindset”?

Entrepreneurial mindset has been defined in a number of ways (ex: Haynie et al 2010; Neneh 2012; Kriewall and Mekemson 2010). For this work, we adopt a definition that centers on the set of cognitive behaviors that orient an engineer towards opportunity recognition and value creation in any context, not just that of an entrepreneurial venture. In this context, EM has clear benefits for individuals, communities, industry/corporations, and the United States.

**OPINION:****Why EM? The Potential Benefits of Instilling an Entrepreneurial Mindset****ARGUMENTS FOR THE BENEFIT OF ENTREPRENEURIAL MINDSET (EM)****Arguments for Individual Benefit**

The impact of EM on individuals is best measured in the context of their professions. Trends in both employer and employee behaviors suggest that the cognitive behaviors associated with EM are beneficial if not crucial for long-term success.

Decades of employment trends from the U.S. Bureau of Labor Statistics show that since the 1970s, long-term unemployment is increasing (Kosanavich and Sherman, 2015) and the labor participation rate is at its lowest point since that decade (FRED, 2017). Some authors writing on the topic of the millennial job market have popularized the metaphor of a broken escalator (Brownstein, 2010) - What was once regarded as a time-honored upward career track for first employees is no longer a working functional model. Today's rate of market change has created shorter-term needs and greater expectations of employers; employees are expected to be ready to hit the ground running. However, employers regard graduates as inadequately trained, hence the "skills gap," a lack of available talent identified by 39% of U.S. companies (Bessen, 2014).

But the broken escalator is not only because of employer needs and expectations. The loyalty of employees has changed as well. They are stepping off the escalator. A 2016 Deloitte report found that 75% of millennials expected to leave their first job by 2020 (Deloitte, 2016). One might be inclined to believe that this would indicate a dynamic job market. But since 2000, there has been a steady decline in business dynamism in the high technology sector (Haltiwanger, et. al., 2014). Today, an entrepreneurial mindset can enhance an individual's ability to adapt and thrive in a rapidly changing work environment.

This changing professional environment has necessitated changing the way we educate our students. The technical education of engineers has undergone significant changes in response to industry demands. While a technical education must still produce a graduate with problem framing and problem-solving skills, we must also prepare our students with "professional skills," the preferred term for what were previously called "soft skills." These include communication, creativity, life-long learning/ adaptability, and teamwork/leadership among others (Butcher, 2013). Those who hire engineering students expect both technical expertise and proficiency in a range of professional skills (Nilsson, 2010; Grant and Dickson, 2006).

Efforts have been made to add courses to the engineering curriculum that address professional skills, but often these skills are taught outside of the engineering context. Take, for instance, the importance of communicating with stakeholders regarding a problem and the potential solutions engineers might use to solve it. Communication practiced in the context of engineering work makes



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that communication more meaningful and indicates higher level of skills development. Communication with stakeholders is just one element of EM. In addition to developing communication skills, students involved in entrepreneurship education further the ability to design for the end user and work on interdisciplinary teams solving open-ended problems (NAE 2004). A qualitative study that interviewed alumni discovered that these students felt entrepreneurship education contributed to their ability to communicate in a professional setting and ability to collaborate with others (Duval-Couetil & Wheadon, 2013). Inclusion of EM in engineering curricula not only aligns well with the learning and practice of these professional skills, but also provides a context in which students see their relevance (Magee, 2003). Integrating EM through entrepreneurship education therefore supports these professional skills that are important to the engineering design process. Additionally, EM is also well aligned with alternative educational approaches, such as problem-based learning (Du and Kolmos, 2009). Most entrepreneurship training involves some form of experiential learning (Falk and Alberti 2000). These educational approaches align well with the engineering design process and have been shown to positively impact diversity and retention among women and under-represented groups in engineering.

