ENVISIONING VIRGINIA TECH

BEYOND BOUNDARIES

ENVISIONING THE LEARNING SPACES OF THE FUTURE

PREPARED BY:

Meredith Hundley

Office of the Senior Fellow for Resource Development

October 2015

VirginiaTech

Envisioning Virginia Tech in 2047 requires an understanding of the ways in which the university may alter its physical landscape to adapt to the more metaphorically changed higher education landscape. The physical setting will be one reflection of the global land-grant mission at Virginia Tech. We must question the ways that the university of the future might be structured and where it will be located, such as looking at non-traditional delivery options and classes, and whether and towards what ends will there be a continued need for and investment in large capital projects. Shifts away from both geographic homogeneity and traditional course delivery present new challenges to all institutions. These institutions may seek to modify the university campus to best meet the needs of their changing communities and create new mechanisms for interaction and outlets for socialization for geographically-dispersed populations.

As higher education institutions look towards the future to evaluate which types of investments they will make in what facilities and towards what ends, several issues will likely, or at least should, be taken into consideration. This paper addresses some of these factors that Virginia Tech will need to consider in the coming generation in terms of the ways in which knowledge will be created and delivered and the physical infrastructure needs of the university community.

Knowledge Creation and Delivery

Understanding what the campus of the future will look like involves asking and answering questions regarding the nature of education itself. The traditional classroom was designed for lectures and the presentation of information from one to many. However, Brown (2015) notes that the current trajectory for the more broadly-termed "learning spaces" is an evolution away from the lecture style "towards being places of discovery, invention, and knowledge construction" (p. 22). Learning spaces takes learning out of being strictly confined to a lecture hall, or even a formal classroom more generally, to acknowledge and take advantage of the learning opportunities that emerge in common areas, labs, and so-called makerspaces.

This section discusses the differences between learning spaces as can be discerned on the basis of five different categories: purpose, technology, geography, time, and instructor attention. Based on an exploration of these categories, Table 1 is a proposed framework outlining a spectrum of possibilities that exist within each of these categories.

Table 1. Learning Space Spectrums

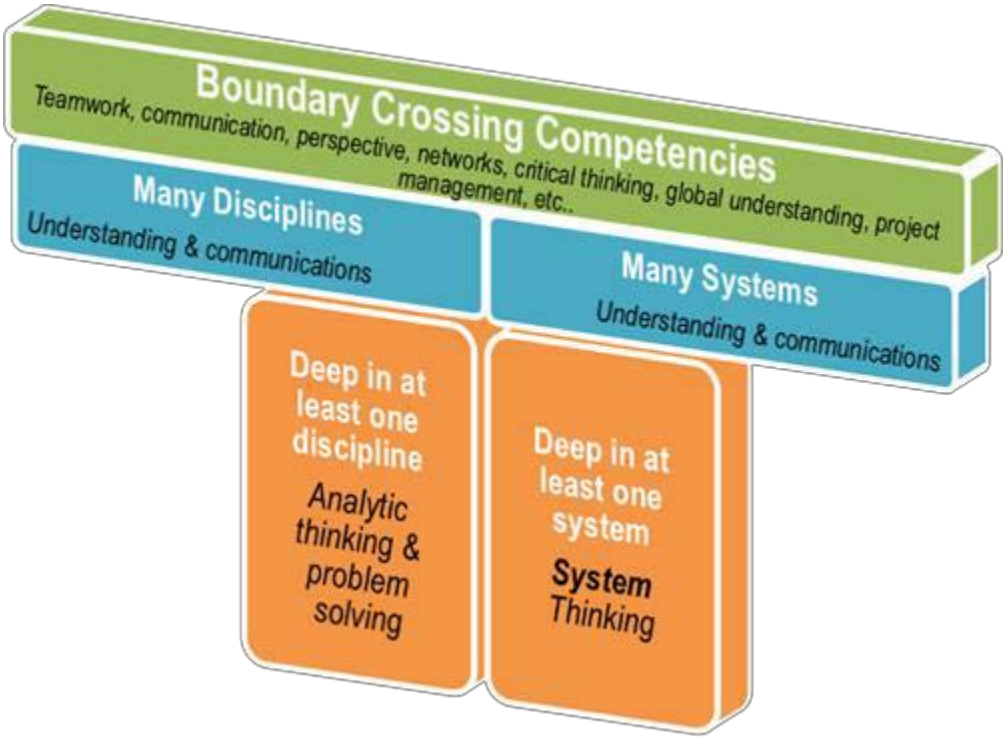
Category	Spectrum
Purpose	Knowledge-oriented—Credential-focused
Technology	Paper-based/Analog—Technology-intensive
Geography	In-person—Fully dispersed
Time	Synchronous—Asynchronous
Instructor Attention	Individual—Mass education

