Joining Hands: Using Consortia to Efficiently Create Easily Accessible International Experiences for Engineering Students

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As globalization has continued to gain momentum as a central theme shaping the modern engineering economy, international experience and global preparedness have become increasingly sought after attributes of graduates headed for industry, professional schools, and academia. Both practicing engineers and researchers will, at some point in their careers, be expected to work closely with collaborators across national, linguistic, and cultural boundaries. This fact is finally resonating with engineers and scientists, leading to an increasing interest in incorporating international experience and perspectives into engineering programs nationwide as a critical element of professional development. It is clear that graduates with a global perspective and international professional experience will have a competitive edge in the modern internationalized labor market, both initially and throughout their careers.

Although the need for incorporating international professional experiences into engineering educational programs is clear, there is still much confusion as to how this goal can be efficiently achieved. The many challenges to engineering internationalization can be roughly divided into two categories driven by student and institutional concerns, respectively.

Time and complexity. Too many engineering curricula are notoriously inflexible, packed full of required coursework with very few electives, and with no minor degree that one could leverage for international preparation. Thus, for students, the primarily challenge is to find a way to integrate an international experience into a busy schedule without substantially delaying graduation. Specifically, the difficulty lies in (a) locating an institution abroad with suitable coursework, that (b) does not cost substantially more to attend than one's home institution, and (c) whose course credits will transfer seamlessly into the student's home degree program. Resolving these difficulties is certainly possible, but the perception remains that it creates an enormous logistical barrier that only a tiny highly motivated minority is able to overcome. This is certainly a primary reason why the percentage of engineering graduates in the U.S. with a study-abroad experience remains stubbornly low, less than 4.0%[1] .

Infrastructure costs. From an institutional perspective, the cost of developing and maintaining the infrastructure necessary to reduce the logistical challenges deterring engineering students from international training remains a central challenge. Although some institutions have made strong commitments in this area, the costs are substantial in terms of both personnel time and related expenditures. Most efforts are centered on the development of multiple close partnerships with foreign partner institutions, known as bi-lateral agreements or simply "bi-laterals". Specific challenges include locating suitable partner institutions in targeted locales, reciprocal travel and hosting to establish the partnership, analysis of curricular offerings to identify transferrable coursework, and long-term maintenance of the relationship. This process must be duplicated for every partner and every locale. Further, these partnerships often work because of a personal relationship between individuals at each institution, and can falter if there is a personnel change.

Each partner can often only accommodate a few students, and the significant effort and expense by the institution to serve a relatively low number of students results in a high institutional cost per student. Given these challenges, many institutions are forced to focus their international efforts tightly on a few partnerships that serve the greatest majority of students. Since traditional study abroad areas center around languages and arts, the chosen institutions are often not suitable for engineering studies.

The clear and growing importance of integrating meaningful international exposure into engineering curricula has only increased the pressure on institutions: how can an institution provide easily accessible, well-integrated international opportunities for its engineering students without taking the financial plunge of developing a selection of engineering specific partnerships? One promising way forward is driven by a simple observation: Given that engineering educational programs are similar across most institutions, including a relatively standard core curriculum and similar accreditation concerns, why should every institution "reinvent the wheel" by establishing new partnerships from scratch? Rather, engineering institutions around the world could join together in a tuition-neutral consortium centered on easy access to core courses in a standard engineering curriculum, taught mainly in English for universal access, and vetting for quality to address accreditation concerns and ensure credit mobility.

In this paper, we examine this consortium-based model, focusing on two successful consortiums that have emerged in the U.S. and Europe. In the U.S., the Institute of International Education (IIE), a leader in international education and training, first formed a consortium of international engineering institutes in 1994 for the explicit purpose of enabling participating educational institutions to "exchange" undergraduate engineering students under a tuition-neutral model. In Germany, seven universities of applied sciences have taken this model and applied their own twist, which has lead to the formation of the UAS7 consortium with selected U.S. and Canadian partner universities.

