7-1-2022

Engineering Education in Developing Nations: Progress on the School of Engineering at Northrise University in Ndola, Zambia

Jeff Gladstone
Dordt University, jeff.gladstone@dordt.edu

Gitogo Churu

John Tixier

Nolan Van Gaalen
Dordt University, nolan.vangaalen@dordt.edu

Engineering Education in Developing Nations: Progress on the School of Engineering at Northrise University in Ndola, Zambia

Abstract

The engineering and technology capabilities of developed nations continues to advance and to be a major driver of the economies of those nations. Developing nations recognize this reality, and they accordingly recognize the importance of nurturing the growth of their own countries' STEM capabilities. Engineering education in developing nations is thus a critical need; but it is work that, for a variety of reasons, tends to be under-resourced by developing nations themselves as well as by potential participants from developed nations. As followers of Jesus, we sometimes find our hearts stirred on behalf of our brothers and sisters in Christ in developing nations by needs along these lines, yet we also sense the staggering magnitude of the challenge. Thus, when the Lord opens an avenue for making a practical and lasting contribution, we might find it hard to resist getting involved. Over the past 5+ years, just such an avenue has been opened at Northrise University in Ndola, Zambia, and four professors—two from Dordt University and two from LeTourneau University—have indeed found the opportunity hard to resist. Led by these four, the development of a school of engineering at Northrise —specifically a 5-year bachelor's degree program in Civil Engineering—is well along and is on track for a target opening date of February 2024. This paper will focus mostly on the practical aspects of the project, divided into three areas of activity related to the development of curriculum, facilities, and faculty. Where appropriate, attention is also given to some of the philosophical and cross-cultural questions that have naturally arisen as the endeavor has progressed.

Keywords

engineering schools, developing countries, Northrise University, Zambia

Disciplines

Christianity | Engineering Education | Higher Education

Comments

- Paper presented at the Christian Engineering Conference, St. Paul, Minnesota, on July 1, 2022.
- Online access to entire proceedings:
  Proceedings of the 2022 Christian Engineering Conference

Engineering Education in Developing Nations: Progress on the School of Engineering at Northrise University in Ndola, Zambia

Gladstone, Jeff, *Dordt University*
Churu, Gitogo, *LeTourneau University*
Tixier, John, *LeTourneau University*
Van Gaalen, Nolan, *Dordt University*

Abstract

The engineering and technology capabilities of developed nations continues to advance and to be a major driver of the economies of those nations. Developing nations recognize this reality, and they accordingly recognize the importance of nurturing the growth of their own countries' STEM capabilities. Engineering education in developing nations is thus a critical need; but it is work that, for a variety of reasons, tends to be under-resourced by developing nations themselves as well as by potential participants from developed nations. As followers of Jesus, we sometimes find our hearts stirred on behalf of our brothers and sisters in Christ in developing nations by needs along these lines, yet we also sense the staggering magnitude of the challenge. Thus, when the Lord opens an avenue for making a practical and lasting contribution, we might find it hard to resist getting involved. Over the past 5+ years, just such an avenue has been opened at Northrise University in Ndola, Zambia, and four professors—two from Dordt University and two from LeTourneau University—have indeed found the opportunity hard to resist. Led by these four, the development of a school of engineering at Northrise —specifically a 5-year bachelor's degree program in Civil Engineering—is well along and is on track for a target opening date of February 2024. This paper will focus mostly on the practical aspects of the project, divided into three areas of activity related to the development of curriculum, facilities, and faculty. Where appropriate, attention is also given to some of the philosophical and cross-cultural questions that have naturally arisen as the endeavor has progressed.

Introduction

The engineering and technology capabilities of developed nations continues to advance and to be a major driver of the economies of those nations. Developing nations recognize this reality, and they accordingly recognize the importance of nurturing the growth of their own countries' STEM capabilities. Engineering education in developing nations is thus a critical need; but it is work that, for a variety of reasons, tends to be under-resourced by developing nations themselves as well as by potential participants from developed nations.

In 2004, in the natural-resource-rich Copperbelt region of the developing country of Zambia, a Christ-centered higher education institution called Northrise University welcomed its first students. Northrise grew steadily in the years that followed, both in terms of enrollment and in terms of breadth of its academics. Then in 2015, Northrise opened a door for involvement in STEM education by quietly beginning to look at the feasibility of adding an engineering program to their growing list of academic offerings. As the initiative picked up momentum in the following couple of years, the work came to be shouldered mainly by four U.S. engineering professors—two from Dordt University (Sioux Center, Iowa) and two from LeTourneau University (Longview, Texas). At present, the development of a school of engineering at Northrise—specifically a 5-year bachelor's degree program in Civil Engineering—is well along and is on track for a target opening date of February 2024. Funding for the project has been given/pledged, construction drawings for the Engineering Building are complete, a candidate search for the first Head of Engineering is underway, and the curriculum plan is beginning to work its way through the accreditation process with Zambia's Higher Education Authority (HEA).

There are several reasons for publishing this paper: pausing to document our activity has been helpful to those of us who are involved with the project; "going public" with the details at this intermediate stage will undoubtedly prompt helpful suggestions; and some readers may find our experiences to be applicable to their engineering education initiatives. But in the midst of all the details, our prayer is that the paper will also be used by the Lord to stir up in some others a desire for involvement.