Purpose. The "purpose" area is focused on understanding the desired outcomes of the educational experience. On one end of the spectrum is the classical pursuit of knowledge for intellectual and personal development rather than as career preparatory. This approach to education was often only made available to privileged groups with enough outside financial support (Association of American Colleges and Universities, 2007). The other end of the spectrum is highly vocationally oriented with students emerging trained and ready to step into a job position with no additional training. The credential-focused end of the spectrum has received significant attention with the push for workforce readiness training via continuing education, certifications, and technical colleges. Georgetown Public Policy Institute estimates that 67% of Virginia jobs will require post-secondary education by 2020 (Carnevale, Smith, & Strohl, 2013, p. 3). For-profit institutions has emerged in increasing numbers to meet the demand for credentials in the workforce, with a 21% increase in the number of for-profit institutions, both baccalaureate and associate's/certificate-granting institutions, between 2009 and 2013 (See Table 1). The technical skill-oriented associate's degree and certificate-granting institutions comprised a larger percentage (72.4%) of the total population of for-profit institutions than their counterpart either not-for-profit institutions (6.4%) or public institutions (61.2%).

As the need for a college degree has risen due to competition in the labor market, the types of skills required in the workplace, and the qualifications desired by employers, there have been shifts inward from either end of the spectrum. On the knowledge-oriented side, there has been a shift from obtaining knowledge for knowledge's sake to ensuring that students are also employable at the end of their time with an institution. The Association of American Colleges and Universities (2015) has revised what is thought of as a liberal arts education to emphasize the development and demonstration of important skills sets, such as critical thinking, communication, and problem-solving, through project-based work (p. 3). Their "Liberal Education and America's Promise (LEAP) initiative refers to this project orientation as "Signature Work" and is underway at University of Massachusetts Amherst and Cornell University, among others (AAC&U, 2015, p. 4).

Competency-Based Education. While the liberal arts world has been developing additional ways of demonstrating the applicability of these broad skills, the vocational side of the spectrum has been arriving at similar conclusions from the opposite end. There has been a growing acknowledgement of the importance of developing "T-shaped" individuals that are able to cultivate both depth of expertise as well as breadth of skillsets (Spohrer, 2013). Skillsets, or so-called "competencies," that cross perceived disciplinary boundaries include "teamwork, communication, perspective, networks, and critical thinking" (Valenti, 2015, p. 36). Figure 1, originally created by Jim Spohrer of IBM and modified by Valenti (2015), demonstrates how T-shaped individuals balance depth and breadth.

Figure 1. T-shaped Individuals



Source: Image taken from Valenti (2015), modified from Jim Spohrer and Michigan State University's image

Western Governors University began offering online competency-based degree programs in 1999 as one of the first in the nation to award degrees on the basis of skillsets learned rather than coursework completed. As of August 2015, WGU has over 60,000 students enrolled including 1,579 Virginians (Western Governors University, 2015).

Southern New Hampshire University designed their program, "College for America," as an initiative to provide an affordable path to college degrees that is both flexible for working adults and geared to developing the skill sets desired by top employers. This program is currently only available to individuals affiliated with one of the university's participating employers, which as of August 2015 included more than 100 organizations across areas such as insurance, government, healthcare, service, manufacturing, nonprofit organizations, retail, and technology. Students are placed in cohorts with other individuals from their employer, and many students have their degree paid for by their employer. Rather than taking traditional courses with instructors, students develop specific "competencies" through individual projects with guidance from so-called ""coaches" and "reviewers" (College for America, 2015). Time to degree completion is dependent on the student's motivation and ability to complete projects in a particular time frame since there are no courses, but is estimated to take two years for an associate's degree or four years for a bachelor's degree.

University of Wisconsin's Flexible Option program is another online, competency-based degree program that, unlike SNHU's College for America, does not require students to be

affiliated with particular employers. Like Western Governors University and College for America, however, students are evaluated based on skillsets demonstrated rather than coursework undertaken. All three of these programs charge tuition on a flat "subscription" rate rather than by credit hour. College for America is the least expensive at $2,500 per year and UW Flexible Option is the most expensive at $9,000 per year (Western Governors University, 2015; College for America, 2015; University of Wisconsin System, 2015). For well-motivated students, however, any of these options can represent significant cost savings compared to the per credit hour structure.

