What Do Engineering Students Really Need for the Workplace and Life?

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Abstract

Each year technology changes impacting the requirements has for engineering entry level jobs. Students must increasingly be prepared for the unexpected in the workplace. Disruptive technologies will have a profound impact on industry and society as a whole. Faculty must also be ready for these changes and adapt engineering programs to this new world. Thus, it is good to periodically examine current engineering programs in light of these anticipated changes and to suggest improvements to the curriculum/programs. Increasingly, the Industrial Advisory Boards will become an important source of industry trends to help define the skills needed for the graduating engineer.

At Baylor University, these skill requirements can be broken down in to five main areas. First students need **academic skills** as broadly identified by ABET and the individual institution. While some standardization does exist, there is much each institution can control to make the experience unique to their institution and to emphasize what is important for their programs. Second, **professional skills** are necessary so that the graduating engineer can function in the industrial environment. One could develop a long list of these skills which would include such topics as teamwork, leadership, and business understanding. Third, **social skills** should not be forgotten. For example, with the advent of social media students interact less on the personal level, face-to-face. This lack of physical interaction has an impact on developing relationships whether they be personal or in the workplace. Fourth, **life skills** are necessary for students to function on their own, away from the extended family or the university campus. This could be tasks as simple as cooking and laundry, to balancing bank accounts. Topics like IRAs, 401Ks and retirement are also of interest to students entering the workforce. An important life skill is also developing a balance between personal and company/graduate school activities. Last, **spiritual awareness** is important for any student to realize there is more to life than what is physically around us. The meaning and purpose of life is a question that everyone must face at some point in their life. Ultimately, the student is responsible for being ready to face the world at graduation. However, while the engineering programs cannot do everything to prepare students for this event, engineering programs should do what they can to adequately prepare students to make a difference when they graduate. This will increase the probability of the success of the graduates who will then become productive members of society, ready to face its challenges.

Introduction

How does the university prepare students for graduation? For what is the university held accountable? How do students participate in their preparation process? What does industry contribute? These are questions that faculty and engineering programs must consider to be successful preparing minds for the next step in their students' life's journey. The university setting is expected to provide an environment to help students transition from high school to being an adult. Are graduates really prepared for what lies ahead?

Each year Baylor University graduates another class of students who will begin their professional life. For those faculty who have had the privilege of teaching both freshman and graduating seniors, seeing the students' personal growth and maturity at graduation is rewarding. Some students are excited about the next step. They have found their "dream" job and are cautiously looking forward to the future. Other students are happy to have a job and begin paying off their student loans. Still others choose to not leave the academic environment but will enter the domain of graduate school either at Baylor University or will move on to other programs. Each year, however, there is a small number of students who do not have jobs and are moving back home. Are all students adequately prepared make that next step in life? Has the academic community accomplished all it can to provide a foundation for student success? Those students without jobs had obviously not found what in engineering brings them joy [1]. Even students graduating with jobs or who will attend graduate school exhibit some apprehension as to what the future will bring. No matter what pathway students follow, the question facing both students and faculty is "what skills do engineering students really need for the workplace and life?" It is the desire of all faculty and universities to insure students are ready for graduation and prepared for that next chapter in life. Engineering programs are partially responsible to provide the needed skills so that students will be successful upon graduation. This challenge does require periodic review [2]. Are universities and engineering programs doing enough? With limited time and resources, are engineering programs adequately preparing students for what they will face? The World Economic Forum stated in their report on the Future of Jobs that 65% of children entering primary school today will end up working in new job types that do not exist at this time using technologies that have not been invented in order to solve problems that are not even known yet [3 - 5]. While some may question the 65% number, one cannot dispute the claim the world is changing and students must be prepared to face these changes [6]. The amount of technical information is doubling every two years which means that for students entering a four year technical degree, half of what they learn in their first year of study will be outdated by the third year of study [5]. Belli suggest the following to prepare for this future job market [7]:

1. Expect the Unexpected
2. Pay Attention to How Technology Impacts Specific Industries
3. Get an Education
4. Develop Human Skills
5. Pursue Your Passions

Engineering programs can and should address all five of these suggestions to help prepare students for graduation and the future job market. Along the way students will encounter disruptive technologies such as listed by Cag [8]:

1. Internet of things
2. Artificial Intelligence
3. Space Colonization
4. 3-D Printing
5. Medical Innovations
6. High-Speed Travel

7. Robotics
8. Blockchain Technology
9. Autonomous Vehicles
10. Advanced Virtual Reality
11. Renewable Energy

Students and universities must anticipate these disruptive technologies, assess their impact on society, and adapt to their influence on the future of engineering. University engineering programs must provide the technical foundation and equip students with the tools to recognize the technologies and assist them in adapting to the impact these technology challenges will have on industry and society.