Part One of this paper will ground the discussion by describing the two consortium models. Part Two turns to a broader philosophical discussion of current needs for increasing the global competency of engineering students and how strategic partnerships such as consortia can help meet these needs.

Part One: **Current Consortia Models for Study Abroad for Engineering Students – IIE's Global Engineering Education Exchange Program and Germany's UAS7 Alliance**

The Global E^3 Program

Developed in 1994-95, the Global Engineering Education Exchange (Global E^3) program is a consortium of U.S. and international engineering institutions.[2] Engineering and computer science students at any member institution in the U.S. can apply to study at any non-US (international) member university. Likewise, students from international institutions not only can study at any U.S. member institution, but also at another international member institute. (This latter twist was recently added in order to make the consortium even more attractive to international universities, and hence the consortium no longer has a strictly U.S. centric organization.) As noted, the Global E^3 program operates on a tuition-swap basis; students pay

tuition only to their home institution while studying abroad, taking appropriate courses (typically engineering or other relevant courses) in English, that enable progress and count towards their home university degree. In this manner, students do not lose time towards graduation, nor have to add language instruction into their academic program.

Global E^3 provides the opportunity for undergraduate engineering (and computer science) students (and in some cases, graduate students) from U.S. institutions to study engineering abroad, while giving students from overseas member institutions the same opportunity. Since its early days, when the program included less than a dozen universities in the U.S. and an equal number in Europe, Global E^3 has grown into a widely recognized international engineering exchange program, currently involving 65 engineering schools around the globe, and still growing. As of January 2014, students enrolled at U.S. member campuses could study abroad at institutions in 20 countries, and international students study at some 35 U.S. member schools, in addition to opportunities in the other 19 countries. To date, over 2,500 students have participated in Global E^3. For the 2013-2014 academic year, there were 75 incoming students to the U.S. and 77 out-going. Additionally, 10 international students studied in a non-U.S. host country.

In summary, using a simple, effective tuition-swap consortium arrangement, Global E^3 provides important benefits to its members in internationalizing their engineering programs. No longer does a member need to create a series of bi-lateral exchange arrangements with a series of host institutions, nor worry about balancing each of these one-to-one exchanges. Rather, there is one agreement with IIE and the balance is simply between the institution's out-going students and the number of incoming students it hosts to and from the consortium. Typically, the balance is done over an extended period, such as three years. Further, institutions do not need to maintain and nurture relationships with each of the partners. In addition, there are other benefits.

Membership Benefits

1. *Diversity of institutions.* Increased participation in study abroad by providing students with a wide variety of host institutions across the globe with relevant courses, in English, even in non-English speaking countries.
2. *Engineering Focus.* The fact that the consortium is comprised specifically of engineering-focused programs guarantees that all partners offer high-quality engineering courses. The need for attention to course content, credit transfer, and accreditation concerns are understood by all members, streamlining communication about curricular issues. As members of a strong collaborative community that meets regularly to establish personal ties among members, institutions are more likely to be helpful with special needs, e.g., facilitating access to internships in faculty research laboratories or in local companies.
3. *Guidance and Support.* Exchange of a flexible number of students with a wide range of partner institutions who provide personalized guidance and support to exchange participants. The ability to provide both guidance and support is a necessary member requirement.
4. *Institutional Visibility.* Increased visibility for engineering programs among the partner institutions and the international students who come on this exchange program and may later seek graduate degree study at the U.S. host.
5. *Recognition of Engineering Study-Abroad Opportunities.* Increased recognition of study abroad opportunities for engineering students on campus; there is no longer a need to only do a semester of humanities/social science courses, or delay graduation for a semester.

