



Learning from Senior-Level Engineering & Business Development Professionals to Create Globally Competent Engineers via On- and Off-Campus Activities

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Abstract

Efforts to scale curricular and co-curricular experiences designed to foster globally competent engineers sit at an important crossroads. Education for global competency, along with the development of other “professional” or “soft” skills, is an important part of the formation of 21st century engineers. There is broad agreement that, “US engineers [of 2020] will face totally different problems from the ones we face today” and “will have to be open to different religions, different ways of thinking, and different social values.”¹ However, consensus does not exist regarding how to cultivate globally competent engineers in a cost- and time-effective manner, nor the minimum level of global competence necessary prior to graduation.

Universities have the opportunity to make curricular and co-curricular decisions guided by the knowledge and experiences of current global professionals. This paper identifies lessons learned from 16 hour-long interviews of senior-level engineering and business development professionals at a large, Multinational Defense Company (MDC) who were currently working in or had previously completed assignments that included extensive international components. Interview transcripts were analyzed via a modified grounded theory approach.^{2, 3} Interviewees were asked (1) to describe their experiences, including how they prepared, their motivations for participating, and what challenges they faced before, during, and afterward; (2) to identify any cultural differences they observed or experienced, including those related to communication, decision-making, project management, problem solving, and style of engineering; and (3) to make recommendations for individuals beginning international assignments and for educational and corporate institutions. Lessons identified include:

1. Try Not to Behave like an ‘Ugly American’
2. Understand the Differences Between the US and the Other Country
3. Focus on Communication
4. Build Relationships, Build Trust
5. Implement A Learn-By-Doing Model of Education for International Work
6. Commit to Ongoing Cycles of Continuing Education and Reflection

The paper concludes with identification of curricular and co-curricular pathways for responding to these lessons at individual and institutional levels via on- and off-campus activities, as well as exploration of how challenges to implementation may be overcome.

Introduction

Within engineering education research and practice, there is increasing emphasis on the pedagogical importance of training engineers who can function professionally, effectively and ethically within global and diverse contexts.^{4, 5, 6, 7, 8} Overall within the last two decades, departments and colleges of engineering have developed a renewed sense of responsibility for

developing the “professional” or “soft” or “essential” skills of students, including what the ABET EC-2000 criteria describe as “the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.”⁹ As Linda Katehi suggested in her written remarks to the Engineer of 2020 Summit on Engineering Education in 2004, there is broad agreement that, “US engineers will face totally different problems from the ones we face today” (p. 152).¹⁰ As Katehi continues, it should now be expected that, “US engineers will be based abroad, will have to travel (physically or virtually) around the world to meet customers, and will have to converse proficiently in more than one language. US engineers will represent a minority culture and, thus, will have to be open to different religions, different ways of thinking, and different social values” (p. 152).

Multiple models exist for developing what Downey, et al (2006) describe as “global competency” for engineers: the “knowledge, ability, and predisposition to work effectively with people who define problems differently than they do” (p. 4).¹¹ At US universities, mechanisms for producing global competency range from single in-class experiences at home universities to full-immersion work or educational experiences in countries outside the United States. Curricular interventions/supplements include minors such as the International Minor for Engineers at the University of Michigan, the International Engineering Minor at the University of Maryland, the Global Engineering Minor at Purdue University, the Global Engineering Minor at Drexel University, the International Engineering Certificate Program at Penn State, the International Engineering Certificate at the University of Colorado at Boulder, the Global Perspective Program at Worcester Polytechnic Institute, and the International Engineering Program at the University of Rhode Island, in which students earn two simultaneous degrees in a 5-year program: a B.S. in an engineering discipline and a B.A. in Chinese, French, German, Italian or Spanish.

In addition, organizations such as Engineers Without Borders (EWB) and Engineering World Health (EWH), amongst many others, provide current engineering students with opportunities to develop global competency in real-world, client- and need-driven contexts. EWB-USA, for example, currently has more than 300 chapters in the United States, made up of 13,800 student and professional members. Litchfield, et al, (2014), in their survey of 566 engineering students at the University of Colorado at Boulder (a pilot study for a nation-wide research project) that significant differences existed between participants in Engineers Without Borders and similar organizations (which the researchers called ‘EWB-like’) when compared to other engineering students in “number of times traveled abroad, the number of countries traveled to, and overall interest and knowledge in global matters” (p. 8).¹² However, programs such as EWB and EWH are not equally viable global competency training mechanisms for students from all fields of engineering. For example, biomedical, environmental, and mechanical engineers participate at greater rates in these organizations than those students with training in aerospace engineering, computer engineering, or materials science engineering.

For engineers currently working within the corporate world, formal training programs via professional/continuing education are significantly less visible, but include the Certificate in Global Integrated Systems Engineering at the University of Washington (jointly offered by the UW College of Engineering and the UW Foster School of Business in collaboration with the Boeing Company). Resources such as lecture notes from the Leadership and Management in a

Global Environment course from Purdue University (originally developed for Purdue's blended BS/MS students)¹³ are available from GlobalHUB, a "virtual global community of students, faculty, and practitioners, interested in global engineering and global citizenship" as are Gary Downey and Juan Lucena's Engineering Cultures® Online 2.0, a series of country-based online multimedia modules. These modules address four questions: (1) How did the nation state emerge and what has counted as 'progress' or 'advancement?'; (2) How have engineers emerged, what has it meant to be an engineer, and what sorts of knowledge have engineers valued?; (3) What counts as a typical career trajectory, including education and worklife?; (4) What trends are emerging in response to the new emphasis on industrial competitiveness?¹⁴

As may be clear from the above, the growing attention to the importance of global competency for engineers has not resulted in agreement regarding definitions, assessment criteria, and/or proposed mechanisms for achieving global competency (including what level of minimal global competence is necessary prior to embarking on an international experience and the most cost- and time-effective mechanism to produce this level of global competency). At universities, the scaling of programs judged to be successful has also posed its own challenges, particularly within what is perceived as an already overburdened engineering curricula (for example, at our university, engineering majors must complete 196 units compared to the 180 units of many other majors) and a contemporary emphasis on reducing rather than expanding costs and time to degree.

Universities – whether focused on the education of current undergraduates or post-baccalaureate and returning students – have the opportunity to make curricular and co-curricular decisions guided by the knowledge and experiences of current global professionals. This paper identifies lessons learned from 16 hour-long interviews (approved by our university Institutional Review Board) of senior-level engineering and business development professionals at a large, Multinational Defense Company (MDC) who were currently working in or had previously completed assignments that included extensive international components. Sixteen interviews occurred in August and September of 2012. The employees either worked in sales and took short international trips frequently, or were assigned to one location in UK for an extended length of time. The one-hour interviews were voice recorded and transcribed by MDC and approved for release versions of the transcripts sent to the researchers in December 2012 and January 2013.

Interviewees were asked (1) to describe their experiences, including how they prepared, their motivations for participating, and what challenges they faced before, during, and afterward; (2) to identify any cultural differences they observed or experienced, including those related to communication, decision-making, project management, problem solving, and style of engineering; and (3) to make recommendations for individuals beginning international assignments and for educational and corporate institutions.