The paper is organized as follows: a feel for national history and educational context is given, Zambia's recognition of their need for engineering talent is described, the history of the university and the Engineering project is summarized, and the three main practical aspects of the project—facilities, faculty, and curriculum—are discussed in some detail.

Political, Economic, and Educational Context

British colonization of eastern Africa was formalized in the late 19th century. The region of eastern Africa belonging today to Zambia was known at that time as Northern Rhodesia. As the era of European colonization in Africa ended in the mid-20th century, Northern Rhodesia also gained its independence, in 1964 becoming the Republic of Zambia. Zambia was governed under a single-party political system for almost three decades until, in 1991, the system was transformed to become a multi-party democracy with presidential elections being held every five years. Recognized by the World Bank as a stable country, Zambia has successfully navigated a peaceful transfer of power nine times between 1991 and 2021[1].

Economically, Zambia is well known for its considerable mineral wealth—they are the second largest producer of copper in Africa and the eighth largest in the world. However, for a variety of reasons, the potential of this vast natural resource to produce a corresponding economic benefit for the nation as a whole has always fallen short of what one would hope. Even so, copper mining and processing is still the largest contributor to Zambia's economy, followed by agriculture, tourism, and manufacturing[2].

Zambia's overall population is both very young and highly urbanized. The median age is around 17, and around 45% of its people live in cities[3]. Ndola, where Northrise is located, is technically the country's third largest city, but is essentially the same size as the second largest city, Kitwe, which is only an hour away by car. Ndola and Kitwe, with a combined population of 800,000, are in the Copperbelt region of Zambia[4]. Both are served by a large, newly-built (2021) international airport, which is located around 10 km from the Northrise campus.

Oversight of higher education in Zambia is provided by the government-chartered Higher Education Authority (HEA), which is located in the capital city of Lusaka, about a 4-hour drive from Ndola. The HEA is responsible for accreditation of all degree-offering institutions and programs in Zambia, including Engineering[5]. The country has two well-established public universities, with both offering all levels of degrees in Engineering: The University of Zambia (UNZA) in Lusaka, and Copperbelt University (CBU) in Kitwe. There are currently no private universities in Zambia that offer degrees in Engineering.

Needs Assessment

While it is almost axiomatic in the current era that engineering education is an important component of a nation's overall economic health, we believe it is nonetheless important to understand how the need is expressed by Zambians themselves. To this end, on a visit to Zambia in 2019 the authors met with several companies, organizations, and agencies, and we discussed engineering and engineering education. These conversations, along with an Internet search for government-level Zambian documents related to the question, have given a tremendous boost to our sense of confidence that Engineering at Northrise will be seen as a significant asset to the country. Government documents are addressed first.

National development goals in Zambia are guided by formal documents known as National Development Plans (NDPs). These NDPs are updated every few years; they are currently working under the 7th National Development Plan (7NDP) [6]. The overarching goal is known as "Vision 2030," with has set a target of becoming a "prosperous middle-income country" by 2030. As would be expected, significant

emphasis is given to education, in general, and to technical education, in particular. Several statements related to engineering education can be found in the document; two sample quotes are given here:

- Training in business development, technical and vocational skills will also be required to support innovation and technology that will drive growth. [Additionally,] measures will be put in place to promote applied research and training in engineering, sciences, mathematics and ICT to enhance the quality and productivity of the labour force.[7]
- Further, to support the development of practical skills in science, technology, engineering and mathematics, the Government will ensure the provision of training equipment, support the upgrading of lecturer qualifications and establish centres of excellence in science, technology and engineering.[8]

Additionally, from the same NDP document, three of the ten Development Outcome Goals are directly dependent on Civil Engineers:

- Development Outcome 4: Improved Energy Production and Distribution for Sustainable Development[9]
- Development Outcome 6: Improved Transport Systems and Infrastructure[10]
- Development Outcome 7: Improved Water Resources Development and Management[11]

As noted above, we visited Zambia in 2019, and we were encouraged to find that these formal statements in government documents were mirrored in all of our conversations with people in the various organizations and agencies with whom we met. In short, it appears to be essentially universally recognized that infrastructure development and technical skills development are important to Zambia's future. Additionally, while the existing State schools (UNZA and CBU) are very much appreciated, the engineering programs in those schools suffer from over-crowding, and there was every indication that Northrise's addition to the nation's engineering education capacity would be applauded.

Overview of Northrise and the School of Engineering Initiative

The vision for a Christ-centered higher education institution in Zambia began in 1988 as the Lord spoke into the hearts of Dr. Moffat and Mrs. Doreen Zimba, a Zambian-born couple who were both pursuing graduate degrees while living in Southern California—Dr. Zimba obtained a doctorate at Fuller Theological Seminary, and Mrs. Zimba received her MBA in Technology from the University of Phoenix. Following 16 years of collaborative work involving the Zimbas and many other individuals and organizations from Zambia, Australia, and the United States, Northrise University first opened its doors in 2004 to 50 students in a large office building in downtown Ndola. The first nationally-recognized private university in Zambia, Northrise later relocated to a government-granted 640-acre plot on the outskirts of Ndola. Over the years since then, the Lord has blessed the university with steady growth. The current form and impact of Northrise is best described in its own words:

> Today, there are over 1,000 students enrolled at Northrise, taking advantage of its deep Christian worldview, full accreditation, and eleven degree programs in business, IT, law, nursing, and theology. Of its 500 alumni, 99% have remained in Zambia taking up positions of leadership in business, government, and ministry. Having achieved what is among the highest academic requirements in Zambia and equipped with strong character and love for their fellow Zambians, these graduates go on to lead fulfilling careers and help to transform their communities and nation. [12]

As the university steadily grew and as new degree programs were launched, Northrise in 2015 opened a door for expansion into STEM education by quietly beginning to look at the feasibility of adding an engineering program. With time, the initiative picked up momentum, and the current form of the development project took shape under the sanctioning of the Northrise University Board of Regents.

General practical oversight of the project is provided by the staff at the university itself and by Northrise University Initiative (NUI), which is the supporting U.S.-based nonprofit.[13]

The team of people doing the work of the project has, as one would expect, been growing in size over time. Dividing the project up under the headings of Faculty, Curriculum, Facilities, and Fundraising, the four authors of this paper have focused the bulk of their practical efforts on formulation of the curriculum, but they also have an advisory role on the activities related to faculty and facilities development. The heavy lifting on the facilities development activity is being accomplished by personnel at one of NUI's industry partners, JTAM Engineering, an energy consulting firm located in Houston. Faculty development is headed by the university's academic affairs leadership in Zambia. The fundraising team is comprised of NUI leadership and Dr. Zimba.

Facilities

Northrise has divided its campus facilities growth plan into five phases, as can be seen in **Figure 1**. Construction of the first phase, which was begun in 2015, had as its focal point the Campus Center building. Phase 2 included facilities for the Nursing program, the first of four large dormitory structures, an alumni house, and the first of four faculty duplexes. The Engineering Program's building is included in Phase 3; its location on the campus is highlighted in **Figure 1** and **Figure 2**.