6. *Quality assurance.* Because institutions must apply for membership in the consortium, they are vetted for basic quality (e.g., accreditation status of engineering programs, adequacy of facilities, reputation, and ability to provide student support services) by the consortium's executive committee. Relatively small size and specific engineering expertise and focus mean that standards can be enforced. Confidence in coursework and internships at consortium partners in increased.
7. *Strong access to consortium partners.* Experience shows that successful and responsive partnerships ultimately depend on personal connections between collaborators. The fundamental nature of a consortium as a community of peers means that direct contacts between a home institution and a hosting institution are expected and invited, including the direct involvement of engineering faculty as consortium contacts. As these facilitated personal relationships evolve, questions focusing on engineering-specific curricula or course content relevant to specific students or programs can be resolved quickly and effectively.
8. *Syllabi and Curricular Integration.* Member institutions are developing a single database which contains the syllabi of courses that have been successfully transferred by students. Since engineering curricula are to a large extent similar, courses that have been vetted to transfer at one institution will likely also meet requirements at another. Students and advisors can access this database to see how credits have been applied by others, easing the ability for students to gain approvals at their home institutions. Additionally, a database of advisors at each institution provides ready-access to colleagues at each institution, so that members can contact each other when needed.
9. *Networking.* Participation in annual international membership meetings to network with partner schools, discuss trends in international engineering education, and share best practices.
10. *Exchange Balance*. Since the balance is maintained with the consortium, and not with an individual international institution, managing the incoming/outgoing balance is considerably easier. The IIE manages and informs members about the balances. It is important to note that often the institutions to which the school sends students are different than those from which it receives students.
11. *Single Point of Contact.* An assigned Global E^3 point-of-contact/mentor at each partner campus for enables continued relationship building and local support of students.
12. *Consortium Manager with Prestige and Global Reach.* With its offices in 13 countries, having IIE serve as the consortium manager provides the gravitas, dedicated resources, and experience to ensure success of the consortium.

Centralized Administration

Along with the aforementioned benefits, as noted, one of the key advantages to the Global E^3 model is that there is centralized administration and program oversight provided by IIE. By having IIE serve as the administrating agency, the program eliminates the need for individual members to manage each institutional relationship. However, this arrangement does not preclude individual member institutions also having bi-lateral agreements with overseas universities, and many members concurrently and successfully operate bi-laterals in addition to active participation in Global E^3. In fact, some of these bi-laterals were inspired by the experience the institutions gained with each other through the Global E^3 program, and these and other agreements provide additional dimensions beyond the scope of the Global E^3 program (for example, faculty exchange or research partnerships).

The program also provides more options for students to study in countries or fields which existing bi-lateral agreements have limited flexibility. That is, by having one streamlined online application system through which students can simultaneously apply to multiple universities, students may simultaneously apply to up to three host institutions. Finally, both students and advisers are able to access a centralized database of essential information on participating universities.

No Revenue Loss and Potential Cost Savings

Since the program operates on a "tuition-swap" basis, there is also no revenue loss for member schools. Further, a "tuition-swap" minimizes study abroad costs, with students being responsible for travel and living costs above their normal tuition. Since students remain directly enrolled at their home school during their study-abroad experience, they normally can continue to receive financial aid and other benefits, such as coverage under their parents' health insurance. The program also reduces administrative cost of managing multiple memorandums of understanding (MOU) and bi-lateral exchanges, and through one program, a participating university is able to exchange a number of students under a single membership fee.

Course Credit and Practical Training Opportunities

When developing the Global E^3 program, IIE wanted to ensure that each member university was able to maintain respective academic standards and criteria. Quality control is thus determined and exercised at the discretion of the individual partner universities (e.g., credit transfer and course equivalency rules, grade determination, and pass/fail options). It is fairly easy to determine credit transfer through information on course equivalency, along with information regarding availability of the incoming student's required engineering courses at the host campus, all of which is provided by IIE.

In addition to studying abroad and receiving credits towards their respective engineering degrees, many Global E^3 students are able to pursue internships abroad, arranged in conjunction with host institutions. Further, some students will enroll in intensive language programs prior to their studies, which can be facilitated by the host institution. The misalignment in the academic calendar of the US versus international institutions actually enables many of these internship or language study experiences possible. These experiences further enhance the student's education and makes graduates more marketable to industry and advanced education after having gained global experience in their field as well as cross-cultural communications, life long learning, and other skills.