The interview transcripts were analyzed via a modified grounded theory approach since this method allows the themes, called codes, to emerge from the text rather than pushing interview responses that have been transcribed into pre-defined categories.^{2,3} The process of identifying themes and codes is iterative and occurs through a cycle of individual analysis and group discussion and focused on coding excerpts that were made up of individual sentences or grouped consecutive sentences. The codes were refined over time with input from new transcripts. This

type of analysis of qualitative data is a common practice within the social sciences and allows for the accurate quantification of qualitative data.¹⁵ Coding of the qualitative data was Dedoose, a commercially available analysis tool designed to support analysis of qualitative research data such as interviews. In addition, three undergraduate students researchers were recruited by the lead researchers to add an independent verification of the analysis. The five major code categories that emerged from this analysis are listed in Table 1, along with the number of excerpts coded within each category. Each code category has numerous sub codes, called ‘child’ codes that further discretize the data. A total of 572 excerpts from the 16 interviews were coded for this analysis.

Table 1: Total Number of Code Instances

Top-Level Code Category	Codes	Interviewees
1. Personal & Professional Motivations to Undertake Int'l Work	17 (2.4%)	8 (50%)
2. Preparation for International Work	119 (16.9%)	16 (100%)
3. Challenges and Observations During International Experience(s)	229 (32.5%)	16 (100%)
4. Strategies or Recommendations for Success	236 (33.5%)	16 (100%)
5. Specific US vs. Other Country Comparisons	104 (14.8%)	16 (100%)
TOTAL	705	16

Drawing from this analysis of the 16 interviews with the senior-level engineering and business development professionals, this paper provides an overview of “lessons learned” and concludes with identification of curricular and co-curricular pathways for responding to these lessons at individual and institutional levels via on- and off-campus activities, as well as exploration of how challenges to implementation may be overcome.

Lesson One: Try Not to Behave like an ‘Ugly American’

Two of the sixteen senior-level engineering and business development professionals at MDC that were interviewed for this project, both of whom have had extensive international experience with the company, explicitly identified the need to avoid behaving as an ‘Ugly American’ during international assignments.

Interview 8

Interviewee 8: ... you can't go in as an ‘Ugly American’. You have to go in looking for mutual benefit.

Interviewer S2: ... So you said you can't go in as the ugly American, you have to go looking for mutual benefit. What does the 'Ugly American' go in looking for in your experience?

Interviewee 8: 'I know all the answers. There's nothing you can tell me. I've done it all before. You're so dumb and I'm so smart.' You see it all the time, particularly overseas and in the business community.

Interview 9

Interviewer S3: ... Have you experienced challenges in your international work and, if so, can you think of a specific example and tell us about the strategies you employed to address the challenging situations?

Interviewee 9: ... The next thing was balancing that need to learn and adapt with the appropriateness of being myself, as I had been invited here because I do add something unique, including my pace and directness and willingness to challenge things. Before I came here I asked the woman I would be working for, 'what should I do or not do as an American?' because the last thing I want to do is be the 'Ugly American'. She felt I would be fine because she could see I was open and curious, with an 'I know I'm new' kind of attitude which I think is important when you're in another country for any reason.

The fourteen other interviewees each identified traits or practices often associated with US culture that may be perceived by those from other countries as ugly, impolite, inappropriate, disruptive, and/or deal-ending. For example, Interviewee 2 stated that, "a lot of Europeans think we are a bunch of snotty brats." When asked by an interviewer, "Does that impact the way they work with you?" Interviewee 2 continued: "Sure it does because they tend to be on the lookout for signs of us being a little more brash about decisions and we're kind of on the lookout for them being 'oh no they take forever to make these decisions'. Americans make decisions quick, our business models are pretty fast. In Europe they take much longer to make decisions."

Overall, according to the interviewees, 'American' traits or practices that are sometimes interpreted by individuals from other countries as 'Ugly American' include being more aggressive, less risk adverse, louder, more brash, less respectful of hierarchy or chain of command, more impatient, less focused on building personal relationships and trust, more transient, and so forth. While many of these specific traits can also be viewed as positive qualities, the key point here is that interviewees stressed the need for individuals in international assignments to understand the perceptions and impacts of these traits within their specific international location and to, in most cases, seek to respect and adapt to the norms of the local culture.

The most common exception to this rule that emerged in the interview data is related to gender norms. Multiple interviewees indicated that they were not willing to adapt to the gender norms of their host country and were committed to upholding the norms of US and MDC cultures regarding a commitment to equitable treatment for women in the workplace. While interviewees were willing, for example, to follow the norm of men and women not shaking hands in many

Middle Eastern countries (e.g., Interviewee 2), they were not willing to modify their team make-up or to allow female team members, or themselves as women, to be disrespected (Interviewee 4) or ignored (Interviewee 8). When gender did emerge as an on-site challenge, however, interviewees did seek to address this challenge in as sensitive and culturally appropriate manner as possible. For example, Interviewee 4 described how his response to sexism differs in the US compared to international locations. Interviewee 4 described multiple situations in which his female superiors were treated badly or ignored. When these situations occurred in United States, Interviewee 4 has felt comfortable taking “several of my US colleagues to task.” He also described how, “In several instances, I closed the meeting and we left because they weren’t treating my [female] boss with the proper respect. So we just, got up and walked out, because I didn’t want to do business that way.” However, as he elaborated,

If I behave in that same manner in an international setting, it does not send the same message. It sends a totally different message. And as a result of that, you must be more judicious and use judgment in your dealings; particular when a female professional is there, and you don’t think she is being treated properly. So the way I typically deal with that, is I have an off to the side and over a drink discussion of cultural differences between the United States and country X or whatever that country happens to be. Generally, the informal discussion is well-received and their behavior improves.

Interview data did not include substantial discussion of how interviewees have or would respond to similarly charged situations related to race, ethnicity, religion, or other social differences. However, based on MDC values and the values expressed by the interviewees during the interviews, we believe it is likely that many employees would respond in similar ways in these similar situations. From a cross-cultural training perspective, this exception can be understood as appropriate. As defined by *Culture Matters* (1997), a cross-cultural training workbook created by a US government program, cultural sensitivity does not mean liking and accepting all the cultural differences identified. Instead, cultural sensitivity “means knowing about and respecting the norms of the local culture . . . The goal in cross-cultural training is to increase your understanding, to give you a powerful set of skills, [and] a framework to make sense of whatever you do and experience” in a cross-cultural setting (p. 2).¹⁶

Lesson Two: Understand the Differences Between the US and the Other Country

Understanding the differences between the US and the other country is closely linked both to trying not to behave like an ‘Ugly American’ and to success in international assignments. In fact, the number one recommendation provided by interviewees for individuals preparing for and in international assignments – and for institutions seeking to support US employees with current or future international assignments – is to understand the differences between the US and the other country. As seen in Table 2, for individuals with future or current international assignments, 15 of the 16 interviewees explicitly made this recommendation.