Technology. Valenti (2015) noted that early integration of modern technology into the classroom tended to be replicating the traditional classroom approach. Chalk on blackboards became transparencies on projectors that, in turn, became PowerPoints. Likewise, lectures continued to be the standard approach to information delivery in larger classrooms, and learning management systems (LMS) provided a digital means to collect the same type of course materials previously assembled in hard copy. The proliferation of wireless networking and mobile devices began to change that direct translation and opened pedagogy up to new ways of teaching and learning that uses technology towards previously impossible ends (Valenti, 2015, p. 34). However, LeBlanc (2015) reminds us that there is more to many students' college experience than strictly the material learned in the classroom. He further argued that

> For students who are attending an institution for a coming-of-age experience along with their academics, there is no technology replacement for long chats with a faculty member about the big questions they are grappling with (everything from the meaning of life to what they should do with their future.) There is no technology replacement for a counselor in the wellness center. There is no technology replacement for being able to take on a leadership role in a student organization. These are human and social engagements, often messy and complicated because…well, because they are human engagements. And they are every bit as much a part of traditional residential higher education as is the academic program. (LeBlanc, 2015, p. 49)

A 2010 Columbia University study commissioned by the Virginia Community College System found that Virginia community college students had poorer outcomes when they enrolled in online courses than the course's face-to-face counterpart. These outcomes included not just being more likely to fail or withdraw from the course but also being less likely to continue their education. Most students in that study also chose to augment their in-person courses with online courses rather than having an entirely online curriculum in any given semester (Columbia University, 2010, p. 24).

Massive Online-Only Courses (MOOCs) came on the scene a few years ago as a way to reduce barriers to access in higher education. While they have attracted much in the way of (well-deserved) criticism, their presence has sparked national dialogue about affordability and accessibility. The Internet has transformed the mechanisms by which information can be

transferred both to and from individuals. It has reduced the costs affiliated with that information transfer. “Higher education’s ‘affair’ with the MOOC, though now waning, has had one lasting impact. It has greatly accelerated the migration of higher education into online education” (Brown, 2015, p. 18). Coursera and edX are just two of the MOOC platforms that now are bringing lectures from leading professors at top universities to the masses by streamlining the lecture process to convey information unidirectionally to groups of students.

Having learned from the successes and failures of early distance learning and MOOCs, higher education institutions are approaching the next generation of technology-assisted learning with a greater degree of finesse. They are also considering the changing world in which students will live and work, which demands more from individuals than being able to simply parrot back the information imparted to them by lecturers in a classroom. The Columbia University report noted that “despite the potential for strong and consistent student-instructor and student-to- student interaction online, some courses may lack this component, leading to a sense of student isolation” (2010, p. 3).On the other end of the instructor attention spectrum from MOOCs, Southern New Hampshire University’s College for America is using technology to create so- called “learning relationship management” (LRM) systems. LRM systems “are built to support the various human interactions that drive learning and try to offer a 360-degree view of each student experience. These systems are built around individualized human dynamics, and technology becomes the enabler, not the shaper, of those human interactions" (LeBlanc, 2015, p. 49). Their programs, while being entirely online, offer highly individualized interactions with faculty that are organized around individual projects rather than general courses, but still culminate in recognized associate’s or bachelor’s degrees.

One way to find balance along a spectrum from paper-based, in-person courses to massive online-only courses is by modifying existing courses to incorporate the advantages of technology-enhanced geospatial and scheduling flexibility and real-time tracking of student progress alongside more in-person interactions is. Another approach is to design hybrid courses from scratch to take advantage of features from both approaches rather than attempting to shoehorn technological solutions into existing course design and delivery. In either instance, a boilerplate approach to technology-enabled learning will likely fall short of taking full advantage of the opportunities and achieving maximum benefits for learners.

Global Freshman Academy. Arizona State University has partnered with edX to deliver their Global Freshman Academy as a way to reduce the overall cost of a degree while opening up college courses to the masses by offering all of their first-year courses online. Two of the primary benefits associated with Arizona State University’s Global Freshman Academy are the decreased costs and increased flexibility for both the institution and the students. ASU intends to offer first-year courses through their partnership with edX at this reduced rate. Three courses were offered for the fall 2015 semester with the remaining courses rolling out over the next two years (Arizona State University, 2015, April 22). The university in their press release emphasized that this program would both increase flexibility and cost savings for students and permit students to begin earning college credits while still in high school. Table 3 shows a

comparison of how much a semester (4 courses) would cost through four different options at ASU. The university charges in-state and out-of-state students the same rate, making the online learning option more expensive for Arizona residents while offering significant cost savings for out-of-state students (Arizona State University 2015b). However, at only $200 per credit hour and $45 in fees per course (edX, 2015), the new Global Freshman Academy is approximately half the price of the next cheapest option, being an in-state student studying in-person in Tempe.

Table 1. Arizona State University Cost to Students per Semester by Program for fall 2015

Program and residency	Tuition per credit hour	Fees*	Total per semester (12 credits)
Global Freshman Academy	$200	$45/course	$2,580 (4 courses)
Online	$677	$97	$5,977
AZ Resident—Tempe campus	$677	$497	$5,239
Nonresident—Tempe Campus	$1,033	$337	$12,729

The Global Freshman Academy has not been without many of the same criticisms that are often levied at MOOCs. Some argue that a quality education is about more than just data transfer from instructor to student. Others make the argument that mechanisms for assessment are not yet able to determine students' readiness for further education or full knowledge assimilation. However, the former criticism could be equally levied at many of the large lecture-style courses that are typical for a first-year college experience at large institutions. The latter criticism regarding assessment mechanisms can likely only be resolved through trial and error.