UAS7 Overview

UAS7 is an alliance of seven German Universities of Applied Sciences $(UAS)^3$. In Germany, the seven are recognized for their excellence in teaching, their strong international orientation, and their focus on applied research. The seven members are:

- Hochschule für Wirtschaft und Recht Berlin (*Berlin School of Economics and Law)*
- Hochschule Bremen (*Bremen University of Applied Sciences)*
- Hochschule für Angewandte Wissenschaften Hamburg (*Hamburg University of Applied Sciences*)

- Fachhochschule Köln (*Cologne University of Applied Sciences*)
- Hochschule für Angewandte Wissenschaften München (Munich *University of Applied Sciences*)
- Fachhochschule Münster (*Münster University of Applied Sciences*)
- Hochschule Osnabrück (*Osnabrück University of Applied Sciences*)

The alliance members support:

- well-established and future-oriented degree programs "made in Germany"
- commitment to programs of professional relevance
- application oriented courses
- faculty with professional experience in industry and business
- international perspective on a distinctly European and German basis with efficient learning environments and small classes
- close relationships to the German business community
- locations in major cities throughout Germany

Most of the UAS7 member universities have a strong focus on engineering. The range of subjects taught at these seven Universities of Applied Sciences extends across twenty engineering disciplines, which are also subdivided into around 30 specialization areas. In total, the seven member institutions offer approximately 600 degree programs at the undergraduate and graduate levels. Combined, the seven have 92,000 students, 2500 full-time faculty members and several thousand part-time lecturers from industry and business. As mentioned in the bulleted list above, the seven members are located in Berlin, Bremen, Cologne, Hamburg, Munich, Münster, and Osnabrück. Collectively, the UAS7 alliance members collaborate with more than 1400 university partners worldwide.

The UAS7 offers a wide variety of exchange opportunities for international students, including summer, semester, and year-long exchange opportunities. In addition, UAS7 offers graduate programs in English for students who are seeking a degree beyond the Bachelor's and Master's level.

The universities of applied sciences (UAS) are relatively new. They were established in the early 1970's with the objective to help German industries maintain their international competitiveness. This new approach to higher education was intended to satisfy a growing demand for an innovative practice-oriented education on a solid academic footing. Over the past forty years, the universities of applied sciences have grown into serious contenders to the more traditional German universities, especially since the European-wide introduction of Bachelor and Master programs, similar to the US and British systems of higher education.

Universities of applied sciences differ from other universities by preparing students for their future professional careers through application-oriented instruction. Their objective is to enable graduates to apply theoretical and method-based knowledge to concrete practical problems. A major strength of universities of applied sciences is the equal emphasis on strong academic foundations as well as on these practical applications. Universities of applied sciences not only offer small class sizes (typically less than 40 students), but their faculty members each have at least five years of industry experience and can offer first-hand knowledge from a workforce

perspective. Further, the universities of applied sciences offer integrated practical semesters in business and industry as well as a variety of applied research projects in strong cooperation with industries. In addition, the universities of applied sciences have a strong international outlook and program structure.

An innovative feature of the UAS7 has been its SIP (Study and Internship Program) initiated in 2006 with partial funding from the German Academic Exchange Service (DAAD). The SIP enables a number of highly qualified undergraduates from U.S. and Canadian colleges and universities to spend a semester at one of the UAS7 institutions, followed by an internship at a company in Germany. Students typically arrange for their internship once they begin their studies in Germany, often with the assistance of the host institution. The SIP program recently has been expanded to also allow for an internship in a research lab on campus. Unlike the typical German internship, which is often up to six months long, these on-campus internships can be shorter (three to six months). Another feature of the SIP program is that it enables students to take courses in English (for the lab internships on campus the working language might even be English). Non-native German speaking students are also encouraged to enroll in an intensive German language course prior to beginning their studies, and to continue with a German language course as part of their academic program. All students who apply for the SIP program are automatically considered for either a travel scholarship, which covers most of the transatlantic travel expenses, or a full stipend, which is sponsored by the DAAD. Also, students selected for the SIP program receive a tuition waiver during their study, as well as during the internship (students need to be enrolled at the university not only during their study but also during their internship in order to maintain German residence status.