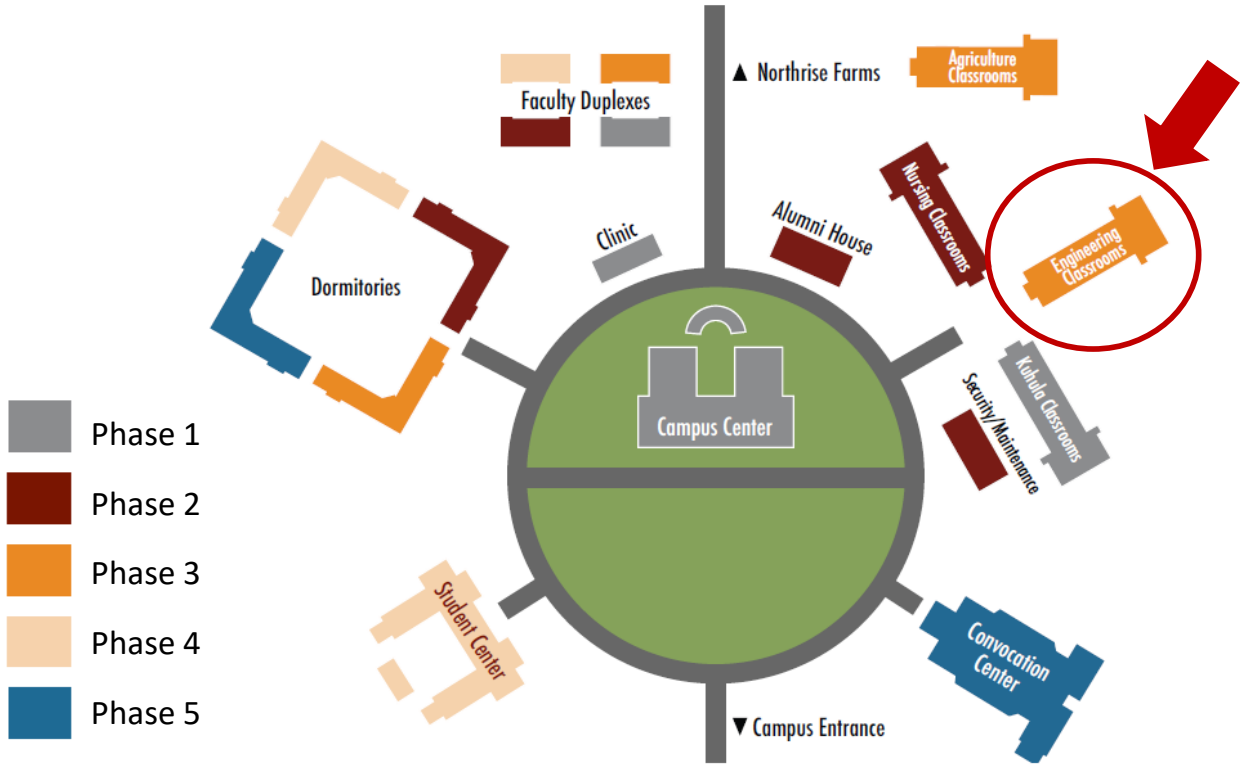

Figure 1. Campus Facilities Growth Plan

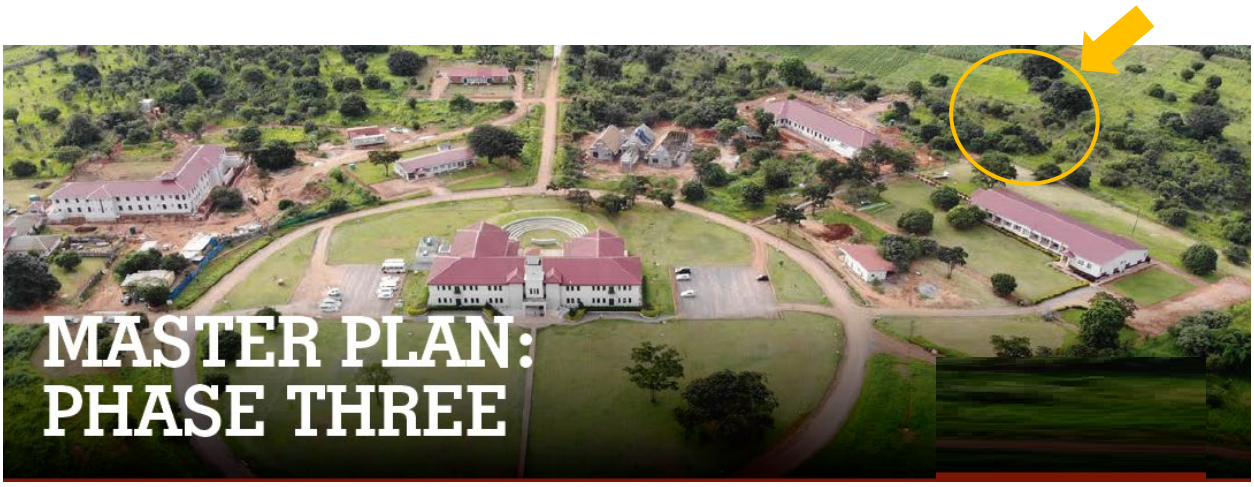

Figure 2. Aerial Photo as of 2021, Site of Engineering Building in Upper Right

Ideas for the design of the engineering building began in 2018, with several concept iterations being considered between then and the current plan, which was finalized in early 2022. Identifying an appropriate size for a brand-new program is always a challenge, and the team leaned heavily on Dordt's experience, since its program is young enough still that the early stages are well remembered. The building thus was sized using a target number of 150 students and classroom and lab area-per-student based on existing facilities at both Dordt and LeTourneau. Shown in **Figure 3** and **Figure 4** are images taken from the recently completed architectural drawings.[14]

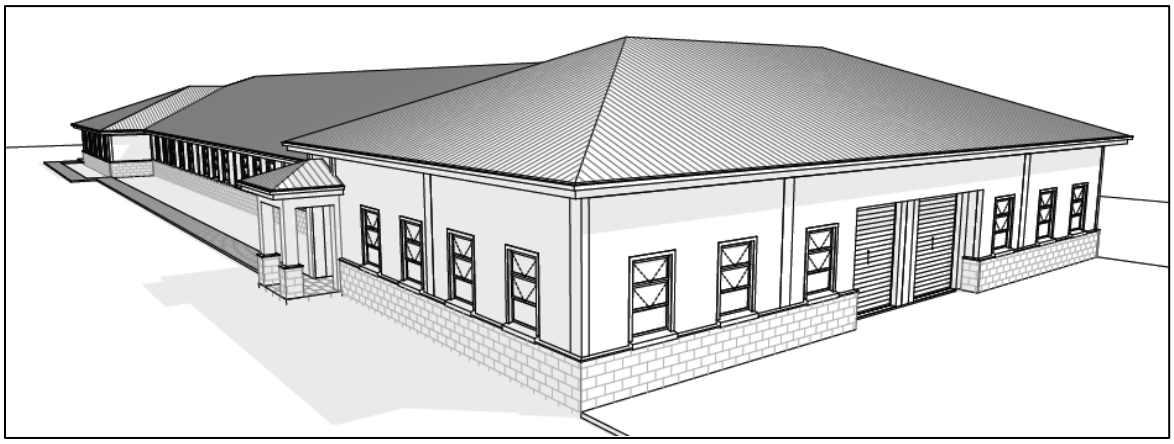

Figure 3. Architectural Rendering of the Lab End of the Engineering Building

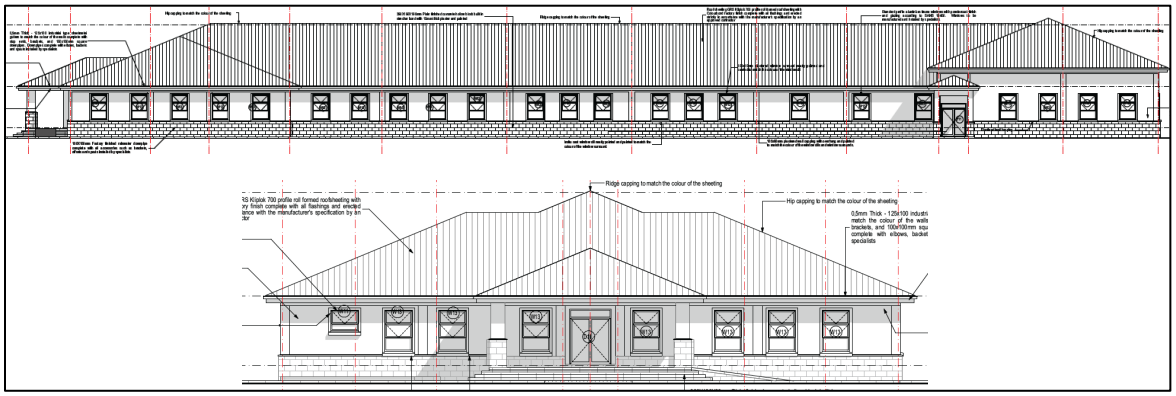

Figure 4. Side Elevation and Elevation Viewed from Campus Center (Not to Scale)