Geography. Attending courses in person in pursuit of an academic degree has been an optional component in higher education since the University of London established its "International Programmes" in 1858 (University of London, 2015). As such, distance learning and education has often been considered the exception rather than the norm when compared with courses with all participants in the same geographic location. Technological advancements in recent decades have brought greater quality and variety in the realm of distance learning. These advancements mean that courses with geographically-dispersed students are not automatically asynchronous. Instead, course participants may meet synchronously using video conferencing technologies. While this has often been used for the individual benefit of students or instructors, some institutions are beginning to experiment with ways in which technology and geography can be combined to improve student experience by facilitating students' global experiences. One such approach is taking place at the Minerva Schools at Keck Graduate Institute.

Minerva Schools at Keck Graduate Institute. The Minerva Schools at Keck Graduate Institute provide a hybrid experience where students have small courses for all four years and the experience of residence-hall living in eight different major metropolitan areas around the world. This model forgoes a traditional classroom or many of the other amenities that individuals have come to expect from a brick and mortar institution. Instead, this new for-profit project connects students regardless of current location by having all courses online in small seminar-style

formats. Minerva ensures a flexible workforce by employing instructors under a three-year contract rather than through the traditional tenure system. As Minerva is still a new undertaking, some questions remain regarding whether instructors design their own courses or if the curriculum is centralized (Ison & Desai, 2014).

One of the ways in which Minerva Schools constrained costs is by not providing many of the amenities that have become typical of the residential college experience. Rather than having collegiate or intermural sports leagues, the institution encourages students to join groups in the communities in which they are located for that term. Students live together communally and utilize group kitchens in residence halls around the globe rather than using centralized dining services. These models both reduce costs for the institution and encourage students to experience the local culture. Minerva's students will spend their first year in San Francisco with subsequent years in cities such as Berlin and Barcelona. Locations in Latin America, Europe, Asia, and Africa also are planned but not announced (Minerva Schools at KGI, 2015). Minerva also constrains costs through avoiding other large capital projects such as lecture halls, academic buildings, computer labs, or physical library spaces. The functions of each of these spaces are instead covered by student-provided MacBook Pros. Access to electronic library resources are available as part of the project's partnership with the 7Cs of the Claremont Colleges Consortium.

Surprisingly, the annual cost is less than half of a comparable liberal arts institution in the same Claremont Colleges Consortium as Minerva Schools' sponsoring institution, the Keck Graduate Institute. Table 4 is a cost comparison for students between the two institutions with data taken from each institution's respective websites (Minerva Schools at KGI, 2015; Pomona College, 2015). This new project has altered many of the traditional features of the higher education experience, though only time will tell how successful these changes will be in terms of sustainability and student outcomes.

Table 2. Minerva Project and Pomona College Cost Comparison, 2015

Institution	Tuition & fees per year	Room and Board per year	Total Cost
Minerva Schools @ KGI	$11,950	$16,000	$27,950
Pomona College	$47,280	$15,490	$62,770
*Minerva Project and Pomona College are both part of the Claremont Colleges Consortium			

Time. "Time" takes into account the degree to which courses happen in real time with all members of a course participating at the same time. In a traditional lecture-style course, knowledge transfer in the form of lectures take place in a synchronous format in which all members of a course are in attendance at the same time such that information is transmitted and received at the same time. What is traditionally thought of as "homework" in which the knowledge gained in the lecture is applied occurs outside of this time period as scheduled by the student. In a flipped classroom setting, "what was once class time (listen to the lecture) is now homework and what was once homework (solve the problem) is now class time" (Valenti, 2015, p. 34). Some courses are designed to have very little activity outside of the person-to-person interactions while others take place entirely asynchronously. Technology has both increased the

ability of classes to exchange information asynchronously while also improving their ability to have synchronous communication that does not take place in the same physical space.

Geography and time considerations emerge as separate but related areas in one of the more macro approaches taken by Stanford University's Institute of Design ("d.school") in imagining higher education differently. The d.school's big thinkers have envisioned a university setting consisting of what they term "in-loops" and "out-loops" over a lifetime rather than four-year period of time in which students will oscillate between time spent on campus and time spent elsewhere. Their "Open Loop University" idea includes six years of coursework time spread out over a lifetime of broader experiences to give opportunities for the knowledge and skills learned in the classroom to be practiced and applied outside of the classroom followed by taking the experiences from outside of academia and applying them in later courses (Stanford2025, 2014). However, there are currently pushes in the higher education discourse to reduce time to degree completion, which would be hindered by this lengthened degree process. Competency-based learning, such as with the programs mentioned in the purpose section, could offer ways to recognize and reward students for skills learned outside of the classroom (Zalaznick, 2014).