In addition to the SIP program, UAS7 also offers the SP (Study Program) as well as the IP (Internship Program). SP provides students with the opportunity to take credit courses at a UAS7 member institution for one semester while IP is designed for students who are interested in an on-campus lab internship which can range from 2-6 months and enables students to receive valuable hands-on research experience at a UAS7 Campus.

Part Two:
Choosing an Effective Strategy for Developing International Partnerships.

International partnerships are the central element of any internationalization initiative. Regardless of how the on-campus experience is augmented with special coursework, projects, or seminars to increase international exposure and cross-cultural awareness, the apex of any internationalization program will always be some sort of international experience. Unfortunately, a structured international experience is also the most costly element of campus internationalization, for both students and the institution. For students, the challenges center mainly on the costs of travel and program fees, and efficiently integrating the international experience into an already packed engineering curriculum. The costs and logistical challenges for the institution are more complex, and vary greatly depending on the exact nature of the international experience envisioned plus the international education infrastructure, support and organization at the specific campus.

In Part I of this paper, we focused narrowly on international consortia as a potential solution to this institutional challenge, describing several successful engineering consortia that have been

developed in recent years. In this section, we will explore a broader context for our discussion of the consortium-based approach by examining the entire spectrum of international partnering possibilities from a strategic program development perspective. We begin by characterizing the range of contributions that international partnerships could possibly provide to an engineering internationalization initiative. We then examine the pros and cons of various partnering strategies (including participating in consortia), leading to a discussion of strategic best practices in developing a robust network of partners.

Given that all partnerships involve some sort of up-front investment to establish the relationship, a reasonable question to ask is whether international partnerships are necessary at all. What do international partnerships provide that is difficult or impossible for a home institution to provide? The answer should be obvious: access to logistics and academic infrastructure at a foreign locale, including classroom space, existing curricula, libraries, laboratories, dormitories, and facilitation of internships in local companies and research labs. What this means is that one or more robust international partnerships are absolutely necessary to support any international experience that goes beyond a superficial tour of a foreign country; yet, even such tours require at least basic partnerships if any sort of academic element (e.g., campus tours, student conferences) is to be included. More generally, the range of "services" that an international partner might offer include:

- *Basic logistics.* Anyone who has ever planned a foreign trip to a little-known locale knows how difficult and error-prone such planning can be. A local partner will have extensive knowledge of local infrastructure, including academic spaces, lodging, and travel within the region. For short, faculty-led programs abroad, this means access to classroom space and short-term lodging; for longer-term stays, existing university infrastructure for local students can be leveraged for everything ranging from dormitory access to help with travel, health care, and visa issues. In our experience, up to 95% of mundane logistics issues encountered by our students abroad are handled by our partners' international offices with no intervention required on our part.

- *Academic training opportunities.* Other than short-term faculty-led programs abroad, most international experiences involve some sort of study at a foreign institution. Low-cost access to a complete academic curriculum with a broad range of coursework choices (in English) for students is one of the most compelling reasons to form partnerships.

- *Internship opportunities.* An international internship or co-op rotation is perhaps the most valuable achievement an engineer student could list on a resume, demonstrating integrated application of linguistic, cultural and professional competence. Well-established institutions abroad have formal and informal connections to regional engineering companies, often as part of formal internship requirements in their own academic programs. Internships in university research laboratories can also be easily facilitated to provide research-oriented students with this type of educational opportunity. Access to this network of regional internship providers would be essentially impossible to establish from afar, and represents another compelling reason for strategic partnerships.

In sum, local logistic support and access to academic and professional training abroad make international partnerships an indispensible part of any STEM internationalization initiative.