Who is Accountable for Student Preparation?

Each participant involved in the education process has a degree of accountability to insure that the appropriate preparation and training for students occurs by graduation. These participants would be the university, students, and industry. What is the responsibility of the university in this preparation process? Universities are, in a basic sense, thought of as a place where students receive degrees and then find jobs. In fact, universities are so much more. True, they are places where new knowledge is created and then presented to the students. They are also places where critical thinking is developed. The university is a community where personal development occurs. A function of the university is embodied in the phrase "in loco parentis." Legally, it means "in place of a parent" and refers to the obligation of a person or organization to take on some of the functions and responsibilities of a parent. At the university, students should receive a quality education while, at the same time, achieve an acceptable level of maturity. Each student enters the university at a different level of maturity and it is hoped that in four years they will leave prepared for the challenges ahead. However, as the students entered the university with different skill levels, they will leave with different levels of preparation. How much preparation is needed and in what areas is open to discussion. Some advocate an ecological model for the university, one that is deeply networked with the society around it, makes knowledge resources freely available, and engages actively to bring about a better world [9]. Others see the evolution of the university as transforming itself to become an online entity or a combination of live and online teaching [10]. The future of universities will continue to be debated. Whatever the form, universities must prepare students for graduation and for the students to be able to adapt to the changes they will face.

Students themselves have a responsibility to take advantage of what is offered during their university education. Some form of university expectations for students is listed in any university student handbook. The expectations include attending class and coming prepared, complete assignments in a timely fashion, participate in class, communication, avoid making excuses, respectful of others' ideas and opinions, and develop a comprehensive plan to achieve educational goals [11]. Students must make a choice to become a part of the learning community and to take time to think about their future. When discussing universities one mainly thinks of academics, however, there are other opportunities in which students can participate. What is the right mix of curricular and co-curricular activities? Kovalchuk et al. see this as the

right question to ask and that a lack of a proper mix can adversely influence readiness when becoming part of the work force or entering graduate school [12].

Another important participant in the preparation of students are Industrial Advisory Boards (IAB). For students entering the workforce this is particularly important. Much has been written about IABs and their interaction with engineering programs. An IAB is a group of individuals, usually industry representatives who hire students, retired industry representatives or alumni that have an expertise, who can provide feedback to the engineering programs [13]. These IABs can be on the School or College level as well as on the department level. The feedback given by the IAB generally supports the ABET accreditation of the program. Depending on the purpose of the IAB it is necessary to select the appropriate people [14-16]. Often IABs are thought of only as opportunities for fundraising and scholarship, however, IABs can be so much more. The conclusion of both Lunt [17] and Genheimer and Shehab [18] are that presently IABs are not as effective as they could be. Their effectiveness depends heavily on strong school leadership who believe in the process and senior board membership who are committed to the program. Traditionally programs solicit IAB members from local companies who could support the program. The reality is that the vision for IABs must expand if the IAB wants to have an impact on the program and the preparation of students for employment [19]. Instead of an IAB meeting once or twice a year, members should be involved on a deeper level, such as sponsoring/mentoring capstone design [20]. IAB members are often underutilized and, given the opportunity, could contribute more than just money [21]. A wide range of impacts on engineering programs are possible. One such impact is looking ahead to anticipate the engineer of the future and, as a result, helping shape the development of any engineering program to satisfy these requirements.

Student Skills Preparation to Confidently Face the Future

In order to help students face the challenges in the workplace and in life, students must have a firm foundation from which to operate. They must have a confidence in their abilities. There are basic skill which, if internalized correctly, will help students face the challenges of tomorrow. At Baylor University, these skill revolve around the categories Academic Skills, Professional Skills, Social Skills, Life Skills, and Spiritual Awareness. Universities and engineering programs must be an active part of the development of students in each of these areas.

<u>Academic Skills</u>

Minimum standards for engineering programs in the United States are defined by the accreditation agency, ABET [22]. This organization is a creation of the various engineering professional societies. Programs who are doing well assessed every six years by an ABET Team. These teams are volunteers and come from a combination of academia, industry and government positions.