Table 2: Recommendation to Understand Differences between the US and Other Country

Understand Differences between the US and Other Country	Codes	Interviewees	Recommendation Ranking
As an Individual Strategy	58 (38.2%)	15	1

	(n= 152)		
As an Institutional Strategy	27 (32.1%) (n=84)	8	1

As Interviewee 10 stated, “You’ve just got to understand why they make decisions and once you do that, it’s a lot easier to plan how you want to do things.” Interviewee 4 added that, “Understanding those cultures is essential to any business activity that you pursue. The Germans are different than Italians, the Italians are different than British and we’re different than all of them. Even though we speak a common language with the British we are sometimes separated by meanings of the same word.” In fact, a number of interviewees with UK international assignments talked extensively about the need to understand the differences between the US and UK. For example, Interviewee 15 described his own lack of awareness of these differences when beginning his UK assignment:

Patience would be a good virtue to have. And then I’d say understanding up front that there are cultural differences between the two of us – and that’s true in any international business. But I think I went in, personally went in, with “it’s the English – how different could it be?” We came from their culture so it kind of woke me up a little bit that there are still cultural differences. So that would be the 2 things – patience and understanding there is cultural difference. And probably the patience part is really on the language barriers that we have.

According to the interviewees, understanding differences between the US and other countries includes many factors and types of information, including understanding verbal and non-verbal communication practices and how business is conducted: meeting protocols; negotiation, management and decision-making styles and processes; hierarchies and chains of command; and industry/government relationships. In addition, interviewees described differences in conceptions of time and distance (a number of interviewees, for example, referenced the saying that “the difference between England and America is that America thinks 200 years is a long time and England thinks 200 miles is a long way”) and laws and treaties (particularly import/export controls) as factors shaping their international experiences.

The importance of understanding the differences between the US and the other country is confirmed by the transcript analysis of the challenges experienced by the interviewees on site: 41.1% of the challenges experienced on the work site were related to the differences in how business is conducted. Differences identified include differences in process, business interactions, hierarchy, human resource (HR) practices and labor laws, and relationships with government officials. For example, multiple interviewees discussed differences in chain-of-command and decision-making between the US and the UK Interviewee 15 stated that “they’re very prim and proper in how they do things in the UK Government. They’re very level oriented, kind of chain of command oriented ... So that’s been difficult; you don’t overstep your boundaries with who you talk to. You don’t overstep your boundaries with what you say.” Interviewee 1 shared a similar observation, stating,

[Y]ou really have to respect the chain of command. You would tell someone who is your counterpart asking them or assuming they would pass it up to their chain of command.

Whereas, the familiarity between the company like MDC and their customers often times allows direct communication to those people without any intervening. ... Now the British Ministry of Defense I don't deal with too many layers so obviously that's not a serious problem, but once again I think it's important to follow the chain of command and let people know in the proper sequence.

Interviewee 7 had the same experience, indicating that "Their leadership approach is very ... what's the right term? Hierarchical – there's a rank distinction that's still alive and well. For example, it's difficult doing all-hand meetings over there – very few questions get asked." Interviewee 16 also noted a related difference in transparency of decision-making between the US and the UK, stating that, "The thing that surprised me the most was probably not a cultural thing. It was more of a, how, how closely this strategic alignment was kept not flowed down to the various team members until right until they wanted to introduce it to them." She continued, "It was not something that we would be able to keep that quiet in the States. At least in our business, it would not have been held that tightly with those doing the integration."

Other interviewees talked about how cultural differences can even impact design and engineering practices. For example, Interviewee 9 noted that, "my general observation is that what I could consider standard systems engineering approaches are not in place. Again, this is likely because they were in a capability sustainment mode these last years and could succeed without that rigor. But still it is surprising to me that people don't think in that structured way – start with requirements, then design, build, test, etc." As another example, Interviewee 8 described how "build drawings for submarines" differ between the US and UK:

Well, they consider themselves excellent ship builders and they are very good but they don't like to be told how to do stuff the way we do it and they had developed a culture where they minimized the directions on a drawing and let the tradesman execute their trade. ... In the case of build drawings for submarines the Brits will not heavily laden their drawing, they'll use whatever they need to put the drawing to develop the drawing lower and then they use common shop practices to execute the drawing. In the US for our nuclear submarines we detail everything that's going to happen on that drawing. Now that makes the drawing busy and tremendously expensive but you don't make errors.

Here, the interviewee focuses on cost as the primary factor in producing these cultural differences. However, research in the history of engineering also suggests that the development of design plans, working drawings, shop drawings and production-control drawings differs in the US and UK after the 1850s. University of Virginia historian John Brown – in his Usher Prize-winning article "Design Plans, Working Drawings, National Styles: Engineering Practice in Great Britain and the United States, 1775-1945" – argues that engineering "drawings were far more than a tool; they became a language reflective of the context in which they originated" (2000, p. 237).¹⁷

As US engineering culture developed, Brown argues that engineers began to use shop drawings "to achieve thorough control over the labor of patternmakers, blacksmiths, machinists, and erectors" (p. 216) and, in combination with piecework, facilitated the "firm's effort to subdivide and standardize work tasks" (p. 217). As Brown continues, "Shop drawings and piecework pay

provided American engineer-managers with two interlocking methods to divide up work tasks, boost productive efficiency, and transform craft labor into industrial work” (p. 217) and “represented a substantial managerial incursion into craft workers’ autonomy, suggesting a de-skilling motive” (p. 218).

Brown documents a different history within British engineering culture. Rather than adopting a production-control, standardization, and/or efficiency emphasis, British engineers continued to emphasize “design creativity” as a component of their professional identity. Brown shows that “by focusing on design originality and product quality, these engineers reinforced the position and power of craft skills” (pp. 219-220). In contrast “with American engineers’ efforts to control workers, lessen their reliance on skilled men, and cut costs by rationalizing production,” British engineers saw drawings as “instruments . . . to mandate the best possible design, and they saw workers’ skills as integral to achieving product quality” (pp. 220-221). The difference between US and UK engineering cultures can be seen, for example, in the widespread adoption and use of “as fitted” drawings in Britain, “[d]rawn by a firm’s junior draftsmen and based on actual measurements from the product (taken after its completion), these drawings delineated all the compromises that had been rendered in metal between the designers’ final plans and the execution of that design by foremen and skilled workers” (p. 230).

Brown suggests that there are multiple intersecting explanation for this divergence in engineering cultures. These include market-size; the comparative cost of skilled labor, quality of labor skills, and skilled craft worker militancy; the presence or absence of publicly-funded primary and secondary schools; the preferred model of engineering education (school vs. apprenticeship); and the relationship between engineering and management. Too, rather than identifying with management, British engineers emphasized independence as the “traditional hallmark of truly professional status” (p. 229) and “were more likely to see workers as allies in a joint endeavor” (p. 231).

US employees working at this multinational defense contractor in the UK are not the first to wrestle with the impact of this difference in engineering styles. Brown outlines, for example, the difficulties that emerged “[a]fter Henry Ford agreed to mass produce B-24 bombers at the rate of one every hour” (p. 236). However, when Ford received the engineering drawings from the original designer, Consolidated Aircraft Company, the firms

found they spoke different languages. Where Consolidated used fractional dimensions—the survival of a cruder age of aircraft construction—Ford used decimal notations entirely. Moreover the Consolidated draftsmen all presumed that their drawings would be interpreted by experienced foremen. They made use of all sorts of signs and symbols without amplification (Holley, 1964, p. 522; quoted in Brown, 2000, p. 236).