Alternatives for providing access to international experiences for engineers

In general, establishing and maintaining partnerships is the most cost- and effort-intensive aspect of engineering internationalization. This cost of maintaining access to high-quality partners must be recognized as a major obstacle to making comprehensive internationalization a common offering at U.S. institutions. A significant and deliberate effort, with commitments of personnel, time, and expense, must be invested in order to reap rewards. An institution cannot "dabble" at internationalization, but must invest in the resources required to meet their objectives; "dabbling" can result in frustrated students and faculty, loss of confidence by partners, and demise of programs which can take years to rebuild and re-establish. Possible approaches overcome these challenges can be roughly divided into three categories:

Establish direct partnerships. Under this model, the home institution identifies potential partners in targeted locales, makes contact, and establishes a partnership relationship. The advantages of this approach lie in the "deep connection" to the partner, including detailed knowledge of courses and research facilities, faculty and local industry, and the enhanced trust and commitment that comes with a direct relationship. For instance, detailed knowledge of the curriculum can lead to pre-approved equivalency and credit transfers for certain courses, removing a major source of student anxiety; detailed knowledge of faculties can open the door to independent study or research with specific faculty mentors. Another major advantage of direct partnerships is that they are typically based on reciprocal exchange agreements, meaning that tuition is waived at the foreign university for students moving in each direction, provided that the exchange stays more or less in balance. Aside from travel, the cost of studying abroad to the student under this model is essentially the same as study at the home institution if cost-of-living is comparable.

The primary disadvantage of the direct exchange approach is the cost of establishing and maintaining these close collaborative relationships. Simply finding potentially suitable partners is non-trivial, typically involving extensive sifting through endless and often confusing institutional websites to discover the programs, courses, and research strengths of potential partner institutions. After making contact with the appropriate person, and assuming the targeted partner is interested, extensive communication and reciprocal visits are required to clarify needs and offerings, ensure the quality of the academic and social environment, and to develop a mutually acceptable collaborative model leading to a partnership agreement. After the partnership is established, continual close communication is required to manage the relationship, keep curricular options up-to-date, and, of course, provide advising, coursework, and pastoral services for students coming in from partners within the reciprocal partnership. Finally, it should be obvious that the substantial investment required to establish and maintain direct partnerships means that the number of such partnerships must necessarily remain small, inevitably limiting the locations and engineering programs accessible to students.

Leverage large-scale third-party providers. An alternative to direct partnerships is to essentially outsource management of international experiences – including partnership-building and management – to a third party. This has been an attractive formula for easy "campus internationalization" for many decades, with an enormous number of for-profit and non-profit organizations specializing in providing international experiences for college students. A few examples include the American Institute for Foreign Study (AIFS), Institute for International Education of Students (IES) Abroad, and the Council on International Educational Exchange (CIEE). The advantages of the third-party approach center are simplicity and low cost to the

home institution: students are simply directed into the organization's intake mechanism and the organization takes care of the rest, including all logistics, advising, university registration, travel and pastoral care while abroad. The disadvantages of this approach are numerous, beginning with the relatively high cost to the student: program costs range between $5,000 and $15,000 a semester, depending on whether they are packaged including travel, home-stays, excursions, and other options. There are practical disadvantages from the specific perspective of engineering internationalization as well, including lack of detailed knowledge (and thus transfer eligibility) of coursework, lack of knowledge of quality and extent of relevant course offerings at participating destinations, and lack of contact with individual faculty. More generally, simple economics dictate that third-party programs focus on the biggest market, meaning that they typically have an overall focus on general studies and cultural experiences rather than engineering-oriented technical training. In combination with tight engineering curricula and a very practical, outcome-focused world view, these obstacles have meant that very few engineering students have historically been attracted to these offerings.

However, some of these third-party organizations are now beginning to explore programs that are specifically directed towards engineering students. It is also possible to do a hybrid model with a third-party, where some of the coursework is provided by the home university's faculty and the rest provided by the third-party. An example is the University of Pittsburgh's "Engineering of the Renaissance," a six-credit, four-week summer program in Florence, Italy. Here Pitt engineering faculty provide the technical course while CAPA (a third-party) provides an accompanying course on the history and culture of the region, as well as providing the housing and other logistics for the students.

