Obtaining a Combined BSE and MSE in 4.5 to 5 Years, What are Implications of this Path for Students and Employers?

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Abstract

Looking back 20 to 30 years, it was not unusual to expect a BSE degree followed sequentially by an MSE degree to take anywhere from 5.5 to 6 years for full-time students to complete both degrees. Part-time MSE graduate students often took 3-4 years to complete their MSE while working fulltime as a BSE engineer. Many part-time graduate engineering students did not complete their MSE degrees. Recent trends have indicated most fulltime BSE students opting for the combined BSE+MSE programs are completing both degrees in 5 years, with a significant fraction completing both degrees in only 4.5 years.

Beginning in 1990s and early 2000s the first combined BSE/MSE programs appeared at major academic institutions. This corresponded to the increasing numbers of incoming engineering students with advanced placement and college credits and a decrease in the number of foreign graduate student applications. The combined "4+1" BSE/MSE programs were developed and expanded to address these trends. Currently combined BSE/MSE programs are very prevalent and sought after by incoming undergraduate students. Reasons for the success of these programs is self-evident. The MSE degree typically brings students higher starting salaries, more attractive assignments, and signifies a higher academic achievement. It is easy to understand why these programs have gained so much popularity amongst BSE students. What is unclear is if this path is the best choice for BSE students, considering those who will seek MSE or Ph.D. degrees

This paper examines this trend from both pro and con positions for the student and future employers. The authors explore economic, experiential, and educational implications of a student pursuing the combined degrees vs. seeking graduate education after completing a BSE. Employer preferences or requirements of new engineers with advanced degrees was also surveyed to evaluate this trend from employment implications as well. This paper is meant to start or continue the debate as to whether these BSE/MSE programs be generally recommended to most students.

Keywords

BSE degree, MSE degree, time to matriculate.

Introduction & Background

Engineering graduate student enrollment has often fluctuated with the changing employment demands for newly minted engineers. Graduate school was frequently viewed as good place to weather an economic storm and improve one's skills. Salaries for MSE graduates are higher than

BSE graduates. However, fulltime combined BSE/MSE students forego professional engineering salaries and employment benefits such as health insurance and saving plans while continuing to pay graduate school tuition for an additional year.

Graduate school was traditionally sought by graduate engineers to develop engineering skills and expertise in a particular area, rather than continue a broader style of undergraduate education. Typically, these post-graduate degrees led to engineering career paths focusing on research.

Some educators view the combined BSE/MSE as a first professional degree at programs where the BSE degree is limited to 120 credits. In years past, BSE degrees were typically 130-140 credits. This view is not widely held.

Traditional graduate MSE enrollments have been impacted by waning numbers of full-time graduate student enrollments of post baccalaureate graduate students. More international students have opted for graduate education at non-US institutions since the World Trade Center attacks and subsequent changes in the US immigration policy. This has encouraged most American universities to open their graduate programs to their undergraduates.

Beginnings of 5th year programs in Georgia

Mercer University began offering a 5th year MSE program in 1997, as an outgrowth of their existing MSE program. This 5th year program changed to a 4+1 BSE/MSE program in 2016 to satisfy federal financial aid guidelines. Georgia Institute of Technology started offering a combined BSME/MSME in 2001, increasing MSE enrollments to offset any reduction of traditional MSE students entering the program.

The total graduate enrollment at Mercer has increased over 100% in the last 18 years, see Figure 1. Much of that growth has come from 4+1 students. Currently over 66% of the students in Mercer's graduate engineering program are 4+1 students, see Figure 2. While percent enrollment of 4+1 students is not available prior to 2013, those of us teaching graduate classes in the early 2000's could testify the percentage to be below 50% and often below 25%. Intense recruiting efforts for 4+1 students began at Mercer in 2016 including a 50% reduction of graduate tuition (5^{th} year) and automatic acceptance of Mercer students with a 3.2 GPA or higher.

Another interesting statistic is the percentage of BSE students that enter the 4+1 MSE program. In recent years, approximately 40% of our BSE students continue at Mercer with the MSE program, see Figure 3.