The ABET requirements change with respect to time. For example, the current minimum standards for numbers of semester hours are shown below.

Table 1 Current ABET Minimum Standards

Review year	Semester hours of engineering science	Semester hours of science and mathematics
2018-2019 [23]	48	32
2019-2020 [24]	45	30

These changes reflects a change in approach. The minimum number of hours was once defined in terms of numbers of years (1.5 years of engineering science and 1.0 years of math/science). It has now been changed to just require a certain number of semester hours. The specific number of required hours has also been slightly reduced.

Many discipline specific programs, such as Mechanical Engineering, require many more than 45 semester hours of engineering science. The second author is an ME ABET Program Evaluator. It has been his experience that most Mechanical Engineering programs have considerably more engineering science hours than what is required.

This requirement still provides a great deal of flexibility to each university, something that will allow engineering programs to respond to changes in the workplace. There are still concerns by faculty members in science heavy disciplines like chemistry and biomedical that ABET should allow fewer engineering hours if this is accompanied by more science/math hours. This issue is being actively discussed at several levels within the ABET system. Changes in these requirements may significantly change some programs, but have little effect on others.

Another way that the academic skills are being changed is by the changing discipline specific program criteria. An example is the changes that have occurred within the Mechanical Engineering Criteria.

Table 2 – Changes to Mechanical Engineering Criteria

Evaluation Year	ABET ME Criteria statement
2006—2007	The program must demonstrate that graduates have: knowledge of chemistry and calculus-based physics with depth in at least one; the ability to apply advanced mathematics through multivariate calculus and differential equations; familiarity with statistics and linear algebra; the ability to work professionally in both thermal and mechanical systems areas including the design and realization of such systems.
2012—2013	The curriculum must require students to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations); to model, analyze, design, and realize physical systems, components or processes; and prepare students to work professionally in both thermal and mechanical systems areas.
2019—2020	The curriculum must require students to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations); to model, analyze, design, and realize physical systems, components or processes; and prepare students to work professionally in either thermal or mechanical systems while requiring topics in each area.

As can be seen in the above table, mechanical engineering program requirements have become much more general. Traditionally the Mechanical Engineering curriculum has been broken into two broad streams, Thermal Systems and Mechanical Systems. In 2006 students had to be able to work and design in both areas. Starting in 2012 students then had to be able to work in both areas, but were only required to be able to do design in one area. It was made even more general in 2019. Now students only have to able to work in one area, but must have some courses in both areas.

This change means that programs can add in other topics such as bio and nano and decrease some of the traditional course topics. It also means that universities can modify their programs to emphasize the area most important to their students and local employers. So for now, a university can put most of their hours into thermal systems, if that meets local needs, while still having some classes in mechanical systems.

These changes do not require any program to change its curriculum. However, it gives programs the flexibility to create programs that best meet local and regional needs. Over the long term, this will change the body of knowledge possessed by mechanical engineers, for not everyone will have the same background in the two key areas.

Professional Skills

Professional Skills can be thought of as skills or career competencies which are often not taught in the curriculum but that are practiced and acquired during the education process. They are considered "value-added" skills which are essential to a person's career. Discussion of professional skills begins by listing broad categories, such as Doyle [25] proposes. She lists the top five mechanical engineering professional skills (applicable to all engineering) as:

1. Problem Solving
2. Creativity
3. Communication Skills
4. Teamwork
5. Math Skills to Analyze Problems

While these skills are mainly thought to be useful in the academic environment, there is a wider application of these skills. The list can be expanded to include a collection of other, non-engineering related topics that students should have to be successful. Some of these topics are:

1. Resumes
2. Job Search
3. Interviewing
4. Negotiating
5. Financial Planning – IRAs, 401Ks, and Retirement
6. Work as worship – Character
7. Company Culture
8. Work/Life Balance
9. Time Management

10. Business Understanding
11. Career Planning – Mentor – Change – Future of Work?
12. Interpersonal Relationships – Superior and subordinate
13. Ethics
14. Communication – Written, Oral, Social Media
15. Processional Societies
16. Service/Outreach
17. Teams/ Leadership
18. Creativity
19. Connections
20. Creating Value