Instructor attention. Even in the age of technology, the level of instructor attention on an individual learner can vary from one-to-one attention to one-to-ten thousand attention. As institutions feel increasing pressures to do more work with fewer resources, class sizes may increase, and faculty employment models are changing. Fortunately, large classes have many new opportunities for engagement with the material beyond a lecture-style transmission of information from one speaker to many audience members. However, new engagement opportunities that may exist between professors and their students can only be realized with the right level of institutional support and available resources, including time. Regardless of the amount and type of technological innovations, professors are still restricted in the number of hours available to spend in consultation with students. This becomes especially problematic when individual course sizes increase but are taught by adjuncts with increased course loads, which doubly reduces the amount of time available to give to students.

Two related solutions are project-based learning, through "Signature Work," or competency-based education as discussed in the *Purpose* section. Project-based learning emphasizes individualized work and feedback from mentors rather than lectures and standardized tests from instructors. In a virtual world, these interactions are handled through a Learning Relationship Management (LRM) system. Such work could also be guided through small seminars with separate one-on-one meetings with professors in the physical world.

Student Quality of Life

Beyond the classroom-oriented learning environment, an additional component to keep in mind with the campus of the future is designing a campus that maintains and improves students' quality of life. The *2014 Gallup-Purdue Index Report* highlighted five areas of well-being that extend beyond the immediate workplace or the classroom to influence a more holistic sense of

self and well-being: purpose, social, financial, community, and physical well-being (p. 4). In their survey of more than 30,000 US college graduates, Gallup and Purdue University discovered that the relative prestige of an institution mattered less in terms of its influence on an individual's overall sense of well-being than perceptions of support and experiential learning while at their alma mater. Supportive relationships were primarily described in terms of individual relationships with professors and/or mentors. Experiential learning could include projects taking a semester or longer to complete, internships or jobs to directly apply material learned in the classroom, and engagement in extracurricular activities and organizations (Gallup & Purdue University, 2014, p. 14). Many of these interpersonal relationships and applied learning opportunities involve engagement outside of courses and can be more difficult for courses that do not have periods of face-to-face interaction time, which should be taken into consideration when evaluating alternative course designs and delivery systems.

Directly referencing these findings, the Virginia Tech Student Experience Task Force (2015) recommended that the university focus efforts on creating a "'campus commons initiative' that would "establish multiple hubs of energy and engagement" (p. 7). This would integrate intentional congregating spaces across the university to ensure that all parts of the campus have areas for encouraging the development of interpersonal relationships that will enrich the learning experience and students' lives far beyond their college years.

Physical Infrastructure Considerations

Technology. LeBlanc (2015) notes that "even if technology will not soon replace people, it seems poised to dramatically redefine roles and to change the nature of faculty/staff work" (p. 48). In order to remain relevant as even a campus of today, much less of tomorrow, institutions of higher education feel pressure to continue to make investments in their telecommunications infrastructure, computing systems, and other forms of research technologies. Allocating funds to meet today's needs will result in a continual race to keep up with increasing standards, while investing in infrastructure with the elasticity to adapt to new circumstances with only incremental additional investments and upgrades will result in a more nimble institution.

The past 10 years have seen an explosion in the demand for networking, and the infrastructure necessary to enable it has struggled to keep up with that demand. University communities have been affected doubly with increasing pressure on the research side for computing power to support the rise of "big data" and heavier loads on campus networks as a result of the use of multiple personal devices all requiring internet access by growing percentages of the university population. Virginia Tech has not been immune to this push for faster speeds and greater capacity, and has been involved in local, regional, and national dialogue and efforts geared towards improving connectivity at all levels.

Technology that was "cutting-edge" is middle of the pack five years later and considered obsolete after 10 years. Case in point was Virginia Tech's System X supercomputer, ranked #3 in the world when it debuted in 2003 and decommissioned by 2012. Since 2009, Virginia Tech has added five more high-performance computing systems (supercomputers) to its Advanced

Research Computing program to support Big Data processing: Ithaca in 2009, HokieSpeed and HokieOne in 2012, Blue Ridge in 2013, and NewRiver (released in August 2015). The need for high-speed, high-capacity data processing is only likely to increase in the future as researchers continue to and begin to use Big Data in their research in an increasing variety of fields.

Alongside of and supporting its supercomputing abilities, the university has required continuous re-investment in telecommunications infrastructure to meet increasing data needs from all members of the university. Virginia Tech has been a leader in meeting these infrastructure needs beyond the campus borders with its efforts in Gig.U and the Mid-Atlantic Research Infrastructure Alliance (MARIA). Gig.U is a nationwide effort among more than 30 colleges and their surrounding communities to improve connectivity both on and off-campus that emerged from the original Google Fiber competition by communities to attract gigabit internet service by Google to their communities. These institutions recognize that the importance of high- quality, affordable internet access does not end when faculty, staff, and students leave campus and has significant implications for both "economic growth and educational innovation" (Levin & Linn 2015, p. 5). MARIA is comprised of seven higher education research institutions in Virginia: The College of William & Mary, George Mason University, James Madison University, Old Dominion University, The University of Virginia, Virginia Commonwealth University, and Virginia Tech. Virginia Tech provides operations support for the network, which ensures that participating institutions have access to high-speed, high-capacity connectivity to major internet exchange locations in Atlanta and Northern Virginia (MARIA). As of April 2015, MARIA is providing 100 gigabits per second connectivity for these institutions to connect with a major interconnection point of the Internet with the Internet2 Network (MARIA, Inc., 2015). The infrastructure used to provide this connectivity has room to increase its speed and capacity in the future as the need for higher speeds and higher capacity continues to grow.