As later described by two war-time commissioners,

British marine engine builders and other manufacturers in general leave many details off the drawings to shop practice. . . . For US conditions, however, it was necessary to amplify and re-dimension the British plans in respect to tolerances, fits and clearances, degree of finish, fillets, &c. . . . Also the British practice is to include many items on the

one tracing, and it was necessary to break these down into single item plans” (Thompson & Hunter, 1942, quoted in Brown, 2000, p. 236).

In the end, “The only feasible solution Ford’s engineers could offer to these difficulties was to redraw Consolidated’s thirty thousand working drawings. To suit their own production approach, tooling, and workers, they ended up drawing sixty thousand plans.”¹⁷

Building off of the insights shared by the interviewees, this brief case study of differences in engineering drawing styles illustrates how understanding the different histories of US and British engineering cultures may function as a resource for US engineers with an international assignment that includes substantial work in the United Kingdom, and with countries whose engineering culture was shaped by British engineering practices (for example, Australia and India).¹⁸ Understanding this history may also assist us in understanding more about our own contemporary engineering culture, and its development, as US engineering is commonly understood as “shaped by two traditions: a French (or continental European) tradition and a British tradition, better adapted to American economic and political conditions and American social values than either of its predecessors.”¹⁹

Lesson Three: Focus on Communication

Communication during international assignments is one of the biggest challenges identified by those interviewed, with 15 of the 16 interviewees describing their experiences of communication challenges and 26.3% of the overall on-site challenges coded (n=175) related to communication. Paying attention to and improving communication is also the second most provided recommendation for individuals preparing for and in international assignments, explicitly discussed by 12 of the 16 interviewees.

As described by the interviewees, communication is both verbal and non-verbal, and can include obvious differences like first language as well as less obvious differences such as whether or not a specific communication culture allows for the voicing of disagreement or dissent. For example, Interviewee 2 described a common situation when US employees work in various Asian cultures:

Yes, because in the Asian culture, I don’t care what you say to them they will always say “Hai” and nod their head up and down. It’s a nod of respect and just acknowledgment that “yes, I hear you.” “I hear you” does not mean, “I agree with you.” So time, and time again we’ve had people go to Asia and come back and say “yes I talked to them about it, this is what they want,” it just means I heard you. And there and the Asian culture is not confrontational, they don’t get into you face and say, “No, it is not what I told you I wanted, I want this.” That’s the way we talk with each other, but the Asian will never, ever say that to you. Now I don’t know about the generation graduating from college now that’s going to populate their corporations, I don’t know about that but the ones we’re dealing with today would never say to me or a male counterpart “You guys aren’t listening, I’m trying to tell you I don’t want that, you’re not listening to me.” They will nod, you’ll have a meeting, I’ve seen this so many times, we get up from our side of the table and go back to the hotel and say “High-5, man, we got it,” and the reality is you

didn't get anything, all you got was "Hai." So that's a cultural difference, that where you have to understand what it is they are really saying.

Interviewee 1 described a related situation in the UK:

I guess the biggest cultural difference, apart from the language I guess and the driving on the other side of the road which is easily adjusted to, is perhaps the perception that just because people speak the same language as you, you don't necessarily communicate. The words or phrases that people use, the immense reliance on acronyms and things like that, which is probably not unique to the aerospace industry, but is certainly carried to a great level over here. Culturally, the British are people who strive very much so to not offend anyone and that's obviously a very nice attribute under most conditions, but in some situations it's very difficult to have effective communication with people ... particularly in an environment where you want to make a rapid decision.

Not understanding how individuals in specific cultures communicate dissent can create significant difficulties for US workers with international assignments. For example, rather than communicating dissent in business meetings, Japanese engineering firms still tend to practice *nominikeshon*, a word "that has been coined from the Japanese word *nomi* (drinking) and the section of the English word 'communication'. This word translates as 'communication through drinking' and reflects the need to being slightly drunk as an enabler of frank conversations."²⁰

Communication challenges can also emerge due to conflicts in meeting cultures. Interviewee 9, for example, stated that,

[A]t work, the biggest difference so far is that things take a long time because there's such a value on having a face-to-face appointment. I have stakeholders I need to talk to and with many of them, early in our relationships, I just can't pick up the phone and call them. There has to be, you know, at least a half an hour of face-to-face and "get to know you" and so forth.

However, this interviewee also believes that, in some cases, the communication practices of the other culture need to shift. She continues, "I have respected that pace for establishing relationships initially but beyond that, I've been discussing this bias for face-to-face with some of my [UK] team and showing them how it can stop work from getting done. The delays that occur when you write something down for later [to be discussed at the next face-to-face meeting] vs. just picking up the phone and resolving it immediately, are significant." Here, what is key from this interviewee's perspective is creating open communication about communication differences, and establishing explicit and shared best practices for communication within emergent relationships (for example, when a US company acquires a company based in another country), as was the case in the situation described by Interviewee 9.

Interviewees suggested that one of the best ways to address communication challenges is through active listening and active observation. For example, Interviewee 10 stated, "You've got to learn to listen instead of talking all the time. You go sit in a few meetings and you listen to what people are saying and you watch the body language. You can tell who's in charge especially in

the Middle East. It's very clear who's in charge and who's not in charge and who's respected and who's not respected. ... You know, you can find out more about your job and everything else if you go in listening first ... listen to what people are asking you and what people are telling you." Interviewee 1 also makes this point: "you basically read the body language and the comments of people that [are] receiving presentations and data papers, things like that and you understand what really, you try different things when you think that things could be better. Basically it's a trial and error period where you simply watch the reaction and provide the best response." As another example, Interviewee 2 described how one of the primary capacities she looks for when making hiring decisions is active listening: "they have to be a listener, cause most of us humans come in one of two poles; we're either big transmitters or we're big listeners and actually you want somebody who's kind of in the in between but predominantly a respectful listener that can hear what the customer is trying to say to them and give the customer the courtesy of really explaining what they want by asking the right questions at the right time. Just a small example of nuance. You know as Americans we butt in on each other, we finish each other's sentences, to us that's ok. Other cultures don't really like being butt in on especially an Asian culture. They have a very known hierarchy."

Lesson Four: Build Relationships, Build Trust

For individuals in future or current international assignments, the third most commonly recommended strategy for success by the employees interviewed is to build relationships and build trust. Relationships were identified as a challenge by 9 of the 16 interviewees and a recommendation to carefully build relationships and build trust was made explicitly by 10 of the 16 interviewees. Interviewees caution that this can take a substantial amount of time. For example, Interviewee 4 notes that while "As Americans we're typically impatient,"

What happens nine times out of ten, is international business results from long term interpersonal relationships. That is so true, I saw that inside the Government, I see it day to day inside industry. Only through establishing a level of personal rapport over time will international business be successful. It's not a drive by... I'm in, I'll sell you 50 missiles, sign on the dotted line, and I'm outta here. That does not work. That will never work in an international environment, least wise in the various countries where I have engaged in business. That is simply a key to failure. Long-term relationships are essential. And that goes back to the cultural aspect. Take a little time and get to know your counterparts in meetings. Remember that rarely you close a deal on the first meeting. It's probably the 15th or 16th meeting before you ever get to the closing the deal.