The planned 1850 sq m (19,900 sq ft) facility is comprised of the following educational and faculty spaces:

- Four 32-seat classrooms, two of which will likely be first configured as "flex classroom lab" spaces for CAD/CAE workstations and for Physics & Electronics
- Two 56-seat lecture halls
- Four side-by-side engineering teaching lab spaces furnished with lab tables for up to 16 student workstations in each
- Six office spaces for regular faculty
- A larger office for the Head of Department with an adjacent administrative office area
- A 32 sq m conference room, also suitable for small group study
- A 360 sq m student center/study lounge area that will easily accommodate 80 to 100 students

As noted above, sizing of the building was based on the existing facility at Dordt, mostly using floor-area-per-student as the figure of merit. Comparison of the two facilities is summarized in **Table 1**. Note that the Dordt figures are less precise than the Northrise figures owing to the fact that Dordt's various science, math, and engineering programs share a lot of the same spaces, so it is difficult to quantify which spaces "belong" to engineering. Nonetheless, it can be seen that the areas and quantities of the spaces at Northrise are in the same ballpark as those same parameters at Dordt, and Dordt has been well served by its facility.

Obviously, an adequately sized and well-equipped building is a critical component of the development of the engineering school at Northrise, and the university has been very blessed by the hearty and generous response of donors who have recently pledged gifts sufficient to allow the construction of this $1.7M (US) facility.

Table 1. Comparison of Facility Size Parameters—Northrise vs. Dordt

Parameter		Dordt	Northrise
Number of Engineering Students		180	150
Classroom, Lecture Hall, and Computer Lab Spaces	Total Area, m^2	795	590
	Area Per Student, m^2	4.4	3.9
Lab Spaces (other than Computer Labs)	Total Area, m^2	810	610
	Area Per Student, m^2	4.5	4.1
Student Lounge Spaces	Total Area, m^2	300	360
	Area Per Student, m^2	1.7	2.4
Labs and Classrooms, Qty	Total Number	13	10
Faculty Offices, Qty	Total Number	10	7

Faculty Development

Of the three major development activities, it is anticipated that faculty development will be the most challenging. Yet, as it involves the hearts of God's people, it is also the point at which Holy Spirit intervention can be leaned into with faith in God for His provision.

Attracting and retaining technically competent and truly Christ-centered engineering faculty is a challenge regardless in which country an institution is located. Faculty salaries at Christian undergraduate institutions in the United States, as those of us in education know first-hand, are well below what practicing engineers are earning. Another layer to this challenge is added in Zambia: even practicing engineers face the temptation of leaving the country for higher salaries and increased opportunities in

developed nations—how much more a trained engineer with advanced degrees? Thankfully, an economics-based analysis of the situation only goes so far. Hearts gripped by God's grace, attentive to His "follow me" call, and with tastes transformed to richer understandings of "gain" have always been willing to take economic losses.

Yet at the practical level, the work still involves candidate searches. With a target opening date of February 2024, our hope and goal is to hire a qualified Head of Department (HOD) at least a year in advance of that date. The candidate search formally began in May of this year. As currently envisioned, the hiring of this person would mark a major milestone—the beginning of the handoff of vision-crafting from the advisory committee over to a Northrise faculty member. From that point forward, the HOD would increasingly be taking responsibility for the shape and tone of the School of Engineering. Obviously, the candidate must possess solid technical, teaching, and leadership skills. But he or she will also be setting the spiritual tone. Accordingly, the job description states that the candidate must possess "An active and growing Christian faith and walk" and "A vision for articulating the integration of the Christian faith with the practice of engineering, both in the teaching of students and also in the engagement of the topic with colleagues inside and outside Northrise." And so, we pray and trust for the Lord's stirring in the heart of the right person.

The need for faculty in addition to the HOD will be proportional to the number of engineering-related courses on-offer each year. In Year 1, since only first-year students will be in the program, and since the target number of students for the first cohort will be relatively small (15-20), the teaching load can easily be handled by two faculty. It is envisioned that one new faculty would be added each year or two in the ensuing years, which would result in a total of 4-5 full-time equivalents by Year 5. Of course, all of this is subject to the requirements of the HEA. We met with the HEA in Lusaka during our 2019 visit, and they indicated that not all faculty need to be in place at the very beginning but that there definitely needed to be a viable plan in place from the start. This is considered to be something of a risk since, until formal approval is obtained, changes to earlier "understandings" are possible.