Transportation. Transportation remains a pivotal part of institutions with a physical presence. Whether a campus is fully or partially integrated into its surrounding community, mechanisms are needed to ensure that faculty, staff, and students can easily get to and around campus. Depending on geography and the particulars of a university community, these mechanisms may include public transit, parking services, bicycle-friendly paths, and designs that encourages pedestrian usage. If the composition or geo-location of a university community shifts, then the transportation needs and opportunities of that community may also shift. As a result, the potential impact of planned changes on transportation should be included in future planning. Conversely, if a community has particular desires for its future transportation systems, reducing automobile traffic to campus and the demand for on-campus parking facilities is one example, then considering options that would enable that desire to become a reality is important.

On a broader scale, as universities strive to become more global in their focus, improved mass transit options become necessary to connect more-isolated university settings to the national and international communities. For members of the Virginia Tech Blacksburg community and its visitors, convenient direct connection between campus and major global hubs

is minimal. The combination of travel time to Roanoke-Blacksburg Regional Airport and limited direct flights at the airport can make regular travel to non-East Coast cities difficult to the extent where many members of the community travel 3-5 hours by car to fly out of the Charlotte or DC-area airports. Martin (2009) notes that major employers, in addition to chambers of commerce and economic development agencies "are the principal driver[s] of air service demand in the area" (p.28). In addition to driving air service demand via the need for business-related travel by current leaders and employees, large public universities can also increase air travel demand in a region as they form relationships with international faculty, recruit more non-regional students, and encourage on-campus students to gain new experiences around the globe.

Energy. A side effect of the increasing reliance on technology is an increased reliance and demands for electrical power. However, one of the findings from the 2013 Virginia Tech Presidential Search was a desire for increased environmental sustainability, including a decreased reliance on coal as the main source of electricity on campus. Research institutions like Virginia Tech are ideally positioned to be at the forefront of experimentation with, and full implementation of, alternative energy sources. The Center for Energy and the Global Environment is one example, and the university was also awarded a $1.25 million five-year contract to operate a Smart Grid Information Clearinghouse website in 2009 (Micale, 2009). Yet, the implementation of this research to the campus setting and beyond appears to still be experimental rather than widespread. Looking to the future, becoming energy independent would not only showcase Virginia Tech's research and innovations but also would reduce its environmental impact and expenses related to power consumption. Institutions such as Drexel University have begun implementing "smart campus" projects as part of larger community efforts to deploy smart grid technologies. While the Drexel project was funding largely by a Department of Energy grant as part of the 2009 Recovery Act programs, a 2014 Electric Power Research Institute case study explores the results of this project with an eye towards learning opportunities for other campuses (p.9).

Buildings. *University Business* recently completed its annual survey of campus construction and found that "despite the economic and demographic factors that indicate challenging times ahead for higher ed, campuses across the country are busy building" (Papandria, 2015). A consideration of the type of campus it wants to be in the future should be made before Virginia Tech invests in the construction of new facilities. Brown (2015) notes that "the built environment is particularly conspicuous, both because of its cost and because it physically affords certain kinds of usage while discouraging others" (p. 24). Continuing to construct buildings filled with lecture halls may be short sighted as the notion of a "flipped classroom" gains prominence. Similarly, constructing buildings with a single purpose, even if that purpose is in supporting smaller breakout groups in keeping with the flipped classroom approach, may be unnecessarily limiting compared to designing flexible spaces that can be adapted to meet changing student demands. The Virginia Tech Student Experience Task Force

(2015) noted that "over time, older buildings accumulate deferred maintenance and become outdated while state-of-the-art facilities are constructed" (p. 5).

The Student Experience Task Force (2015) found that as a result of inflexible design and construction of facilities on campus, "the useful programmatic life of a building is often much shorter than the physical life of a building" (p. 5). Monahan (2002) describes five facets of design that affect spatial flexibility: fluidity, versatility, convertibility, scalability, and modifiability. Including these facets in current and future construction planning may reduce the need for ground-up construction in the future as existing buildings will be easier to retrofit and adapt them to new needs.