Participate in an engineering-oriented academic consortium. Until recently, institutions considering engineering internationalization were forced to choose between the alternatives just described: either make a major investment in developing attractive but costly direct engineering-oriented partnerships, or simply promote access to generic third-party providers and hope for the best. With a few notable exceptions, the vast majority of U.S. institutions have opted for the latter option – again, a significant reason that internationalization statistics in engineering lag so far behind other disciplines [1]. The consortia described in this paper represent attractive, new options on this spectrum, a hybrid between direct partnerships and large third-party providers. The advantages of such arrangements have been discussed above.

In essence, the consortium concept offers many of the advantages of direct partnerships, but avoids the enormous "cost-of-entry" associated with building a network of direct partnerships; the consortium establishes a specific vision of engineering exchange along with a ready-made collaboration framework, bringing together like-minded institutions with complementary needs. Although the consortium approach greatly reduces the cost of launching an engineering internationalization initiative, partners must be prepared to commit to more than merely paying the annual membership fee. This is an important point. By definition, a consortium requires commitment and active participation of members to function robustly. At minimum, this requires assigning engineering deans or faculty, and their associated professional staff, to act as liaisons to the consortium. These liaisons are responsible for providing institutional input to the group and to ensure that engineering-related questions and issues associated with hosting incoming students from the consortium are resolved promptly. Attendance at regular consortium meetings allows development of the direct personal relationships with other consortium partners,

and to better understand the issues that members are facing on their home campuses, that are so critical for smoothly functioning exchanges.

Developing a custom strategic partnership strategy.
The partnership models outlined in the previous section are not, of course, mutually exclusive. A savvy institution will strategically combine the three approaches in some way to develop a custom palette of offerings precisely tailored to the needs of its specific internationalization initiative. This strategic development challenge is driven by the familiar cost-benefit calculus of program design: maximize the number of study locales and language options and the quality of the experiences, while minimizing operational costs of the initiative. The most relevant characteristics to consider are:

- *Focus of studies abroad.* Will engineers going abroad actually be taking engineering coursework, or will the international experience be targeted more on cultural exposure, with students taking and transferring back primary general education studies credits? Engineering coursework may require more careful attention to course quality and content to allow credit transfer which, in turn, requires quality advising and closer collaboration with competent partners abroad. Direct partnerships or engineering consortia are best suited to fill this need. For students interested primarily in the cultural exposure, general education and/or generic engineering coursework, the partnering locales offered by a third-party provider may be adequate.

- *Study vs. Internship.* Will students only be taking courses, or are internships (research or corporate) also desired? If only coursework is needed, then consortium partners or, in some cases, generic third-party partners will be adequate. Internships in university research laboratories or in local corporations arranged through the partners connections generally require a level of trust and commitment developed only through personal relationships. This sort of connection exists by definition in a direct partnership, but may also be developed through interaction between committed consortium partners.

- *Choice of a Specific Partner or Country.* What is the value-added of study-abroad or international internships if the same education can be obtained at the home campus? While the science of thermodynamics should be more-or-less the same no matter where the subject is learned, the local provides a unique educational opportunity that cannot be gained at the home institution, and both the students and the institutions should take advantage of that. For example, a student might opt to study at a German university because of the relationship of that institution to the wind energy industry and/or research facilities/expertise in that area that is not available at the home institution. Specifically targeting institutions that have a value-added beyond just the international dimension of culture and language could be advantageous.

- *Language Constraints.* Linguistic constraints are perhaps the most difficult issue to resolve when sending students to non-English-speaking locales. Although many foreign universities now offer some coursework in English, many are general studies courses designed for broad appeal; finding suitable engineering courses offered in English can be a major challenge. One possible solution is to arrange independent study experiences or project-based courses for students, taking advantage of English competency of individual faculty or other students to compensate for a student's linguistic weaknesses. Clearly,

these arrangements generally require the commitment and close collaboration offered by direct partnerships or well-establishing intra-consortium connections. If general studies coursework is the focus, third-party providers might be an appropriate choice, given that they specialize in easy-access (English language) coursework with mass appeal abroad.