Arguments for Community Benefit

Several studies indicate instilling an entrepreneurial mindset among students through entrepreneurship education increases their entrepreneurial self-efficacy, entrepreneurial intention and likelihood of becoming entrepreneurs (Charney and Libecap 2000; Athayde 2009; Duval-Couetil et al, 2012). Growing the population of capable entrepreneurs has been shown to have positive impact on community economic growth. Economist and researcher Enrico Moretti discovered a causal relationship in job creation across a range of professions (Moretti, 2012). When comparing various industry sectors, the technical innovation sector (engineers and scientists) lead to the highest job multiplier studied. Within a metropolitan area, for every position in the technical sector, five additional jobs are created. In comparison, the traditional manufacturing creates far fewer: 1.6 additional jobs. For example, while Apple employs 12,000 in Cupertino, Moretti would assert that there are at least 60,000 related jobs. As Moretti states, “in Silicon Valley, high-tech jobs are the cause of local prosperity, and the doctors, lawyers, roofers, and yoga teachers are the effect.” Similarly, the authors of “Patenting Prosperity” (Rothwell, et al., 2016) write “Inventions, embodied in patents, are a major driver of long-term regional economic performance, especially if the patents are of higher quality. In recent decades, patenting is associated with higher productivity growth, lower unemployment rates, and the creation of more publicly-traded companies. The effect of patents on growth is roughly equal to that of having a highly-educated workforce. A low-patenting metro area could gain \$4,300 more per worker over a decade’s time, if it became a high-patenting metro area.” Given the impact

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on communities, we would argue that instill an entrepreneurial mindset in our students drives an economic engine for communities that benefits many different groups.

Arguments for Corporate Impact

While entrepreneurial thinking is most often associated with start-ups and other new ventures, engineers exhibiting the entrepreneurial mindset are beneficial for traditional corporations as well. As noted by (Menzel et al, 2007) “the presence of entrepreneurial minded technologists [in existing companies] is most relevant for technological innovation.” The rate of corporate disruption and corporate overturns (i.e., changes in dominant companies) demand regular and frequent innovation. Some companies, such as Apple, have recognized the need to retain entrepreneurial thinking after success. Companies that cannot afford to stand still, because of competition or obsolescence, need their own internal regenerating engine. These companies need intrapreneurs, individuals who turn their entrepreneurial mindset toward internal improvements of their companies, rather than striking out on their own. In 2015, the intrapreneurial activity (i.e., via entrepreneurial employees) is 7% in the US (GEM, 2015). This is the rate of involvement of employees in entrepreneurial activities, such as developing or launching new goods or services, for setting up a new business unit, a new establishment or subsidiary. That suggests that 93% of the workforce is engaged in more maintenance activities. Many companies recognize the need for intrapreneurs. For example, a survey of Ohio companies demonstrated the corporate interest in employees with an entrepreneurial mindset, etc. (Stuckey and Yoder, 2014).

Arguments for National Impact

Impact of EM on the national scale is felt in two ways. Intrapreneurship – the bottom-up initiatives started by individual employees – is associated with higher GDP in a multi-national study (Bosma et al, 2011). In addition, the behaviors fostered with EM support actual entrepreneurship in addition to bringing benefits to existing ventures.

Despite the growing conversation about EM in educational circles, entrepreneurship itself has seen a decline nationally since the 1970’s. Increasing attention to EM in STEM education has the potential to positively impact and increase the frequency of entrepreneurship in all sectors, including the government. We believe that EM is essential for the United States to remain globally competitive. According to the Brookings Institution, “... the United States still ranks very high globally on many important measures of innovative capacity, though other developed countries have caught up or overtaken it. The World Economic Forum rates the U.S. as third in the world in terms of innovative capacity (Klaus, 2016). Another study rates the United States fourth, but notes that it ranks near the bottom on changes over the previous ten years in the underlying variables (Atkinson and Andes,



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2011). We would also argue that global competition is not only about being a leader. Rather, the health and wealth of nations is not a zero-sum game, since all can prosper.

ARGUMENTS FOR SYSTEMIC CHANGE

As with every new idea, there are arguments against and concerns about the inclusion of entrepreneurial mindset within an engineering curriculum. Key to this discussion is our counter-arguments to those who challenge the presence of EM pedagogies in engineering education. Those disagreements are themselves productive and beneficial, creating new perspectives from which to view the goal of improving engineering education. Rather than turn away from these disagreements, we welcome them. These arguments might emerge in the form of comments by colleagues when they hear that we as advocates for integrating EM into engineering education. In this section, we attempt to document and address these concerns in the form of arguments against EM that we have heard and responses that we believe address the argument.