When talking about Northrise Engineering with other North Americans, a question that often comes up when considering the topic of engineering faculty is whether it will be comprised entirely of Zambians. Some aspects of the question are merely practical—there is a job that needs doing, and one has to do what one has to do. When considering the question from this angle, one can easily arrive at a strategy of meeting the start-up needs of the program (the first 5-10 years, more or less) by recruiting from pools of talent with which we are most familiar. Though we cannot predict the future, it's not inconceivable that this kind of approach could produce a faculty makeup that is skewed toward expatriates from the U.S. or from other non-African countries. Yet the question also seems to reflect an intuitive recognition that faculty strategies and goals ought to take into account sensitivities to Zambia's colonial past. With this in mind, we are looking to find opportunities to increasingly hand over the reins to Northrise-rooted personnel, under the assumption that questions along these lines are naturally and regularly being addressed by Northrise leadership.

Despite many open questions, we move forward trusting that in due time the core of full-time Engineering faculty will come to take shape. Then, supporting that core, it is exciting to consider other avenues for faculty development, and also to consider opportunities for temporary and part-time involvement for engineering faculty from our North American institutions. Three examples along these lines have been discussed:

- Visiting engineering faculty from other Christian institutions spending a semester teaching at Northrise—either retired professors or active professors "on loan" from their institutions.
- On-line education will almost certainly play a role in the future at Northrise, and this will be an avenue for involvement for outside faculty.
- We can envision faculty exchange programs where full-time Northrise faculty spend a semester teaching at our institutions.

Finally, it is our desire, and it is the stated intention of Northrise, that all academic programs at Northrise be genuinely Christian in their content and ethos. Doing this well in an engineering program, as we know from experience, is an ongoing challenge even in our long-established institutions. It is easy to imagine that, in the flurry of activity to simply execute the basics of engineering instruction at Northrise, the finer points of "doing engineering Christianly" will tend to fall through the cracks. At this early stage, it would be an overstatement to say that we have a strategy in place. However, we have brainstormed some possible initiatives in this vein, as listed here, and we would also welcome ideas from our readers:

- Seek out ways to engage with existing Christ-centered organizations, both international (for example, International Network for Christian Higher Education, INCHE) and in Africa.
- Develop online summer workshops related to this topic involving U.S. institutions, Northrise, and perhaps other African institutions. (Helpfully, the school year at Northrise takes an extended break during North American summers.)
- Provide funds for Northrise faculty to attend appropriately-themed conferences, such as the CEC.
- Consider ways that on-exchange faculty could promote discussion and activities along these lines while they are at Northrise.
- Generally promote and support two-way faculty exchange initiatives between Northrise and our U.S. institutions.

An implied over-arching theme of all this is that we, as an advisory committee, see our involvement with Northrise Engineering as an ongoing commitment, and in the years ahead we want to sensitively maintain a posture of engagement, interaction, and shared Christian mission with our fellow believers at Northrise.

Curriculum Development

Developing the curriculum for Northrise Engineering has been a major undertaking, one that has been in the works at various levels of activity for about four years. At a practical level, it has been a large project simply creating the document that describes the curriculum and that meets the content and formatting requirements of the HEA. But interwoven with that effort have been development efforts and decisions stemming from 1) differences between American educational models and Zambian (British-based) educational models, 2) differences between developed-nation and developing-nation approaches to higher education, and 3) differences between the familiar (to us) ABET accreditation requirements and the unfamiliar (to us) HEA accreditation requirements. Four specific expressions of these differences needed to be—and some are still needing to be—addressed and accommodated:

- Transforming our 4-year programs into a 5-year engineering program
- Determining whether the (BSE) Bachelor of Science in Engineering degree programs popular in smaller Christian engineering schools would be accepted and accredited in Zambia
- Finding ways to incorporate more hands-on elements into the curriculum, as compared to their more theoretical methods
- Seeking to infuse a basic engineering program with an explicitly Christian ethos

Five-year Program

Northrise has given us guidance that the Engineering will be a 5-year program—consistent with Nursing, which is currently their other science-heavy program. To some extent the extra year is rooted in the British educational model, which employs an educational model that makes use of "A-Levels[15]". In the United Kingdom, A-Levels are a two-year study-and-exam process for pre-certifying that prospective students are indeed qualified for study at the university level. As applied at Northrise, a student's first year is focused on aligning his or her educational foundation with the plan of study that lies ahead, and demonstrating at the end of that year, by means of passing exams, that he or she is qualified.

At one level, it was not difficult to map a version of Dordt's and LeTourneau's 4-year Engineering curricula (Civil Engineering, to be more specific, as will be discussed below), as our comparison of our two programs showed that they are very similar to each other, and also similar to UNZA and CBU. And, of course, expanding is certainly easier than compressing. But we are perceiving that the challenge will lie in helping secondary school graduates step up to the demands of engineering math and physics, and graciously giving alternative guidance to those students who don't have the aptitude or the sustained interest. While this is a process that we face in our U.S. institutions—one that occurs somewhat informally over the first 2-5 semesters—our general sense is that the average level of preparation in Zambia for more rigorous math and physics is lower than in the U.S. Thus, we are seeing it as a positive for students to have an extra year at the beginning of the study program, and our courses and course content will be aimed at 1) establishment and evaluation of fundamental academic skills, and 2) providing students with insight into the work of an engineer, as we recognize some will find engineering is not what they thought it was. At present, we envision that we will be designing-in two qualifying hurdles: the first will be exam-based at the end of Year-1, and the second will be GPA-based sometime in Year-4.