This list is not exhaustive and might be seen to overlap somewhat with life skills. Being exposed to topics such as these not only prepares students to face the future, but practicing these topics will give students a confidence to face the challenges that will occur on the road to graduation and after. For instance, Business Understanding is essential for a student to function in the industry environment. How do companies operate? What is the role of engineering in a company? What career paths are available? How would an advanced degree help or hurt my career? Is an advanced technical degree or a Masters of Business Administration appropriate? The answers depend on the career aspirations as often engineers become project managers in a company. Understanding how a company operates will also help when new technologies are introduced. Recognizing the impact of the technology on the work of the company and embracing change would be seen as positive attributes. Being flexible and ready for change would help with career progression. At Baylor University, business models have been incorporated into capstone design projects and elective projects involving teams [26]. Operating teams as companies and exposing students to industry procedures gives them a setting in which to experience the work environment before graduation. Wisler of GE Aircraft Engines recognized this weakness and wrote about it in a paper "Engineering – What You Don't Necessarily Learn in School [27]." He has 12 suggestions to be a successful engineer which includes business understanding as number one:

1. Learn to be business oriented
2. Expect multidisciplinary problems
3. Learn to work and network in a new environment
4. Understand the differences between Academe and Industry
5. Learn to differentiate all over again
6. Understand the values, code of conduct, and culture of your particular company
7. Be open to ideas from everywhere
8. Have unyielding integrity
9. Make your manager a success
10. Support your university and technical society
11. Have fun
12. Manage your career

These are topics that all engineering students should be exposed to before they enter the workforce. It is good advice from an industry professional. This should be part of professional development.

Other topics emphasized at Baylor University are creativity, connections and creating value. Baylor University is part of the Kern Entrepreneurial Engineering Network (KEEN). KEEN is "a national partnership of universities with the shared mission to graduate engineers with an entrepreneurial mindset so they can create personal, economic, and societal value through a lifetime of meaningful work" [28]. This is accomplished by incorporating entrepreneurially minded learning (EML) into the classroom, instilling curiosity, connections, and creating value in the students. What results is a mindset and skillset which prepares Baylor University students to be competitive in the workplace. Making Baylor University students more aware of what will be faced in industry was a motivation to modify capstone design and elective design courses [29].

Some of these topics are available to the students outside the classroom as well. At Baylor University, student professional societies have assumed the responsibility to hold resume writing/reviews prior to a career fair. Recently, one student society went so far as to hold seminars entitled "Professional Development" and had retired industry leaders in the local area address the students on topics such as leadership and teamwork. While the advice given to students by these individuals was invaluable, only 20-30 students attended each meeting. Another recent undertaking at Baylor University is the partnership of the engineering programs with the business school's career services. This has opened a wide range of topics areas to engineering students. An example is an evening seminar on salary negotiation after receiving a job offer. Again, this was an excellent topic for engineering students seeking employment, however, only 20 or so students attended. While student professional societies and organizations do provide meaningful experiences to those involved, they do not reach all engineering students, particularly the ones who most need the encouragement. For that reason something more is needed to give students the exposure and confidence in these professional skills areas.

In order to expose all students to these topics, it is necessary to integrate professional skills into the curriculum. Davis and Michalaka [30] illustrate what this might look like in a civil engineering curriculum. This is done by incorporating topics into course objectives and then evaluating the objectives. Others authors address only one particular topic in objectives such as teams [31] or leadership [32]. What Baylor University is exploring is a professional skills course to help students transition to graduation and beyond. It is the model used at most universities to help freshmen transition from high school to the university environment. At Baylor University there exists a course, EGR 1095 Engineering New Student Experience, designed to help students transition to the rigorous university academic environment. This is a one hour no-credit course that is required of all engineering freshmen. The goal of this course is to strengthen a student's mind, body, and soul for an academic career at Baylor University, and more importantly, their life at home or after graduation. The main focus is on the successful transition to the university. Included in the course are topics such as Success Resources, Essential Relationships, Wellness, Advising, Professional Development, and Resume Building. On average, 70 – 80 % of the students indicated that they would use the information covered in these sessions. This approach of a no-credit seminar course should be considered for helping students transition from Baylor

University to the workforce/graduate program. For example, Trevey et al. propose a series of three one-hour professional courses focused on leadership [32]. They clearly indicate that a dedicated class must be supplemented by co-curricular activities as well. Baylor University proposes to focus, as the freshmen courses do, on the more practical skills needed to be successful in the job application process and in life. Some life skills are essential for professional development as well and could be included in such a course. The question becomes where in the curriculum would this be appropriate? The answer depends on the goal for the course. If a successful job search is the goal then this should occur early in the junior year. If preparation for entry into the work force is the goal, then the senior year would be appropriate.