EM in class reinforces engineering concepts rather than distracting from them

Upon first hearing about EM in engineering education, some colleagues may dismiss it as a fad or yet another course that must be squeezed into an already packed curriculum. In previous decades, this same argument has been made about a variety of other professional skills, including teamwork and communication, two non-technical skills now widely accepted as critical to the work and success of engineers (NAE 2004). Furthermore, as is the case in the approach that many institutions use for teaching other professional skills, there is flexibility in how entrepreneurial mindset is incorporated within a curriculum. In other words, a new course on “entrepreneurial mindset” does not necessarily need to be created.

In fact, EM is effective at supporting and reinforcing learning in traditional engineering topics. For example, a student team challenged to propose an effective use for waste heat isn't just practicing opportunity recognition and value creation; they're practicing thermodynamics in a manner likely to improve their motivation to learn and enhance long-term retention (Prince, 2004). We further note that aspects of the entrepreneurial mindset (e.g., creativity, empathy, flexibility to change course on an idea when necessary, etc.) are closely related to topics in engineering design, a longstanding part of the undergraduate engineering curriculum.

EM education can help engineering be more inclusive

The benefits of engineering education, like the benefits of entrepreneurship, have historically been unevenly distributed. A valid concern, therefore, is that an initiative that attempts to bring

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these concepts together will compound, rather than ameliorate, historic imbalances. Retention of historically underrepresented groups in engineering is aided by active learning and the types of problem-based approaches that also foster EM (Freeman et al, 2014). Giving all students access to education that develops mindsets geared towards life-long learning, open-ended problem-solving, and value-creation will give more engineers the opportunity to participate meaningfully in intrapreneurial and entrepreneurial activities.

As a mindset, EM is about an engineer's orientation towards problem solving, not the type of problem

When discussing this topic with colleagues, the authors have heard several objections that focus on the “entrepreneurial” and not the “mindset” in EM. Sometimes, colleagues jump swiftly to the conclusion that this is education on business topics, driving solely towards student’s starting ventures to commercialize a product. While there is nothing inherently wrong with teaching students about how to commercialize an idea, we also point out that entrepreneurship can include social entrepreneurship, or efforts focused on advancing social causes more than emphasizing financial gain. Additionally, the focus here is on teaching the entrepreneurial *mindset*, which includes topics not directly related to making money, such as empathy, creativity, and the appreciation of others’ expertise.

Further, integrating EM in the curriculum does not necessarily mean placing an emphasis on starting a company. It also includes developing a certain mindset that will equip them with certain characteristics that will enhance their performance in any job they have in the future. While faculty certainly can influence the career trajectories of their students, it is fundamentally up to students to decide their own career path even if it means starting their own business over pursuing a job or engineering-related research. Exposing students to entrepreneurship may also open new opportunities that students would not have been presented in a traditional engineering curriculum. Students, therefore, have the opportunity to create their own job by starting a business; they may even have more opportunities as a result of entrepreneurship exposure.

We are advocating for the inclusion of the entrepreneurial mindset among the course activities; it does not need to be an isolated activity. We recognize that it is possible that a faculty member may have little to no entrepreneurial experience; however nearly every faculty member has *intrapreneurial* experience from starting a research lab, advocating for new courses or majors, and advocating for funding. The faculty’s ability to navigate an unfamiliar territory is a typical part of our role since we strive to prepare students who can respond to contemporary issues. This is characteristic of what it means to be a lifelong learner and is something we must model while encouraging our students to do the same. This includes and extends beyond the topic of entrepreneurship. Furthermore, many



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of the attributes contained within the entrepreneurial mindset (e.g., creativity, perseverance) are consistent with the attributes we expect our students to exhibit as they engage in the engineering design process, which is an area that engineering faculty already feel comfortable teaching. While we recognize that entrepreneurship is a topic that is commonly taught in the school of business, it has a place in engineering education as well since contextualizing a concept for students in a discipline is important. Simply offloading this topic to another department is a missed opportunity. If we followed this logic, engineers would not teach subjects like math, science, communication, teamwork, etc.

CONCLUSION

We present this piece as a justification for the inclusion of EM in college curricula, particularly in STEM curricula. Delineating the benefits of EM on the individual, the community, corporations, and the nation shows how widespread the impact can be. Further, presenting the arguments for (and against) EM can help defuse the negative evaluations and point us toward new ways to gain buy in. As we look forward to increasing support for EM in engineering education, we anticipate growing agreement with our base contention that EM is as essential to our students' future as their knowledge of mathematics, their skills in communication, and their abilities to design solutions that benefit others.

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