General Engineering Degree (BSE) vs Discipline-Specific Degree

Many small engineering programs in the U.S., including those at Dordt and at LeTourneau, have taken the single-degree approach to accreditation under ABET (though LeTourneau now also offers some discipline-specific engineering degrees). By offering a single engineering degree—a Bachelor of Science in Engineering (BSE)—with a number of possible concentrations, this has allowed small engineering programs to offer a wide range of options for their students while still being accredited by ABET. Were they to offer discipline-specific engineering degrees—a BSCE or a BSME, for example—each degree program would have to be accredited separately by ABET, which adds a significant amount of administrative work to the department in order to maintain accreditation. A philosophical argument for the single engineering degree is that it develops more of a multi-disciplinary mindset in students, which is reflective of trends toward more multidisciplinary demands on practicing engineers. Finally, a more marketing-driven motivation for this approach for small engineering programs is that it allows for the engineering department to offer a wide array of concentrations to potential students—a strong selling-point in the U.S. where providing a large variety of options is an extremely important cultural value. The downside of this single-degree approach is, in Dordt's experience, quite minimal.

On our 2019 visit to Zambia, we met with the HEA and took the opportunity to discuss this topic. Based partly on that conversation, we have come to believe that in Zambia there is less of an upside and more of a downside to the single-degree strategy. Providing a wide array of options for engineering concentrations is not likely to increase the demand for an engineering education at Northrise compared to an engineering education elsewhere, as there simply is very little competition. Over the medium-term, our objectives are to offer programs in Civil, Mechanical, and Electrical Engineering, and we believe that those will provide adequate variety for the foreseeable future. Thus, the upside motivation is largely removed. The downside of single-degree approach is that graduates would sometimes need to answer the question, "What kind of engineer are you?" While we have found this to be a relatively infrequent question in the U.S.—and even then, a non-threatening question—that does not seem to be the case in Zambia. Some of those that we spoke with (the HEA and others) indicated that it is important for graduates to be able to state plainly, without any explaining, that they hold a BSCE (or BSME, etc.). With the new engineering program at Northrise, it will be important to avoid unnecessary impediments to building our credibility in the professional arena.

For these reasons, it was decided that Northrise Engineering will begin with a single degree in Civil Engineering, a BSCE, rather than a BSE with a concentration in Civil Engineering[16].

"Hands-On" Engineering Education

Engineering education in the U.S. has long recognized the value of hands-on experience, reflective of the fact that the engineering profession itself is nearly always, ultimately, product-oriented rather than

information-oriented. As we ourselves are very much convinced of the value of hands-on experience, it has been our intention from the beginning to embed "hands-on" in the DNA of Northrise Engineering. During our visits with Zambian employers and agencies in 2017 and 2019 we would often bring up the question of whether hands-on educational experiences are perceived as valuable. Essentially without exception, the question was met with some expression of disappointment in the lack of hands-on experience in graduates from the state universities. Given this consistent trend, we began asking more nuanced questions about this issue; the following paragraphs discuss some of our findings.

We found that there is the potential for confusion related to the phrase "hands-on" when, for instance, talking with agencies chartered to guide the scope of engineering curriculum (for example, the HEA). There are those in technical fields who make their living doing hands-on work—technicians, mechanics, etc. Formal training of technicians and mechanics in Zambia often takes place at technical colleges. We needed to clarify that our intentions to emphasize "hand-on" were not aimed at this depth of hands-on capability. Fortunately, we found that engineering employers use the term more naturally in the same way as we do. They see the value in developing a practical feel for hardware, such as that which comes when a person actually can do things with his or her hands—working on a car's engine, taking apart a computer, installing appliances in the house, building a backyard shed.

In Zambia as well as in the US, hands-on experience ideally would begin at home. But even if that hasn't happened, some significant hands-on experience can be gained through labs and projects in the engineering program at Northrise. While we want to be careful to not speak beyond our direct knowledge, our conversations left us with the impression that the Zambian state schools—UNZA and CBU—have a difficult time offering deep engagement with labs and projects due to their facilities being over-crowded.

Finally, in an interesting conversation with TEVETA—the Zambian agency that promotes and guides technical and vocational training—the question was asked whether in Zambia it was seen as being "beneath" the status of an engineering professional to do practical work with his/her hands. The answer was that, yes, this tended to be an impediment to technical people gaining both theoretical skills and practical, hands-on skills. As we move forward, we will be keeping an eye out for whether this is indeed a significant impediment.

