Campus of the Future

University Principles

Virginia Tech in the future will combine its land-grant legacy with 21st century opportunity to uphold its motto of Ut Prosim (That I may serve) through hands-on, minds-on experiential learning. With this combination, the university will translate research into innovative solutions to global problems.

The university will maintain both global and local presence and focus with urban and rural footprints to form a tightly-coupled system of non-collocated campuses, or binary stars. The university of the future will be made up of multiple binary star systems, and Virginia Tech will use those centers of mass to continue connecting with others.

The campus of the future will be designed in such a way as to encourage the development of VT-shaped individuals. The university will continue to develop disciplinary depth in its students while also focusing on broad-based skills, such as communications and critical thinking, along with an emphasis on service. It will holistically incorporate both diversity and inclusivity with an emphasis on equity of access.

**DESIGN CHARACTERISTICS include spaces and places that:**

1) Ensure flexibility to change within fixed situations.
   - a) Represent a continuum of spaces that foster collaboration, both in person and through the use of technology, as well as including spaces that allow quiet, focus, and privacy.

2) Are adaptable with the ability to change over time and respond to new situations
   - a) Include autonomous systems and smart rooms that adapt to users.

3) Encourage Creativity.

4) Are connected, both physically (inter- and intra-site/campus) and with an improved physical and virtual presence for a distributed campus/global environment.

5) Create communities of people with a common set of interests; fuse intellectual life with co-curricular life that encompasses a whole community and not only students.

6) Highlight some aspects of the university community, infrastructure, and environment will stay quite the same while others will change dramatically. A variety of forms of infrastructure will accommodate these aspects of campus life in some cases and, in other cases, drive them.
**Trends**

*Technology*

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. Technology that was “cutting-edge” is middle of the pack five years later and considered obsolete after 10 years. 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.

*Globalization*

A global education should provide domestic and international students with distinctive and transformative opportunities that will prepare them for a globalized world. Although many students can gain global skills in a domestic setting, genuine international experiences are increasingly of value. In addition, a growing number of international students are seeking an education at American universities and posing challenges related to the evaluation of candidates, the preparation of newly admitted students, and the integration of international students on campus. To address these challenges, universities need to collaborate and compete globally for the brightest minds, the highest standards in research and education, and the best solutions to the world’s problems. Success requires a “globalized campus” that facilitates global engagements through a flexible global presences that can range from study abroad programs conducted in collaboration with international partners to extensive and permanent international campuses.

*Student Populations*

As Virginia Tech looks towards its 175th anniversary, questions regarding what kind of student body it intends to serve must be answered. At present, the university is serving an almost-exclusively “traditional” student body, which is typical of many residential colleges and of its peer institutions. The university will almost certainly continue to recruit and be attractive to this population, which is likely to grow in the future based on current Census projections. There are also opportunities to expand its role as the “people’s university” to educate more of the non-traditional student populations as part of its land-grant mission. Future decisions and priorities for the university will be based on the student population Virginia Tech wants to attract and educate as different types of students will require different forms of support.

*Transportation*

Understanding the transportation needs of both the campus and the broader community is an
important component of planning the campus of the future. Transportation needs will vary depending on where students and faculty/staff live in relation to our campuses, but a future presence in Blacksburg will require careful planning of local, regional, and broader transportation. Beyond local transportation needs, convenient and affordable mass transit mechanisms for connecting the campus with the larger region and locations around the globe, such as through passenger rail and air travel, are needed. If a region is cut off from the broader world because of a lack of ability to travel to and from the region, the growth of new firms and relocation of existing ones to the area are unlikely. The firms that do develop in the region will likely relocate as the need for interconnection with individuals and markets elsewhere grows.

**THEREFORE, WE ENVISION THAT THE CAMPUS OF THE FUTURE WILL**

1. Support human to human interaction across a spectrum of environments: natural, built, and virtual to promote innovation through “productive collisions.”
2. Remain flexible in its approach to curriculum, infrastructure, and technology to promote individuality while encouraging community through multi-disciplinary, multi-generational, and multicultural engagement.
3. Be comprised of complex heterogeneous networks and innovation districts facilitated by technology.
4. Be sustainable.
5. Be global.
6. Be adaptable in the future by undertaking iterative reflections on behaviors. Design by its nature is iterative.