As he continues, "The first credential [your international counterparts] want to validate is, can I trust you as person... that you're going to be honest with me, and you are ethical ... until the proper level of trust and respect is validated, your international counterpart will be somewhat skeptical."

Interviewee 2 echoes this recommendation, stating, "Well, I think you always, no matter what part of the world, you always have to build trust." Further, as she continues, "And you know trust is a different definition to different people. I've never done business in Poland, or the

Ukraine, or Russia, but I'm going to guess that trust means something different there than it does maybe in the Netherlands." Thus, building relationships and building trust cannot occur without understanding the specific differences between the US and the other country (Lesson 2, above). Interviewee 11 also stated that, in the Middle East for example, "they want to be able to trust you personally before they trust you professionally. So it takes a long time to try to get in that realm of trust because they don't do a whole lot of business with the US government. They're just starting to so they're not overly familiar with that kind of, let's say, the drive-through Western model of business, that drive-through transaction where you don't have to know who's at the counter. You don't have to know anything about them. You just get your stuff and go kind of thing. They really do not subscribe to that. They want to know who you are. They want to know that you understand their interests, that you understand why they're going after certain things, and that you are looking at it from their perspective as well as yours."

At the institutional level, building relationships is also important and can involve multiple factors, starting with an organization's commitment to providing the resources, time, and space for individuals to develop interpersonal relationships with their counterparts. However, relationship-building can also be understood relative to other areas addressed by interviewees when they discussed institutional-level strategies for success. For example, building relationships involves careful and long-term processes for pursuing and creating international partnerships and acquisitions. Four of the interviewees talked about the ways in which the process-focus of the MDC Corporate Culture can be both a challenge and a resource in building the relationship between MDC and an acquired firm. Interviewee 9, for example, describes how she was brought to the international site to "take their continuous improvement / lean six sigma processes to the next level. Among other things, that means creating an environment where every employee is empowered to fix problems immediately. That's the influence they brought me in to have. The trick is to pick the right pace to impose that kind of change on a culture that's been working another way for a long time." Interviewee 15 spoke to the ways in which the corporate culture increased the documentation of processes and indicated that, "they just, they saw the benefit of it." Interviewee 13, who had previously worked for the acquired firm, also described the ways in which adapting the MDC Corporate Culture increased the clarity of business requirements, business goals, and ethics within the workplace. Lastly, as described by the interviewees, relationship-building at the institutional level can involve both awareness of and engagement with national and international laws, treaties, and agreements.

Lesson Five: Implement A Learn-By-Doing Model of Education for International Work

MDC interviewees described undertaking or participating in four pathways of preparation for international work: 1) on-the-job training (primarily at MDC but including some previous corporate experiences); 2) informal life long learning practices; 3) formal education; and 4) military experiences and training, as seen in Table 3.

At MDC, the majority of preparation for the cultural complexities of international work that interviewees identified occurred on-the-job (75.6% of all mentions of preparation) and occurred primarily in a self-directed or informal manner (53 of the 90 mentions of on-the-job training). As seen in Table 3, this self-directed preparation was mentioned more than two times as often as the two categories of on-the-job training programs combined (formal specific training for

international assignments include programs focused on ITAR: International Traffic in Arms Regulations and the Foreign Corrupt Practices Act; a formal organized training program not related to a specific international assignment included the MDC Engineering Leadership Development Program).

Table 3: Code Structure for Preparation for International Work

Code and Sub-Code Categories	Codes	Interviewees
On-the-Job Training	90 (75.6%)	15 (93.75%)
Self-Directed or Informal On-the-Job	53	15
Formal Specific Training for International Assignments	25	12
Formal Organized Training Program not related to a Specific International Assignment	12	10
Informal-Lifelong Learning Practices	12 (10.1%)	6 (37.5%)
Formal Education	9 (7.6%)	7 (43.75%)
Non-International Related Degree	6	5
International Related Degree	1	1
Military	8 (6.7%)	4 (25.0%)
TOTAL	119	

Within the category of self-directed or informal on-the-job training, interviewees identified their primary preparation strategy as talking to someone in MDC who had previously spent time in their assigned international location. For the most part, matching of these newly assigned international workers with more experienced MDC staff with country-specific knowledge does not appear to occur systematically – instead, interviewees described utilizing their MDC networks to identify these country-specific experts. In some cases, as part of these emergent one-on-one mentoring relationships, interviewees described written checklists, tips, or even PowerPoint presentations that were created and/or shared. Interviewees also described important individual relationships with a “helpful person” in HR, corporate International Business Development, or the “Brussels’s office.” Others emphasized the need to establish a good relationship with and learn from in-country consultants and/or from in-country translators. In some cases, however, this strategy of preparation failed, with some interviewees describing themselves, as “the only one here so there wasn’t anybody else to ask” (Interviewee 1).

In some specific instances within the category of self-directed or informal training, interviewees described their efforts to institutionalize an apprenticeship-based model of knowledge transfer. For example, more than one individual interviewed described very successful training practices within their division or group, with one interviewee being very explicit that “It’s my responsibility as a leader to ensure I transfer the knowledge.” Interviewee 9 responded to the question, “Do you have a program where you take people who are experienced in traveling, helping people that are new coming in?” by stating that “I’ve taken young officers with me on travel so they could experience and learn. Ah, it was worth spending the extra money so someday they’re gonna have to do it on their own, but that’s the only program of such that I know of and it wasn’t formal.” Interviewee 4 also discussed a very explicit process in which he

brings young staffers with him on international experiences so that they can learn best practices in situ – even though this increases the overall cost of the trip.

I send employees to training classes learn and master export controls, international finance and the like, but when it comes to doing business internationally, I take people with me. I will take an employee with me on international trips. After each engagement, whether a business meeting or a reception I do an after action review critique. What did we do right? What did we do wrong? What could we improve next time? What did I miss? Did we do something that was, inadvertently offensive to someone? We talk through what happened in each international meeting. When you do that, it becomes a real educational experience for that particular individual accompanying me. It's the on-the-job knowledge transfer process that is the single most effective approach in terms of learning to do business internationally. This is a very inefficient way of doing business, and I recognize that upfront, but the long-term payoffs outweigh the short-term inefficiency.

We do wish to note, however, that the interview transcripts show little evidence that these local processes are intentionally replicated or even known about across the organization.