Explicitly Christian Ethos

On their website, Northrise states that they are…

> …committed to its mission as a Christ-centered institution of higher education. Biblically oriented learning is a necessity for the Christian community and integration of faith and learning is at the heart of authentic Christian higher education. Our faculty and staff are wholeheartedly committed to the integration of faith and learning across our campus and the curriculum.
>
> We begin with a faith commitment that informs all learning, which also shapes expectations for living and results in moral and spiritual virtues. The moral and spiritual virtues have vital cognitive significance and strengthen the entire academic spectrum of teaching, learning, and research.[17]

One practical approach the university employs for applying this vision are four "Christian Thought and Practice" courses that they require each student to take, which of course we welcome. In addition to these, as we have formulated our engineering curriculum, we are hoping to incorporate courses from Dordt and LeTourneau that specifically address engineering from the perspective of a Christian worldview. For example, two courses from Dordt— "History of Science and Technology" and "Technology and Society"—are both addressing the reality that technology is not values-neutral and that humanity's technological developments affect people and society in ways that are often not in a direction promoting true human flourishing. Versions of these two courses we would like to see in the Engineering curriculum at Northrise.

However, as we have moved more deeply into the details of the curriculum approval process, we are beginning to sense that there might be some pushback from the HEA against courses that are not specifically focused on the development of engineering skills. Having said that, it is important to note that if there is going to be pushback, it will be rooted in pragmatism, not anti-Christian sentiment. Zambians generally view Christianity favorably; in fact, it is written in their Constitution that Zambia is a Christian nation. However, their educational model, being rooted in the British/European approach, puts value almost exclusively on the major area of study and doesn't seem to recognize the value of a broader, more holistic treatment of the field. Where this specifically shows up in the curriculum planning is that, as it appears at present, we are probably going to be capped by the HEA at 15 credits per semester, which would be 150 credits for the 5-year program. As we understand it, their reason for this requirement is to keep the workload manageable for the students. We don't yet know how this will turn out. Finally, it must be admitted that even if those courses are approved for the curriculum, instructors who have not engaged engineering from this perspective might have a difficult time being effective without coaching—perhaps an opportunity for an online course, at least at first.

Conclusion

An endeavor like this cannot be talked about without using terms like *goals* and *objectives*. On the one hand, a practical project must be treated practically—as the saying goes, failing to plan is planning to fail. On the other hand, Kingdom work gives us exposure to some of the marvelous dimensions of God's ways, which are often mysterious and unpredictable from our perspective. The Scriptures are replete with examples and themes of God bringing glory to His name by accomplishing the work by His own hand—not by Man's hand—so that there would be no room for human boasting (Judges 7:2). Indeed, as the psalmist said (Ps. 127:1), "Unless the Lord builds the house, those who build it labor in vain." Our desire is to move in step with that reality.

Much work has been accomplished, by God's grace, and much remains. Many unknowns have become knowns, but many more unknowns remain. We are grateful for the opportunity to share this long description of the project, and we would welcome insights, suggestions, involvement—and prayers—from the fellowship of Christ-followers in the Christian Engineering Society.

Finally, we are grateful to the Lord for the opportunity to serve in this way alongside our brothers and sisters at Northrise as they seek to be the hands and feet of Jesus to their fellow Zambians, broadcasting and demonstrating the good news of the Kingdom.

References and Notes

[1] "The World Bank in Zambia – Overview." *The World Bank*, 17 April 2022, www.worldbank.org/en/country/zambia/overview#1.

[2] "BLOG – Agriculture, Mining, Manufacturing and Tourism- Four Key Economic Sectors to Drive Zambia's Economic Stabilisation Agenda." *Policy Monitoring and Research Center*, 9 September 2021, pmrczambia.com/blog-agriculture-mining-manufacturing-and-tourism-four-key-economic-sectors-to-drive-zambias-economic-stabilisation-agenda/.

[3] "Children in Zambia." *UNICEF*, www.unicef.org/zambia/children-zambia#:~:text=Zambia%20is%20a%20country%20of,in%20the%20region%20and%20globally, Accessed 14 June 2022.

[4] "Population of Cities in Zambia (2022)." *World Population Review*, worldpopulationreview.com/countries/cities/Zambia, Accessed 14 June 2022.

[5] While there is still some uncertainty about the parties that will be involved in accreditation, it is believed at this time that the Engineering Institution of Zambia (EIZ) will also have input.

[6] “National Development Plan 7 – 2017-2021 – Volume 1”, *Ministry of National Development Planning,* 14 June 2017, www.mndp.gov.zm/wp-content/uploads/2018/05/7NDP.pdf.

[7] Ibid., p. 96.

[8] Ibid., p. 100.

[9] Ibid., p. 72.

[10] Ibid., p. 77.

[11] Ibid., p. 78.

[12] “The Amazing Story of Northrise.” *Northrise University,* northrise.edu.zm/about/history/, Accessed 14 June 2022.

[13] The Northrise University Initiative (NUI) exists to support and communicate the vision and mission of NU, to accelerate growth and provide opportunities for students and faculty. NUI creates opportunities and involvement through their Scholarship Fund, Capital Campaigns, and Partnerships. For more information, see https://northrise.edu.zm/about-nui/northrise-university-initiative/.

[14] The architect is located in South Africa; the same firm has been used in all building phases to date.

[15] A-Levels is short for Advanced Levels, as compared to Ordinary Levels (O-Levels), which are exams that mark the end of a student’s secondary education.

[16] Civil Engineering was selected as the initial program offering based on in-person discussions with many businesses and agencies in Zambia on visits in 2017 and 2019.

[17] “Our Conviction for a Biblically Oriented Education.” *Northrise University,* northrise.edu.zm/about/faith-and-learning/, Accessed 14 June 2022.