**Transformative Platforms**

The Campus of the Future working group has created three transformative platforms that members envision as being part of the university in 2047: Innovation Hubs, Human Centered Smart Environments, and Global Engagement Hubs. The three platforms have areas of overlap in that all three are aligned with the university principles and vision articulated above and structured according to the design characteristics. In short, Innovation Hubs are spaces on the core university campus where individuals are organized around areas of mutual concern. Human-Centered Smart Environments focus on the types of learning and research that take place with an emphasis for the hands-on, minds-on learning approach. Global Engagement Hubs are focused external to the core university and intended to be created to solve complex problems of public concern in keeping with Virginia Tech’s land-grant mission. Each platform is discussed in more detail in the following sections.

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1 The group is closing in on using this nomenclature, but terms have not yet been finalized.
Innovation Hubs

**Group members:** Tim Baird, Juan de la Rosa Diaz, Anne Khademian, Frank Shushok, Jason Soileau, Robert Sumichrast

We reimagine the infrastructure and design of the campus of the future as integrating the currently segregated academic, living, recreation, innovation, and even business and industry zones into **Innovation Hubs** formed around thematic areas of global or societal importance. These hubs will establish relatively discrete spatial arrangements comprised of residential, dining, academic, research, commons, business (e.g., start-ups), and administration. These spaces, which may be housed in a single building or small group of buildings, are meant to contrast with, and supplement, silo-ed approaches to distributing these campus or societal functions. Hubs will exist in the various university campuses and locations, including the main campus in Blacksburg, VTCRI in Roanoke, and the National Capital Region. Hub members will include students, faculty, staff, administrators, and local residents. These groups will bring disciplinary depth in the natural, physical, and social sciences, the humanities, art & design, policy, business and wellbeing. See the Appendix for a visual depiction of the interactions between disciplines and sectors that would result in thematically-oriented Innovation Hubs.

Shared spaces and physical proximity increase the likelihood of serendipitous and productive intellectual collisions across disciplines and between colleagues. Hubs are intended to: (1) connect discrete, disciplinary campus units; (2) to experiment with novel collaborations, perspectives and expertise; (3) to address the most pressing social, economic, and environmental challenges at local to global scales; (4) to be disruptive; (5) to be modular; (6) to be continually self-reflective and adaptive; and (7) to be temporary.

The physical space will incorporate autonomous systems at the scales that range from clothing and furniture to the building to the surrounding landscape. The systems will assist hub members with multiple ways which include supporting wellness, collaboration, solitude, inspiration, and disruption. These systems will be informed by the latest research in neuroscience, organizational psychology, architecture, and human/computer interactions. Technology will be an integral part of the Innovation Hub model to ensure connectivity with all hub members, regardless of whether they always inhabit the same physical spaces. Tools and spaces will be diverse in terms of both their form and function.

The campus of the future will be a *reflexive living lab* space where knowledge of the practices, processes and circumstances that generate creativity, learning, innovation, advancement, and more are purposefully and rigorously part of the campus experience. Innovation hubs will serve as experiments and will therefore vary from each other in form and method. All members will have formal training in communication and interdisciplinarity. In addition to these actors, each

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2 Some have referred to these spaces “Creativity and Innovation Districts” or “Innovation Neighborhoods.”
hub will have permanent assessment personnel that will monitor and evaluate their mission, strategy and efficacy. Continual, comparative assessment of structure, processes and outcomes will highlight strengths and weaknesses, challenges and opportunities. The campus of the future as living lab is a continuously reflexive space of examination and research of the capacity and components and qualities of the creative process: the dynamics, organization, interaction with technology and space, relationships, diversity of knowledge and social experience, and more. Innovation Hubs would be part of a reflexive effort to understand the raw and advanced components of innovation that leads to actual impact and problem solving.

Aspects of this vision are already taking shape at Virginia Tech and elsewhere. ICAT, Living and Learning communities, research centers, incubators, and other groups are bringing many of these pieces together, providing a foundation upon which future spaces can learn and grow.
Human-Centered Smart Environments

Group members: Kathryn Albright, Judy Alford, Bob Broyden, Jaime Camelio, Ben Knapp

The campus of the future will emphasize hands-on, minds-on learning through translational engagements in Human-Centered Smart Environments (HCSEs). Simulation, virtual reality, and technology will underlie these environments. Simulations will take a variety of forms ranging from the more traditional, practical application in a safe environment of materials learned to technology-enabled virtual/augmented reality environments. The spectrum of engagements goes beyond simulations and can refer to any human involvement in a process.