Social Skills

Social skills is defined as the skills used to interact (communicate) with other people. These are the qualities that are often thought of as interpersonal skills used in direct personal contact with other people. This is both verbal and non-verbal communication [33]. Engineers are often stereotyped as lacking social skills. They are perceived to be people who avoid human contact if at all possible, have a fascination with gadgets, do not care about their appearance, are Star Trek/Star Wars fans, rarely date, are extremely honest, are not big spenders and avoid risk. Two such TV shows illustrating this stereotype are the Big Bang Theory and Scorpions. The Big Bang Theory depicts four engineers and scientists who are portrayed as "geeky". They love their work but have some difficulty relating to each other and those around them. This produces many laughs but continues to portray stereotypes of engineers and scientists in a less than positive light. Scorpions is a TV show which highlights a team of geniuses that consistently save the world in each episode. These geniuses have trouble navigating the real world and have a "normal" person who helps them interpret their surroundings. This has to stop and engineers need to have a better view of themselves.

Often when the topic of social skills is discussed the conversation immediately turns to social media. The use of Facebook, Instagram, and Twitter has exploded and young engineers are not shy about using these media. In fact, communication using social media is often more attractive for engineers (and for that matter most young people in society today) because it offers a communication link without direct personal contact. It seems more non-threatening and today's engineering students spend considerable amounts of time using these media. Social media has its place in moderation and students must remember that. Also, posting every detail of your life on Facebook can have a negative effect on your job search and students need to be aware of this. Consider anything posted to the internet to public because it will be public sooner or later.

Faculty feel their students are skilled at communication because they can create a PowerPoint slide show and present it in the classroom. While this is a useful skill, other faculty also say writing is equally as important and students need opportunities to practice this skill as well. Feedback from IABs at Baylor University is that students can adequately present a PPT slide show. IABs also say writing is adequate but needs improvement to be more what would be expected in a technical report, not to write like a student would talk or text in a casual conversation. Writing is especially important when it comes to communicating clearly and succinctly in an e-mail or memo. Where Baylor University's students are lacking, according to the IABs, is being able to communicate in a personal interview or in a casual setting such as

going to lunch. Students (and society as a whole) needs to put down the technology and to spend time building relationships. These relationships and the trust developed as a result are the foundation for business interactions.

The need for social skills is a key factor for engineering students to develop interpersonal skills according to Lopes et al. [34]. This is especially true in the team environment. Lopes et al. have developed a program to promote interpersonal skills at their university called PROPDIP (Interpersonal Professional Development Program). They put their students in a series of experiences to give them opportunities for development. Included in these experiences is a strong encouragement to be involved with an internship. Assessment of results showed an improvement in interpersonal skills. While this is positive, Waters et al. showed that students perceive that they have improved interpersonal skills over their four years in an engineering program [35]. Improvement does not necessarily mean proficiency. In light of the IAB feedback, there is still more room for additional improvement. Developing these social skills will result in [33]:

1. More and better relationships – people trust you and want to be around you
2. Better communication – being able to relate with people
3. Greater Efficiency – using time wisely for social interactions
4. Advancing Career Prospects – relating to people in the organization better
5. Increased Overall Happiness – getting along and understanding people

As engineering programs, it is desired to give students opportunities to exercise their social skills to gain confidence in these situations. This will prepare them to be ready for any circumstance in work or life.

Life Skills

Life Skills could be thought of as tasks such as cooking and laundry, to balancing bank accounts. Topics like IRAs, 401Ks and retirement are also of interest to students entering the workforce. However, to achieve a productive engineering career, faculty encourage a new engineer to achieve significance, not just success. Faculty suggest that an engineer has obtained some degree of significance when he or she is consistently living within his or her principles, achieving the wanted results in their professional and personal life. For faculty, from a professional perspective, significance frequently means having an important impact upon students, the university, and/or the appropriate research field. An engineer needs to understand who he or she really is and what he or she really wants in life. This is a philosophical reflection that many pragmatic engineering faculty find difficult to do. However, this is an absolutely critical first step. Dr. Jordan discusses this significance in his paper titled "*Launching a Successful Academic Career*" [36].