Lesson Six: Commit to Ongoing Cycles of Continuing Education and Reflection

As we listened to the interviewees and read and re-read their transcripts, it became clear to us that the interviewees practiced multiple and ongoing cycles of their learn-by-doing approach to education for international work. These cycles integrated action, observation, reflection, analysis, identification of resources, planning, and new actions or implementations. Within engineering education literatures and in related professional fields, there is increasing attention to what Donald Schön (1987) described as reflective practice, a “dialogue of thinking and doing through which I become more skillful” (p. 31).²¹ Reflection, as discussed by Schön (1983)²² and supplemented by Killion and Todnem (1991),²³ involves ‘reflection-in-action’, ‘reflection-on-action’, and ‘reflection-for-action’. Many models have been developed to explain this cyclical model of experiential learning, sometimes described as occurring through action learning or action research. For example, one common model is Kolb’s Experiential Learning Cycle (see Figure 1), originally proposed in 1984. Stanford Business School leadership coach Andrea Corney has created what she describes as the “simplest experiential learning cycle” (Figure 2). No matter the particular model selected, ongoing cycles of action and reflection are integral to all experiential learning theories. In other words, education for global competence does not involve simply acquiring knowledge (e.g., ‘what is the current status of design and manufacturing in Country X?’ or ‘what is the role of business cards in Country Y?’). Rather, education for global competence is a process, and learners need the tools to enact and succeed in this cycle.

As discussed in Section 1, Lesson One: Try Not to Behave like an ‘Ugly American’, as part of this experiential learning cycle, the 16 interviewees sometimes employed their skills in cultural analysis to examine how their own behavior and practices are shaped by – or may be perceived as shaped by – the dominant values of US culture. That is, the interviewees engaged in “critical inquiry” regarding their own “values and cherished beliefs” and examination of “constructed self-images in relation to how one has learned to perceive others.”²⁴ This self-analysis is

necessary because, as noted in the cross-cultural training workbook *Culture Matters*, “People from other cultures ... aren’t different by nature, but only different in relation to a particular standard they’re being measured against. To even see those differences, therefore, you have to examine that standard.”¹⁶ Professional development coach and trainer Gillie Bolton (2010) argues that this “deep questioning” is “missed out if the practitioner merely undertakes reflection as practical problem-solving.”²⁵ Instead, as Bolton continues, deep questioning includes “making aspects of the self strange: focusing close attention upon *one’s own* actions, thoughts, feelings, values, identity, and their effect upon others, situations, and professional and social structures” (p. 14). The goal of this self-examination, or reflection, as described by the MDC interviewees, is to better understand and respond to their context, their clients, partners, collaborators and colleagues.

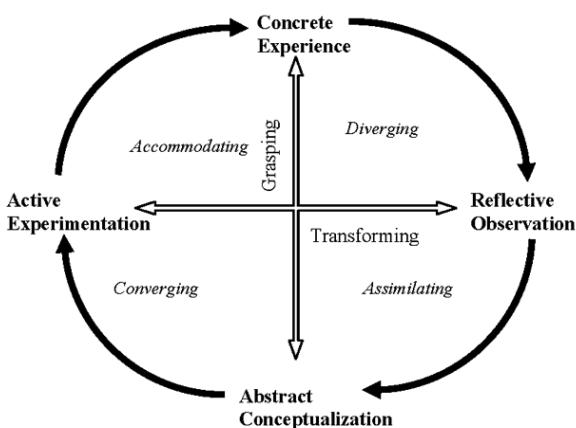


Figure 1: Experiential Learning Cycle.
Reproduced from Kolb, A. Y., Kolb, D. A. (2009).

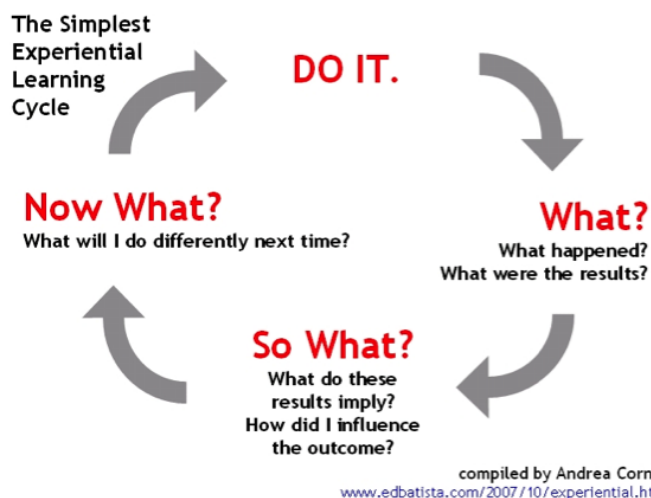


Figure 2: The Simplest Experiential Learning Cycle

Learning from the Six Lessons

As described above, experiential learning or ‘learn-by-doing’ is an integral component of the recommendations provided by the 16 interviewees. In the careers of the interviewees, much of this experiential learning occurred in a self-directed or informal manner, and, in many cases, included the support of one or more experienced mentors and/or other individual supporters (such as on-site consultants, HR, and so forth) with which the interviewee developed a personal relationship. When asked to identify strategies or recommendations based on their experiences, it seemed easier for interviewees to make recommendations for individuals and more difficult for them to make recommendations for how institutions, like MDC or our university, might learn from their experiences and knowledge. Of the 236 excerpts coded in the ‘Strategies or Recommendations for Success’ code category, 64.4% of these focused on individual strategies. At the same time, we want to be aware that there may be individuals at MDC for whom the self-directed and informal nature of training for international assignments described by the interviewees did not work – but who may have had increased success in international

assignments with a more formalized or systemic training program that draws from the expertise of the interviewees and others with international success.

How to share the six lessons we learned from the interviewees with individuals across an institution or a field, and how to systematically prepare individuals to enact those lessons, thus remains an open and important question. In this last portion of this paper, we conclude by briefly identifying curricular and co-curricular pathways for responding to these lessons at individual and institutional levels via on- and off-campus activities, as well as exploration of how challenges to implementation may be overcome. These recommendations are necessarily shaped by our own institutional context, but we believe they will have broader relevance to the field.

Understand Global Engineering Education as a High Impact Practice to Increase Student Success

Multiple challenges exist to the potential expansion of existing and/or implementation of new curricular and co-curricular offerings explicitly focused on preparing students to graduate from our and other institutions as globally competent engineers and international-ready professionals. In our experience, one of the primary roadblocks identified is the existing curriculum (existing content, units, learn-by-doing experiences, etc.). A second challenge is the effort to increase graduation rates within colleges of engineering, especially for populations from groups historically underrepresented within the field.