Beyond the classroom, the campus of the future may look very different in terms of the traditional residential experience and meeting student needs. As discussed above, shifts are emerging in who is pursuing post-secondary degrees and what needs those individuals will have. If more individuals do not fit the mold of the traditional college student, then student affairs and facilities designed to house and meet the needs of these students will change. Fabris (2011) noted that the majority of college dorms, built in the post-war and baby boomer era of the 1960's and 1970's, already do not meet the needs of today's students who are looking for a place to socialize and learn via co-curricular activities in addition to the traditional requirements of studying and sleeping.

Capital Funding. Schools increasingly appear to be looking at ways to improve the residential experience for students while defraying the costs associated with the construction of new residence halls. For some institutions, this has been accomplished by creating more multi-functional spaces. At the University of Colorado, Pueblo, three new residence halls have classroom space on the bottom floor that can be converted from larger meeting areas to small group rooms (Fabris, 2011). University of Michigan's Munger Graduate Residences are another example of multi-functional space that were designed with a "trans-disciplinary vision." The vision for MGR includes bringing together graduate students from disparate disciplines in an eco-friendly communal setting that includes on-site study spaces, convenience store, music practice space, and on-site fitness center. Universities have chosen various ways of funding these sorts of capital projects, with traditional funding coming from their debt capacity, state appropriations, or generous donors. The construction of the MGR was funded with a generous donation from a University of Michigan alum (University of Michigan, 2015).

Other universities have looked towards external funding sources and partners to address the issue of student housing. Savas (2000) noted that there are three primary types of privatization: delegation, divestment, and displacement. Public-private ventures (PPV, sometimes referred to as public-private partnerships, or P3s) are just one type of delegation that a public agency can undertake to utilize private sector actors to deliver goods and services while still maintaining oversight. Stephens studied this phenomena in her 2013 dissertation examining PPVs for the construction of student housing at Georgia Tech. In her work, she found that individuals involved in these PPVs encountered a "triangle of pressures" in regard to balancing control, responsibility, and oversight for the projects that can make successful implementation of

such partnerships problematic (Stephens, 2013, p. 111). The proper management of these pressures will be important if universities are to continue to use PPVs in the future to reduce dependence on state revenues and debt financing.

Among other entities embarking on relationships across the public-private divide, Arizona State University recently created a partnership with Capstone Management to lease land in return for the creation of new living quarters for students. On the private sector side, the success of American Campus Communities, self-described as "the nation's largest developer, owner and manager of high-quality student housing communities," indicates that public-private partnerships can be lucrative for private partners. The company has completed nearly 100 housing projects across the country with over 220,000 student beds total and has partnered with Arizona State University, Drexel University, University of California-Irvine, and Cleveland State University, among others (American Campus Communities, 2015).

Conclusion

Considering Virginia Tech's campus of the future brings with it many challenges and difficult questions. The definition of "campus" will be largely determined upon how we envision the learning environment of the future. We must consider the following:

- What is the purpose of a Virginia Tech education?
- What role does technology play in shaping the classroom and workspaces?
- Where will Virginia Tech students be located?
- Will classes occur in real time and where?
- How will members of the Virginia Tech community interact with one another?
- How will instructors interact with their students?
- What will the professor's role be in facilitating students' learning processes?

The answers to these and other questions have very real impacts on campus, in surrounding communities in the New River Valley, and in the Commonwealth of Virginia. Additionally, there will be shifts in the types of physical infrastructure the university will need to build and support in the future. Decisions made about the learning environment will affect such broad-reaching areas as housing, transportation infrastructure, regional development, energy consumption, and capital construction planning. A number of other institutions are beginning to experiment with various approaches to addressing tomorrow's issues, and Virginia Tech can take this opportunity to learn from the successes and failures of these institutions.

References

American Campus Communities. (2015). *Case studies*. Retrieved from http://www.americancampus.com/services/case-studies

Arizona State University. (2015, April 22). *ASU, edX reimagine first year of college*. Retrieved from https://asunews.asu.edu/20150422-asu-edx-online-course-partnership

Arizona State University. (2015b). *Tuition and fees.* Retrieved from https://students.asu.edu/tuitionandfees

Association of American Colleges and Universities. (2007). *College learning for the new global century: A report from the National Leadership Council for Liberal Education & America's Promise*. Retrieved from https://www.acu.org/sites/default/files/files/LEAP/GlobalCentury_final.pdf

Brown, M. (June 2015). Six trajectories for digital technology in higher education. *EDUCAUSE Review.* Retrieved from http://er.educause.edu/articles/2015/6/six-trajectories-for-digital-technology-in-higher-education

Carnevale, A.P., Smith, N. & Strohl, J. (June 2013). *Recovery: Job growth and education requirements through 2020: State report.* Georgetown University, Georgetown Public Policy Institute: Center on Education and the Workforce. Retrieved from https://cew.georgetown.edu/wp-content/uploads/StateProjections_6.1.15_agc_v2.pdf

College for America. (2015). *Meet the coaches and reviewers*. Retrieved from http://collegeforamerica.org/for-working-adults/learning-and-development-coaches-and-reviewers/