The authors agree with the perspective of Homkes [37], et al. when they wrote: *"As faculty members, our mission is thus to determine what areas are important to our schools and determine if these areas fit into our own personal value system*." Once one understands both the company environment and one's self, then it is possible to develop a plan to achieve professional significance. This should be consistent with both personal and company goals.

There are a number of different issues new engineers need to think through that are often overlooked. Whether one works for a for-profit company, a non-profit, or a governmental agency will have a dramatic effect upon one's ability to achieve success. This type of work environment needs to match the young engineer's life goals. The engineering position must also match the preferred lifestyle. Engineers can be unsuccessful because the climate of where they work (cold weather or sun-belt) does not match their preferences. Similarly, the location of the company either in a big city, suburban environment, or a relatively rural environment makes a large difference upon the young engineer's satisfaction with life, and therefore his or her success.

The "search for significance" certainly affects an engineer's choice of employer [38]. The importance of this first step has been emphasized by Salem [39]. He writes that engineers should know themselves, starting with their personal goals and objectives as well as the requirements to reach them. He writes that they should understand how their personality interacts with others. Taking a common personality profile test may help them in this process of understanding themselves.

If an engineer has a family, the family members must be taken into consideration when deciding upon a choice of employer. Many authors have made this point. One engineering example of this was provided by Rose [40]. He discusses the need to have spouses be in agreement with these fundamental career choices. This also will require some adjustments to each other's schedules. The authors agree with Rose when he wrote:

> "*It is important to schedule time for personal activities. Too often we tend to place greater significance on our professional commitments leaving our personal life to fit in wherever it can...Keeping a balance between professional and personal activities requires the prioritization and scheduling of both activities simultaneously so that our professional and personal lives can exist in harmony. This requires coordination of schedules of everyone in the family and utilizing flexibility in schedules, when needed*."

Once an engineer has evaluated who he or she is, and what the company really wants, then he or she can evaluate the chances for success at that company. He or she then needs to determine how well their personal and the company's goals overlap.

While planning is important, planning of itself will not necessarily help. It is important that the plan actually reflect the engineer's values. It is also essential that the plan be consulted from time to time to make sure that the engineer is doing what was planned to do. The authors heartily agree with Steven Covey's approach [41] which states that an engineer's plan should be based upon basic principles as to what is important in life. It should reflect where he or she plans to go, not just where they are. Covey's emphasis on putting "First Things First" is very important to the engineer. Using some of his concepts to help an engineer achieve balance has been previously discussed by Samples [42]. An engineer needs to schedule life based on what is truly important, and not just based on what appears to be the immediate problem. This will require saying no to some opportunities in order to be able to fulfill the really important ones.

The authors have been influenced by Richard Swenson's book *Margin* [43]. In *Margin*, Swenson compares a book page to life. No book publisher covers an entire page with text, for it would then be unreadable. There is always some margin left so that the page can be more easily read. Similarly, in life one should not schedule all time in formal commitments. One needs to leave some unscheduled time, or margin, so that one will have the time to deal with unexpected opportunities or unanticipated problems. In his book *The Overload Syndrome* [44], Swenson expands on his thesis in *Margin* to give a number of practical activities that can be used to create margin in your life. Since many (if not most) engineers have significant experiences with an overloaded professional and personal life, this book is highly recommend to fellow overloaded engineering colleagues. Some of Swenson's suggestions to help create margin in our life are:

1. Prioritize activities and commitments so that the most important ones get accomplished.
2. Practice saying no to good things. There are many good things that can be done, but which will keep us from doing things that are actually more important.
3. Consider doing less, not more. This is related to the statement about prioritizing.
4. The engineer should determine to do the right things, not just every task that is presented to him by others.
5. Protect open spaces. The engineer should not schedule all of his time, leave some time periods (and entire days) completely open. One application of this principle is the first author deliberating taking a full day personal retreat every quarter to evaluate his professional and personal life. This involves going somewhere away from campus (the public library is a good location), and thinking through the different aspects of his life.
6. Tame the telephone. Engineers should consider unplugging or turning off the telephone so that they can get more work done. If this is not possible, get and use an answering machine. The first author has used this approach. When in his office and working on something important, he often does not answer his telephone, and lets the answering machine record the message. He then can respond when the time is convenient to him.