We believe it is important for colleges and the universities to understand global engineering education as a high impact practice that will support increased student success and graduation rates rather than detract from these efforts. The American Association of Colleges & Universities (AAC&U) (2008) has identified 10 high impact practices (sometimes referred to as active learning experiences, engaged learning experiences, or educationally purposeful activities) that promote greater learning, improved retention rates, faster progress-to-degree, and higher graduation rates.²⁶ These practices are listed in Table 4:

Table 4: AAC&U High Impact Practices (2008)

- | | |
|---|---|
| 1. First Year Seminars and Experiences | 6. Undergraduate Research |
| 2. Common Intellectual Experiences | 7. Diversity/Global Learning |
| 3. Learning Communities | 8. Service Learning, Community-Based Learning |
| 4. Writing Intensive Courses | 9. Internships |
| 5. Collaborative Assignments and Projects | 10. Capstone Courses and Projects |

Increased curricular and co-curricular experiences focused on the development of global competence for engineers can be understood to intersect with multiple high impact practices, including diversity/global learning; service-learning, community-based learning; undergraduate research; internships, and so forth. As summarized by Brownell and Swaner (2009), the impact of participation is significant:

Specifically, first year students who participated in learning communities, service learning, study abroad, student-faculty research, and senior culminating experiences reported greater gains in learning and personal development. These gains included “deep approaches” to learning, which encompass integrating ideas and diverse perspectives, discussing ideas with faculty and peers outside of class, analyzing and synthesizing ideas, applying theories, judging the value of information as well as one’s own views, and trying to understand others’ perspectives (p. 26).²⁷

Since 2008, multiple researchers have explored whether these high impact practices have an equal or increased impact for students currently underrepresented in STEM professions. For example, a 2013 follow-up publication by the AAC&U, “Assessing Underserved Students’ Engagement in High Impact Practices,” found that these gains were consistent or increased for students from underserved backgrounds. This analysis showed that first generation and transfer students who participated in multiple high impact practices benefitted from engaging in these activities as measured by their “engagement in deep learning, gains in general education, gains in practical competence, and gains in personal and social development.”²⁸ We thus suggest that the expansion of participation in high impact practices, including those related to the development of global engineering competence, may contribute directly to efforts to increase retention, student success, and 4- and 6-year graduation rates within colleges of engineering.

(Re)Frame the Discourse: A Learn-by-Doing Model of Global Engineering Education as Connected to the Engineering Design Process

As we have talked to members of the campus community about our findings – including the ways in which cultural, social, and historical analyses of nations, their norms, and their engineering practices (etc.) may play an important role in creating international-ready engineers – we have sometimes found that this type of training for global competence is understood by our colleagues to be ‘other’ to existing emphases and strengths within our institution’s engineering education. As we have reflected on this notion, we have, in contrast, been struck by the similarities between the iterative and ongoing cycles of continuing education and reflective practice for global competence described above, and the iterative and cyclical nature of the engineering design process and design thinking. There are, of course, many different representations and descriptions of the design process/design thinking. A relatively simple representation developed by the College of Engineering at the University of Colorado Boulder is found in Figure 2 and by the Design Lab at the New York Hall of Science in Figure 3. From our perspective, however, we believe it may be useful to explore intersections, in particular, with the Hasso Plattner Institute of Design at Stanford (or d.school) approach to design thinking: as they define it, “a methodology for innovation that combines creative and analytical approaches, and requires collaboration across disciplines.” What stands out to us about the d.school design thinking model (Figure 4) is its emphasis on the development of empathy for users as the first step of design.

According to the d.school, “empathy is the foundation of a human-centered design process; by deeply understanding people, we are better able to design for them.” They suggest that designers should develop empathy for their users by doing three different types of activities:

Immerse: Experience what your user experiences.
Observe: View users and their behavior in the context of their lives.
Engage: Interact with and interview users through both scheduled and short ‘intercept’ encounters.

THE DESIGN PROCESS

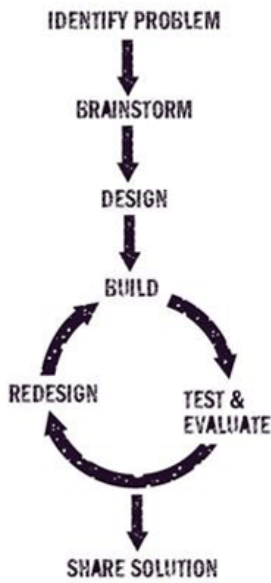


Figure 2: Design Process (College of Engineering at University of Colorado Boulder, 2009)

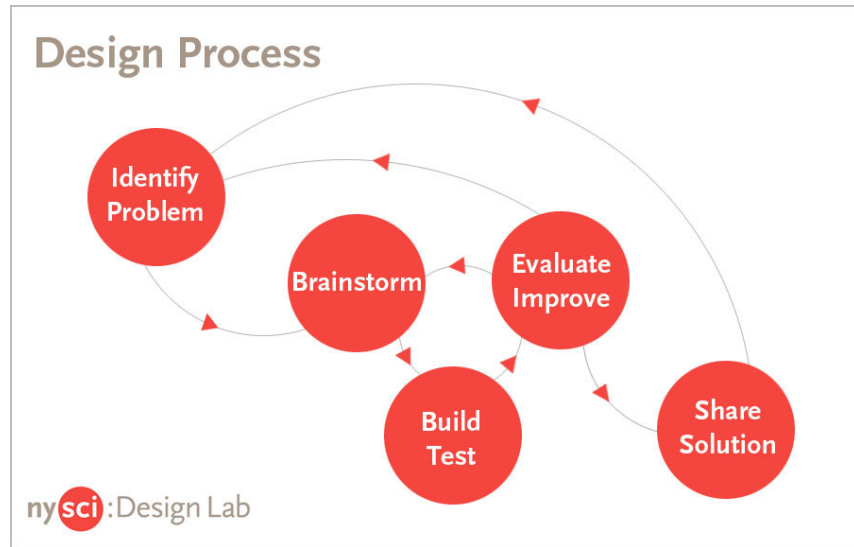


Figure 3: Design Process (Design Lab at the New York Hall of Science, 2014)

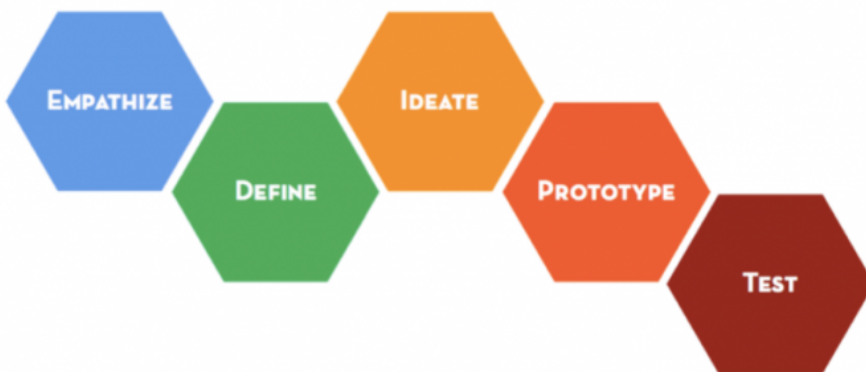


Figure 4: Design Thinking (Stanford d.school, 2014)

Many of the lessons we learned from the MDC interviewees seem to be captured by the idea of developing empathy – as someone who is a participant in US business, engineering, and social cultures, as well as the MDS Corporate Culture – for people who are not. The explicit goal of

developing empathy on international assignments is to then design better experiences, interactions, and products for ‘users’ who, in the case of the MDC employees who were interviewed, include international clients, potential clients, employees and colleagues. We suggest that creating explicit parallels and interrelationships between the ways in which we talk about the engineering design process and the ways in which we talk about global engineering education – whether or not the d.school emphasis on empathy is included in this model – will discursively and visually intervene in implicit and explicit assumptions that global engineering education is an add-on rather than integral to what it means to become and be a 21st century engineer.