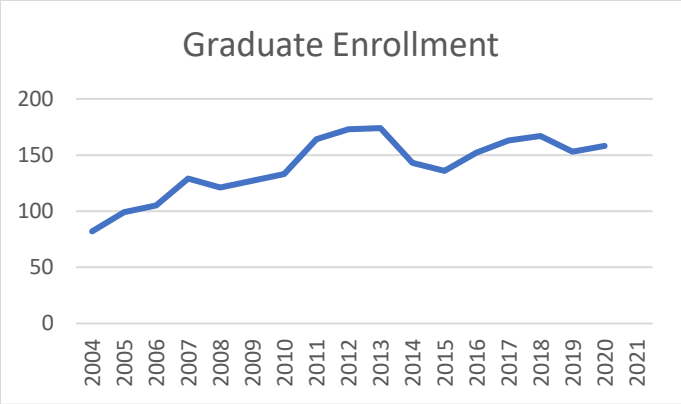

Figure 1 – Mercer Univ. School of Engineering Graduate Enrollment

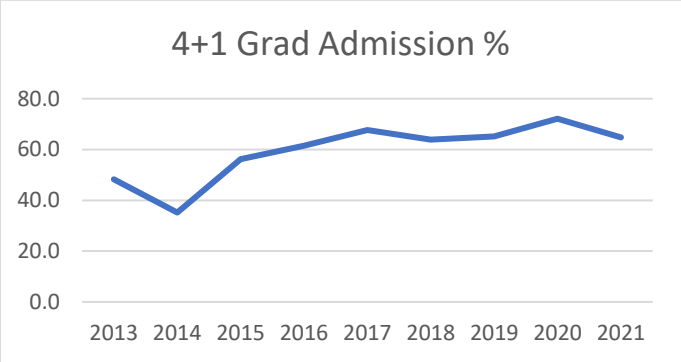

Figure 2 – Percentage of 4+1 Students in Mercer 's Graduate School

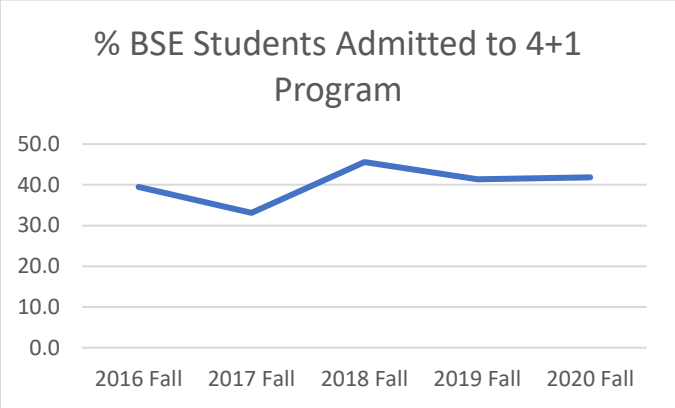

Figure 3 – Percentage of BSE Students who Pursue the 4+1 Program

Employer Needs

It is not clear that the employers are demanding engineers who have earned both BSE and MSE degrees. In fact many employers will advertise positions only listing the minimal BSE requirement and state needed experience and skills by applicants.

Using recent (October 2021) data on USA open positions from Indeed.com, it can be seen that the vast majority of the engineering positions require only a BSE as formal education. There were 5140 positions were listed as requiring "Engineer Bachelor" while only 1676 positions stated "Engineer Master".

Salaries for engineers depend more on the type of engineering and experience rather than degree level, as can be seen by Tables 1 and 2 below. At the senior levels, the variation in salary for MSE and BSE is negligible.

Table 1. Pay scale from Indeed for BSEE and MSEE degrees by job title

Payscale	BSEE		MSEE	
Job Title	**Range**	**Average**	**Range**	**Average**
Electrical Engineer	$62k - $107k	$78,207	$66k - $113k	$82,355
Software Engineer	$65k - $126k	$91,690	$68k - $136k	$97,441
Senior Electrical Engineer	$84k - $135k	$105,061	$85k - $136k	$105,415
Senior Software Engineer	$87k - $156k	$117,548	$89k - $156k	$119,267
Senior Systems Engineer	$90k - $153k	$117,030	$89k - $146k	$113,960
Radio Frequency (RF) Engine	$69k - $126k	$91,537	$76k - $133k	$99,363

Table 2. Pay scale from Indeed for BSME and MSME degrees by job title

Payscale	BSEE		MSEE	
Job Title	**Range**	**Average**	**Range**	**Average**
Mechanical Engineer	$58k - $97k	$73,230	$62k - $101k	$78,421
Senior Mechanical Engineer	$81k - $129k	$101,031	$83k - $127k	$101,655
Manufacturing Engineer	$57k - $92k	$72,024	$62k - $101k	$77,679
Project Engineer	$55k - $100k	$72,061	$59k - $107k	$76,712
Design Engineer	$53k - $88k	$67,282	$62k - $105k	$77,520
Mechanical Design Engineer	$57k - $95k	$72,395	$62k - $112k	$79,543
Aerospace Engineer	$66k - $114k	$85,656	$69k - $119k	$90,052

Options for Graduate Engineering Education

Clearly there are several viable paths to attain a MSE degree for BSE engineers other than a combined BSE/MSE program. If a student desires to attain an advanced focus of knowledge in a specific area, then seeking out specific MSE or 4+1 programs that focus in the area of interest is most important. Usually this will lead to a more traditional post-graduate path and not a 4+1 program. Note: The vast majority of 4+1 students do not do a thesis, only coursework.