Spiritual Awareness

At some point in life people question the philosophical reasons that we exist. It does not matter who you are or from what culture you come, these questions are nevertheless valid. Baylor University is a faith based university in the Christian tradition. As such, the university and the engineering programs have a responsibility to address this dimension of life. Much of the exposure to spiritual awareness at Baylor University comes from attending chapel and being involved in co-curricular activities. Students are also encouraged to attend a church of their choice. It is hoped that while at Baylor University that students will develop a consistent worldview, one that will serve as a filter to view the world.

James Sire, in his book Naming the Elephant: Worldview as a Concept, states that we all have a worldview which is formed by the sum total of life to this point. He states:

> "A worldview is a commitment, a fundamental orientation of the heart, that can be expressed as a story or in a set of presuppositions (assumptions which may be true, partially true or entirely false) which we hold (consciously or subconsciously, consistently or inconsistently) about the basic constitution of reality, and that provides the foundation on which we live and move and have our being [45]."

Naugle, as quoted by Sire, puts forth a Christian perspective of worldview:

> "Worldview in a Christian perspective implies the objective existence of the Trinitarian God whose essential character is establishes the moral order of the universe and whose word, wisdom and law define and govern all aspects of created existence [45]"

This definition acknowledges that there is more to life and that a spiritual dimension has a profound impact on the way a person would think and approach a life challenge. Baylor University proposes a uniquely Christian Worldview:

> "As a Christian, I believe in the Triune God and the personal redemption the individual through the cross of Jesus Christ. God created the universe, of which I am a part, and that these beliefs, coupled with the knowledge and skills developed through the engineering curriculum, motivate me to live the life God would have me live; engaged in the vocation of engineering to make a difference in the world [46]."

Thus, worldview becomes a guide for life and keeps our existence on earth in perspective. It gives purpose to work and helps all strive to be better people for the good of society. In design, engineers have a series of intrinsic and extrinsic decisions that must be addressed. While being a Christian engineer does not change the physical principles used to design something, the motivation for the design could be entirely different which may result in a significantly different design than someone who is not spiritually aware or practices another religion. The result also could be very similar but arrived at with different motivations [47].

Any religion could write a similar worldview statement emphasizing the important tenants of their faith and how it impacts their lives. Baylor University is a university with a diverse student population that includes 10 or more Christian denominations, Catholics, Atheists, Buddhists, Hindu, Jehovah's Witness, Mormons, Moslems and Unitarians. While the predominant religious affiliation at Baylor University is Baptist, there is a freedom to discuss topics associated with spiritual awareness from any viewpoint. It is the desire of Baylor University to help students develop this dimension of their lives to address future challenges and put these challenges in perspective. Developing a worldview will equip the graduates with internal strength and the confidence to face what unknowns may come their way.

Conclusion

The world is changing rapidly and engineering programs need to adapt to prepare students to face these challenges. It is the shared responsibility of the university, the students, and IABs to anticipate the essential changes and then to implement these changes. There needs to be a strong

foundation of skills that, if done correctly, will empower students to face any challenge that would lie ahead. Academic Skills are gained in engineering programs which have the flexibility to adapt to changing technologies. Professional Skills equip the students with the "soft" skills necessary to be effective in their job. Social Skill ensure that students will be able to interact on a personal level, taking away the anxiety associated with new situations. Life Skills are to achieve balance. It is important to have life goals consistent with personal and company objectives. Spiritual Awareness is the foundation upon which one makes life decisions. This will lead to a worldview that will provide a filter for all of life's activities. With these skill a student should be prepared to face any challenge in the future provided they take advantage of the training given them at their universities.

Bill Damon, a professor at Stanford University and the Director of the Stanford Center on Adolescent Excellence, has eloquently expressed his views on what is needed in campus culture. He states:

> "The future of any society depends upon the character and competence of its young. In order to develop character and competence, young people need guidance to provide them with direction and a sense of purpose. They need relationships that embody and communicate high standards. They need to experience activities that are challenging, inspiring, and educative. Many of the conditions for the development of character and competence in the young have deteriorated in recent years . . . young people often encounter inattention, low expectations, cynicism, or community conflict. . . . All of these conditions must be changed if we are to create a society where youngsters can attain their full potential [48]."

The shared goal of the academic world is to have a society where students meet their full potential. Hopefully this happens in engineering programs leading to graduating students who are equipped to become productive members of society, able to adapt and change with the challenges that lie before them.

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