Define Global Competency for Engineering Graduates at the Institutional Level

In this paper, we have identified six lessons we learned from our interviews of MDC employees. We hope that these findings will contribute to the development of a shared definition of what it means to be a globally competent or international-ready engineering graduate at a local, national, and international level. However, whether or not our findings contribute to this definition, however, it is critical for colleges of engineering like ours to develop a shared understanding of the goals for globally focused curricular and co-curricular experiences in terms of their educational value at the institutional level.

Identify & Assess Existing Mechanisms for Creating Globally Competent Engineers

Perhaps even more important than the effort to define global competency, however, is the need for colleges of engineering like ours to develop a shared methodology for assessing the impacts of the various mechanisms in place (and potentially under development) for meeting these global competency goals at the institutional level. Ideally, this assessment plan must be both simple and easy enough to be widely-used, and yet robust enough to distinguish between the relative impacts of different types of global engineering education mechanisms (curricular, co-curricular, short-term, long-term, international, on-campus, first year seminar, senior seminar, etc.). The assessment plan should also be able to measure the singular and cumulative impact of participation in multiple of these high impact practices across an academic year and a college career. Following the development of this assessment plan, the next step would be to fully identify all the different curricular and co-curricular mechanisms that may contribute to global engineering competence and assess these existing mechanisms in order to know which to scale and more fully resource. We also wish to note that given the multiple similarities identified above between service-learning and global engineering education (such as the experiential learning model and the importance of reflection) – and, indeed, the service-based learning nature of existing mechanisms like Engineers Without Borders and some senior projects with international components – we suggest it will be useful to include locally-based service learning as one of the identified existing mechanisms that will be analyzed as part of this baseline assessment.

Increase Funding and Flexibility to Support and Expand Existing Opportunities for High Impact International Experiences

Many previous studies, including those by the AAC&U, have identified international experiences as an existing high-impact practice. NAFSA, the Association of International Educators (founded as the National Association of Foreign Student Advisors in 1948), features information about multiple large, longitudinal studies focused on the long-term impacts of international experiences on its website. For example, the Georgia Learning Outcomes of Students Studying Abroad Research Initiative (GLOSSARI) (2010) found that “students who study abroad tend to have higher grade point averages (GPAs) and better college completion rates than their peers, particularly among underrepresented minority and low-income students.” As summarized by NAFSA, “Students who live and learn in countries and cultures other than their own gain important global competencies and cross-cultural sensitivities that enable them to acclimate in a global climate of constant change. Through their experiences abroad, students also hone essential foreign-language skills through cultural immersion unavailable in their campus classrooms” (p. 1).²⁹

Indeed, the opportunity to study, intern, research, or do service-learning abroad as a student is an enactment of the learn-by-doing model of global engineering education recommended by the MDC interviewees. Thus, while a shared definition for and assessment plan of global competency for engineers are being established at our and other institutions, we believe it is important to simultaneously start scaling programs, resources and opportunities that will increase the number of college of engineering graduates who have participated in an international experience. In addition to increased financial resources, it may also be necessary to review curricula (particularly placement and offering of prerequisite chains) to allow students to make the choice to study or intern abroad. In terms of co-curricular learning – because not all engineering disciplines lend themselves equally to student participation in organizations such as Engineers Without Borders – we also believe it is necessary to identify and publicize international undergraduate research experiences that may expand the types of majors able to participate in co-curricular learning. Lastly, faculty must be provided necessary financial and time resources to develop and maintain international exchange, research, and service programs for engineering students, as well as their own international collaborations.

Develop Resources to Make It Easy to Include Global Engineering Education in Existing Courses & Curricula

Given concerns about adding new courses to the undergraduate engineering curriculum, another strategy that may work at our and other institutions is to develop and share resources (modules, assignments, projects, and so forth) that can be integrated into existing courses. Based on our analysis of the interviews of MDC employees, we believe that these resources should involve experiential learning, an iterative or cyclical process, and structured reflection. It may be useful to explore options for incentivizing the integration of these materials into existing courses. Lastly, faculty must be provided necessary financial and time resources to develop and maintain the international relationships that allow for the creation of engineering design, project, and capstone opportunities that incorporate collaborations with international students and/or clients.

Another potential strategy is to explore whether existing courses at specific institutions may qualify as or substitute for one or more existing technical electives – including courses offered by non-engineering colleges. It is important when undertaking this analysis to identify and

address any existing barriers to participation – for example, at our institution, an upper-level course focused on global engineering and technology development offered by a non-engineering college meets a general education requirement that college of engineering students are not required to complete, leading to low enrollment by engineering students. It is also important to not simply add such courses to the engineering curriculum, but to explicitly engage with faculty teaching those courses as collaborative partners.

Explore Alternative Financial Support Options

At our university, as is the case at many other state institutions, the amount and percentage of state funding that supports academic year education of in-state students is declining. This has the potential to undermine efforts to increase mechanisms to support global engineering education given an increased focus on efficiency and budget cuts rather than increases. However, another potential pathway for the provision of academic credit or certification related to global competency for engineers at our and other state institutions may be a self-support model. Self-support means that state funding is not used to meet the costs of offering the course. At our institution, summer classes for undergraduate and graduate students, in addition to continuing and extended education programs throughout the year, are offered on a self-support model. According to the strategic plan for continuing education at our university, the three primary areas of self-support at our institution are:

- Self-supporting academic programs: courses, certificates, degree programs, and off-campus experiences for academic credit.
- Professional development programs: continuing education units (CEUs), conferences, workshops, and non-credit certificates.
- Personal enrichment courses, e.g., fly fishing and glass blowing.

Self-supporting academic programs include certificate program for specialized skills and fields of study.

From our perspective, it makes sense to explore a dual focus in this area: 1) summer-based undergraduate and graduate courses or programs for academic credit, and 2) certificate programs in which students can enroll simultaneous to their tenure as students or as alumni, following the completion of their degree. This turn to self-support, however, must be accompanied by advancement efforts focused specifically on scholarship and other financial support for students with demonstrated financial need and/or students who have experienced other social or educational barriers to success in engineering to guard against the reproduction of have / have not patterns of participation in these programs.

Figure Out How Other Universities Have Made Global /International Engineering Undergraduate Minors and Certificate Programs Work

While we are sensitive to the constraints of our institution's engineering curriculum, we also know that many other universities have supported the development of active and growing minor and certificate programs focused on global/international engineering. Our final recommendation is that institutions like ours that do not currently offer a global engineering minor or certificate

program conduct regular and iterative analyses of the similarities and differences of curricula between the home institution and these other universities to add to knowledge regarding options for further developing and scaling global engineering education in colleges of engineering and beyond.

Future Work

We are currently exploring the potential for three different types of future work: 1) interviews with junior-level engineering and business development professionals at Multinational Defense Company (MDC) who are currently preparing to, working in or have previously completed assignments that included extensive international components; 2) interviews with senior-level and/or junior-level engineering and business development professionals who are currently working in or had previously completed assignments that included extensive international components at one or more non-MDC corporations ; and/or 3) comparative work with one or more other universities to explore how the lessons we identified in this paper do or do not address their existing or potential institutional contexts for global engineering education.

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