- *Program Volume.* The number of students expected to participate in exchanges is a key consideration, particularly if the international initiative is funded (as with most successful existing programs) on a per-student-abroad formula. If program volume will be substantial, then the investment in a consortium partnership is certainly warranted; if this volume can be directed to a few select locales, then it can justify the development of direct partnerships. If, on the other hand, the aim is merely to provide access to internationalization for a smattering of interested students with widely varying interested in locales, then partnering with a third-party provider is the only viable option.

- *Cross-leveraging with existing international options*. Most institutions already have well-established international options for the student population at large, so common sense dictates leveraging these existing options to round out the offering to engineers. In particular, many universities already have partnering arrangements with one or more third-party providers, meaning the accessing this network can be a zero-cost backup option available to any engineering student.

With these factors in mind, strategic design of a customized partnership strategy involved considering to what extent each of the above characteristics will play a role in the envisioned program, and then carefully tailoring some combination of the options above. The following examples may be helpful to illustrate the strategic considerations.

Example A: Direct Bi-lateral Relationship. A large Mechanical Engineering department wishes to internationalize its program by promoting well-integrated study and internships abroad in Germany due to local corporate interest. The other engineering departments at the institution are ambivalent about participating, and program volume is expected to be 5-7 students a year. In this case, the desire for integrated internships and the tight focus on one discipline and one locale justify developing a special, direct reciprocal exchange relationship with German partner. The cost of entering into a consortium like Global E^3 is difficult to justify, given the interest in just one discipline and locale. Strategically choosing a partner that is also strong in other engineering disciplines will allow later expansion of the partnership to other disciplines at negligible added cost. As the relationship grows, balance may be difficult to attain and growth beyond a small volume difficult to realize.

Example B: Consortium Approach. The Dean of an Engineering College would like to broadly encourage internationalization of all engineering disciplines. Commitment from the faculty is limited, as are funds – at least until the value and attractiveness of the program has proved itself. In this very common scenario, a consortium like Global E^3 presents a perfect solution: access to engineering-specific educational options, spanning many disciplines and locales at a very modest cost. A wide range of options can be promoted to students, and if a particular discipline, language, or partner emerges as especially attractive, that connection can evolve naturally into a direct partnership, while still maintaining all other options via the consortium.

Example C: Hybrid Approach. An Engineering College aims to develop a large-scale, comprehensive internationalization initiative spanning multiple languages and locales, as well as all engineering disciplines. Students will commit early, integrate substantial foreign language study before going abroad, and will both study and perform internships. As a flagship program, volume is expected to be high across the entire engineering college in all disciplines. Here, the high program volume, multiple disciplines, and special research and internship needs justify strategically establishing a small number of direct partnerships, with each spanning all targeted disciplines for a particular language or region. The narrow choice of international destinations implied by this strategy can be offset by also joining a consortium like Global E^3; students that have an express desire to study elsewhere can make arrangements through the consortium, while the majority of students can be directed to the well-developed direct partnerships.

In all of these cases, third-party providers are unlikely to be an adequate solution by themselves, but can certainly act as a final backup choice (e.g., if a student insists on a particular locale that is not represented in the direct or consortium partnerships).

In summary, developing an effective partnering model is a strategic process driven by the specific requirements of the envisioned internationalization initiative. A solid understanding of the options available, their respective advantages and disadvantages, and careful consideration of what specific kinds of educational experiences an internationalization educational initiative is aiming to provide can help an institution to strategically develop a partnering plan that serves immediate needs while balancing the cost and commitment required. As the institution gains experience with global education, and the volume and enthusiasm increase over time, the mix of options in the institution's portfolio can change to best accommodate these new objectives.

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