Columbia University. (2010). *Online learning in the Virginia Community College System.* Retrieved from http://ccrc.tc.columbia.edu/media/k2/attachments/online-learning-virginia.pdf

edX. (2015). *Start learning with Global Freshman Academy*. Retrieved from https://www.edx.org/gfa

Electric Power Research Institute. (May 2014). *A case study on Drexel Smart Campus Project: EPRI Smart Grid Demonstration Initiative.* Retrieved from http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002002131

Fabris, P. (2011). Major trends in university residence halls. *Building Design and Construction*. Retrieved from http://www.bdcnetwork.com/major-trends-university-residence-halls

Gallup, & Purdue University. (May 2014). *Great jobs great lives: The 2014 Gallup-Purdue Index report.* Retrieved from http://www.gallup. com/services/176768/2014-gallup-purdue-index-report.aspx

Ison, L., & Desai, S. (2014, October 31). *A virtual connection: Minerva Schools at KGI strengthens 7C partnership.* Retrieved from http://www.tsl.pomona.edu/articles/2014/10/31/news/5673-a-virtual-connection-minerva-schools-at-kgi-strengthens-7c-partnership

LeBlanc, P. (March 2015). The human-technology intersection: A framework. *EDUCAUSE Review*. Retrieved from http://er.educause.edu/articles/2015/3/the-humantechnology-intersection-a-framework

Levin, B., & Linn, D. (July 2015). *The next generation network connectivity handbook: A guide for community leaders seeking affordable, abundant bandwidth.* Retrieved from: http://www.gig-u.org/cms/assets/uploads/2015/07/Val-NexGen_design_7.9_v2.pdf

MARIA, Inc. (April 2015). Virginia research universities make the leap to 100 gigabits per second. Retrieved from http://www.marialliance.net/news

Martin, S.C. (2009). *Passenger air service development techniques.* (Airport Cooperative Research Program Report 18). Washington, DC: Transportation Research Board. Retrieved from http://www.nap.edu/read/14309

Micale, B.L. (2009, October 27). $1.25 million grant to take lead on Smart Grid Information Clearinghouse Web portal awarded to Virginia Tech. Retrieved from http://www.vtnews.vt.edu/articles/2009/10/2009-801.html

Minerva Schools at Keck Graduate Institute. (2015). *Frequently asked questions.* Retrieved from https://www.minerva.kgi.edu/application/faq/

Monahan, T. (2002). Flexible space & built pedagogy: Emerging IT embodiments. *Inventio* 4(1): 1-19. Retrieved from http://publicsurveillance.com/papers/Inventio.html

Papandria, D. (July 2015). UB's annual construction report: Behind the action on campus construction. *Building a better college campus.* Retrieved from http://www.universitybusiness.com/article/building-better-college-campus

Pomona College. (2015). *Tuition and costs*. Retrieved from https://www.pomona.edu/financial-aid/cost

Savas, E.S. (2000). *Privatization and public-private partnerships.* New York: Chatham House Publishers.

Spohrer, J. (2013). *What's UP at IBM? University programs!* [Powerpoint slides]. Retrieved from http://www.slideshare.net/spohrer/t-shaped-people-20130628-v5

Stanford2025. (2014). *Open Loop University*. Retrieved from http://www.stanford2025.com/open-loop-university

Stephens, J.H. (2013). *Public-private ventures in Georgia's public higher education: A case study of the Georgia Institute of Technology and its use of different financial models for three housing facilities* (Doctoral dissertation). Retrieved from https://getd.libs.uga.edu/pdfs/stephens_jennifer_h_201312_phd.pdf

Twombly, R.C. (1987). *Frank Lloyd Wright: His life and his architecture.* (6th edition). New York: John Wiley & Sons, Inc.

University of London. (2015). *International programmes: Our history.* Retrieved from http://www.londoninternational.ac.uk/our-global-reputation/our-history

University of Michigan. (2015). *Munger Graduate Residences.* Retrieved from http://mungerresidences.org/

University of Wisconsin System. (2015). *UW flexible option: Tuition & financial aid.* Retrieved from http://flex.wisconsin.edu/getting-started/tuition-financial-aid/

Valenti, M.S. (June 2015). Beyond active learning: Transformation of the learning space. *EDUCAUSE Review*. Retrieved from http://er.educause.edu/articles/2015/6/beyond- active-learning-transformation-of-the-learning-space

Virginia Tech. The Virginia Tech Student Experience Task Force (January 2015). *The Virginia Tech student experience: Virginia Tech's next 20 years*. Retrieved from http://www.provost.vt.edu/student-experience/report.pdf

Western Governors University. (2015). *About our students*. Retrieved from http://www.wgu.edu/about_WGU/students_alumni

Zalaznick, M. (April 2014). How flat-rate tuition models are being used to better serve nontraditional students. *University Business* Retrieved from: http://www.universitybusiness.com/article/all-you-can-learn-tuition-takes