Students should be more aware of the availability of graduate assistantships in teaching and research, and should consider which universities are leaders in their areas of interest. Students should also strongly consider attaining a MSE while working. Many employers will pay for graduate school either part-time or full-time. This last approach may take the longest but will likely be the most economically advantaged.

The Cost of an Extra Year

In examining the costs of graduate education, the 4+1 program may be expensive compared to other options. The average cost of graduate tuition per year at 4-year institutions is over $26,000. Forgoing a salary for 1 year is approximately $65,000. Benefits lost (healthcare, 401(k), vacation, etc.) are typically equal to 47% of a salary, $30,500. Thus the true cost of a 4+1 education is over $121,000 (not accounting for taxes). Given this opportunity and assuming a BSE's initial salary is $65,000, an MSE's salary is $70,000, both receive a 5% annual raise each year, and the added cost of an MSE in the first year is $26,000, a simplistic breakeven analysis provided in Figure 4 indicates that a 28 year career is required for the MSE to earn the equivalent of his BSE counterpart. Most successful business ventures look for a 3-5 year return on investment.

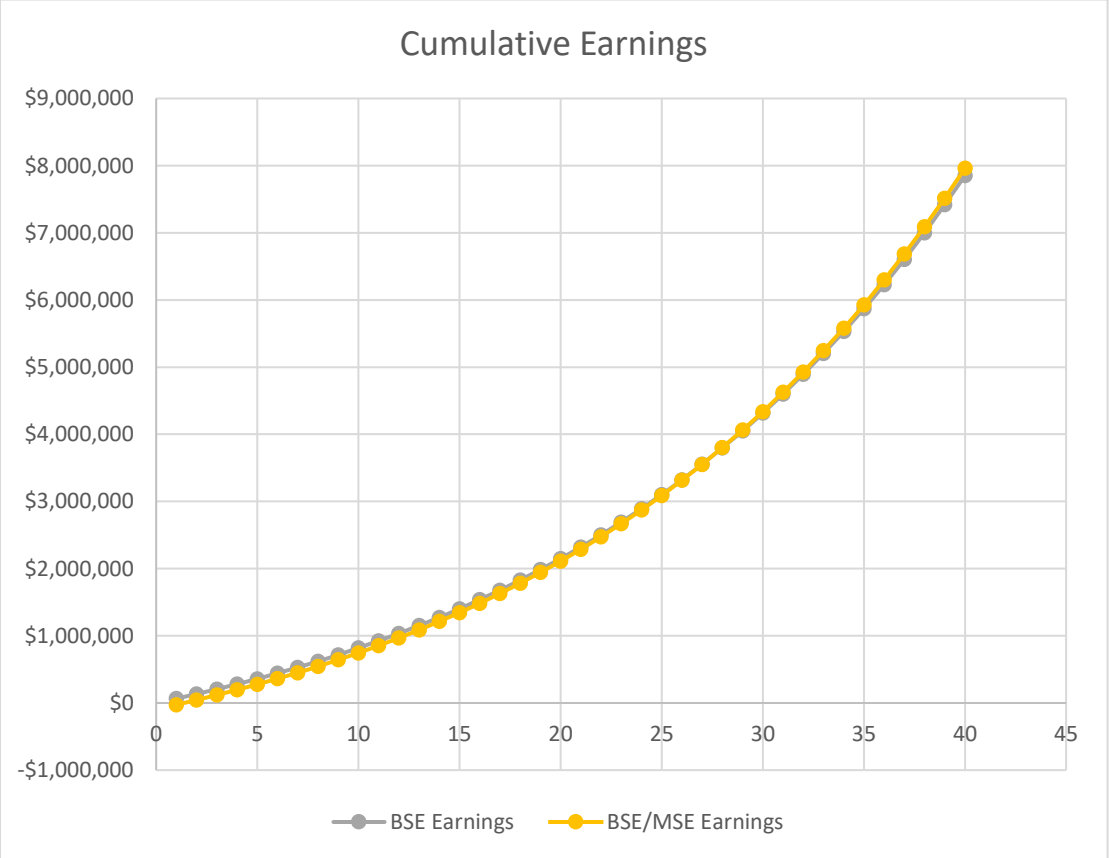

Figure 4 – Cumulative Earnings Comparison Between BSE and BSE/MSE Graduate

Debate

This section uses a debate format to approach the question of "Is a combined MSE/BSE program better than other career/educational options?"