The university’s present smart environments are in high demand from students, which demonstrates a successful proof of concept. Having the successful proof of concept should incentivize the university to devote additional resources to these types of environments and these approaches to learning and engagement and to support these faculty and their activities at a university-wide level. Currently, most smart environments, such as the Cube and the VT Visionarium, are controlled at the individual faculty or department level, and they are not equally spread across the university. As translational engagements spread in this studio-based approach to learning, faculty and instructors from across, the university needs to be willing to think creatively about how they can create the most engaging environments and what the benefits will be for their students. HCSEs have immense under-utilized potential applications in the humanities fields as they can enable remote historical site exploration, anthropological observations, and language immersions for students in richer ways and at earlier stages of their academic career than are widely available at present.

Subject-Matter Expertise

Translational engagements, and smart environments as one way to achieve these engagements, will exist along a spectrum. At one end of the spectrum is the domain-centric subject expertise while the other end of the spectrum is highly applied and incorporates multiple fields of study. For example, the core principles of physics (“fundamental arts”) lie at one extreme while applying those principles to creating a spacecraft are at the other extreme of practical application of fundamentals and merge disciplines such as computer science, engineering, materials science, and management, among others.

Subject-Matter Expertise in Translational Engagements

<table>
<thead>
<tr>
<th>Fundamental Arts</th>
<th>Applied Fields</th>
<th>Applied Use</th>
</tr>
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<tbody>
<tr>
<td>Physics</td>
<td>Art</td>
<td>Drafting &amp; Design</td>
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Role and Use of Technology

Human-Centered Smart Environments depend heavily on the role and use of technology. Technology may be utilized in terms of creating non-immersive, computer-simulated environments, as with the Biocomplexity Institute’s synthetic platforms, or certain applications or to create fully-immersive simulated realities, such as with the Cube. In between the two extremes are hybrid physical-virtual simulated spaces. The diagram below illustrates this spectrum.

Technology in Human-Centered Smart Environment Spectrum

<table>
<thead>
<tr>
<th>Purely computer-simulated</th>
<th>Hybrid</th>
<th>Purely Immersive</th>
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<tbody>
<tr>
<td>Bi’s Synthetic Platforms</td>
<td></td>
<td>VT Visionarium</td>
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<tr>
<td>Cockpit Simulators</td>
<td></td>
<td>The Cube</td>
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<td>Stock Trading Floor Simulator</td>
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As another example, medical professionals previously learned anatomy in part by sketching parts of the body and practiced procedures on cadavers. Learning anatomy can now be enhanced through the use of simulation tables that allow for exploration and learning without the use of cadavers at these early stages of exploration. As surgeons learn, they can progress through surgical simulations of increasing complexity and responsivity before taking a “final exam” on a real human body. The HCSE not only allows individuals to fail/repeat in a safe environment that is less resource intensive but can also enable surgeons to more quickly generate muscle memory necessary for intricate procedures, resulting in better outcomes.

Need for Faculty at all Points of the Spectrum

The university and campus of the future need faculty who exist at points all along these continua/spectra. Having 3D printing does not negate the need for clay modeling, nor does wanting to create a spaceship negate the need for theoretical physics. At each point along the way, faculty need to be able to translate the activities of those on the spectrum a step to the right of them for those at a step to the left of them, and vice versa. One critique of the current university is that we do not have balanced representation spectrums. We need more translators to ensure that the fundamentals can be taken forward into an applied setting and that applied activities remain grounded in the fundamentals of each of the component fields for that activity.
Global Engagement Hubs

Group members: James Harder, Aki Ishida, Gail McMillan, Rolf Mueller, Sanjay Raman, Ayesha Yousafzai

The campus of the future will not be limited to Blacksburg, or even Virginia, but will be projected globally through a network of Global Engagement Hubs (GEHs) that will be distributed around the world. The experience and information gained outside will also be projected back to the university community in Blacksburg.

The GEHs will not follow a "one size fits all" model, but will be selected from a range of options to suit the needs of the any particular international engagement. On the time scale, GEHs will be designed to fit engagements that range from weeks, a few years, to unlimited time spans. GEHs designed for short time spans will support short-term research engagements, for example in the wake of a natural or man-made disaster. To make such engagements possible, a flexible infrastructure will be developed, e.g., based on modular mobile laboratories, that will allow Virginia Tech to be on the forefront of providing research-support for crises around the world. On the other end of these continua will be permanent “brick-and-mortar” GEHs designed to support the establishment of highly reputed programs for education, research, development of faculty talent, and economic development in key global locations where there is a demand and a business case for such programs. Temporary GEHs would also be deployed as an initial testing phase ahead of the establishment of a “brick-and-mortar” GEH. Temporary and permanent GEHs should likewise have a carefully designed physical presence that can convey Virginia Tech’s identity, culture, and values. The Shandong University - Virginia Tech International Laboratory in China is an example of a joint venture that has started from a research collaboration, established a small but highly recognizable physical presence and a collaborative education program and is now on the verge of expanding into a comprehensive joint venture on a new university campus under construction in China.

To be successful, the GEHs do not only require a physical infrastructure (mobile or permanent), but also a local network of support. The larger the scale of the GEH (in time and in size), the more critical this network will be. Each GEH will be supported by a local business case, i.e., there are local partners that see value in Virginia Tech’s presence and are willing to provide the resources for the establishment and operation of the GEH. To build this partner network, the campus of the future will reach out to Virginia Tech alumni as aggressively around the world as it does in Virginia. Alumni’s local connections and reputation will help the establishment of the GEHs, and the GEHs will in turn help to keep international alumni engaged. The architecture department’s Chicago Studio is an existing program in which alumni connections are leveraged for teaching, professional office experience, and resources for classrooms and housing while students study and work in Chicago.
Linking the GEHs to each other and the Blacksburg campus will benefit from improved telepresence solutions and the GEH network should adopt the best available telepresence solutions as quickly as possible. However, to be successful, the GEH network and the Blacksburg campus of the future should be set up to facilitate and encourage mobility of students, faculty and staff, e.g., by providing housing for “floaters.”

Virtual reality and digital representation/fabrication technology will be used to establish “Global Perspective Windows” on the Blacksburg Campus and on the GEHs, i.e., data streams (audio, video, 3-D) will be shared across the GEH network and displayed (time-shifted as needed) at each hub (incl. Blacksburg) in highly-frequented public spaces to give students, faculty, staff, and visitors at each place a global perspective. From the work of the GEHs will come a circulation of knowledge for which the university library will take responsibility. The challenges, processes, progress, and conclusions will be widely and openly communicated and broadcast through the university library which will publish and market it in new ways so that timely developments can be known and built upon by anyone who chooses. There will be opportunities to publicly review and comment pre and post conclusions.
Appendix

Visual Depictions of Campus of the Future Concepts

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3 Nomenclature is not finalized at this time.
Physical spaces will be created on campus that facilitate collaboration in a multi-disciplinary and multi-generational manner. By providing engaging environments which are flexible and multi-functional environments, diversity will be powered with technology to create a dynamic campus community geared toward developing creative strategies to overcome real world problems.

Within Creativity and Innovation Districts, strategically oriented Innovation Hubs will be established to provide students with the opportunity to work in an engaging and cross-disciplinary manner on a specific “big issue” of the day. Innovation Hubs will be experimental by design, with assessment and adjustment built into the process on a continuing basis. These spaces will provide a safe environment where students are allowed to fail with the level of complexity and engagement increasing relative to the distance from the Blacksburg campus.
Virginia Tech will seek opportunities to create Innovation Hubs regionally, nationally, and globally to maximize opportunities to impact “big issues” of the day within the context of a global environment. This will require the development and access to processes and policies which will allow Virginia Tech to respond to issues in a nimble and expedient manner via temporary mobilization of equipment and people.

Virginia Tech will seek to expand technology that provides opportunities for high quality simulation and communication across all locations. These simulation precincts will provide virtual environments which allow participants to “fail miserably” without negative consequences.