Reasons against pursuing 4+1

Students are often enticed into the 4+1 programs at the end of their junior year. It is unclear how well-prepared junior BSE students are to make a good decision on whether to enter a 4+1 program or pursue other career/education options. Many 3rd year undergraduate students do not understand their grad school options, or know exactly what they want from their MSE program, or what career paths are available. Some students see the MSE primarily as another needed/desired credential without a particular emphasis area. Undergraduate students often see graduate education as desirable and a natural next step as their daily role models (faculty) all have Ph.Ds.

The engineering workplace is quite different from academia for students. Advancement and salary increases are based on experience, performance, and skills, not necessarily tied to a degree beyond the BSE. Employers in industry often will not hire Ph.D.s because of fear they are overqualified, may be less interested in non-research work assignments, and have too high salary requirements.

The economics of paying for an extra year of education and forgoing salary and professional engineering experience are not always sufficiently offset by higher starting salaries of engineers with advanced degrees.

Reasons for pursuing 4+1

Reasons to enter the 4+1 programs include double-counting of graduate courses as part of their undergraduate degree requirements (allowing for faster completion of a MSE), possible continuation of scholarships, graduate tuition reduction, and the comfort of staying at their undergraduate institution.

Many students are afraid they might not complete a MSE degree once they start work and increase their occupational and social responsibilities.

Many BSE programs (after completing required math, science, general education, and general engineering courses) only have between 40 to 50 credit hours devoted to discipline specific topics. Pursuing the 4+1 adds another 20 to 30 discipline specific credit hours, a 50% to 75% increase in discipline specific knowledge.

Mercer emphasizes undergraduate research, especially in engineering. Many of our best undergraduates work with faculty in their research labs. These students often pursue the 4+1 program to continue assisting and furthering their research experience. Note: Many of the graduate students are doing non-thesis research.

Another potential reason is that some students may enjoy the student/academic lifestyle. The activities, social environment, limited responsibilities. Extending this lifestyle an additional year while gaining additional knowledge is an attractive alternative to some students.

If an advanced degree is desired, pursuing the degree immediately upon completion of the BSE has benefits in that subject material is still fresh. Going fulltime allows for relatively quick completion. Not having to balance work, a family, or other obligations has its benefits.

Mercer entices 4+1 students with a 50% graduate school scholarship. While it is true that some employers may pay 100% of tuition, others may not. This 50% scholarship, combined with taking 9 or more graduate credits taken while an undergraduate, reduces graduate tuition total costs to a very affordable level of approximately $10,000 for MSE completion.

The MSE may in fact open additional employment/opportunity doors. These students have been in school an additional semester or two and also have had the opportunity for an additional summer internship.

Probably the biggest factor in whether a student should enter the 4+1 programs are the personal reasons a student wishes to earn a master's degree. For some it is the desire to continue their formal learning, for others it is another valuable credential to distinguish oneself in the job market. Many graduate students wish to focus their graduate education to gain engineering expertise in a specific area. Some see it as part of their path towards a Ph.D. leading to a career in research or academia.

Other Factors

Depending on the academic institution size and graduate school enrollment, graduate engineering course offerings may be limited in depth/focus. Graduate programs at smaller institutions without significant funded research, are typically broader in course content and limit area focus/depth of a graduate education. This type of program actually may well suit many 4+1 students who do not know in which area they wish to specialize.

Often undergraduates have limited knowledge about work and graduate school. Many students do not realize that most full-time graduate engineering students are supported financially by teaching assistantships and research assistantships. Some students also do not know that most employers will pay for their BSE employees to get a MSE degree part-time or full-time in rare instances.

These observations and more raise the question "Is a combined MSE/BSE program better than other career/educational options?"

Conclusion

There is not one best path for graduate education for BSE students. Much depends on each student's career goals, personal goals, and financial status. The best approach universities can offer is to present students with graduate school options and to educate them about the pros and cons of each option.

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