ENVIRONMENTAL SCAN

Analysis of environmental characteristics identified by college stakeholders, trajectories, and likely implications: Building a foundation for Pamplin's 2019-2024 Strategic Plan

Abstract

Stakeholder input highlights a number of continuing and emerging characteristics of the environment that make up the world in which we live, work, and learn. The goal of the environmental scan is to identify a comprehensive set of the most critical factors likely to impact Virginia Tech, our students, and the business community during period covered by the next strategic plan and beyond. This document begins the process of defining these influencing factors and understanding the implications of these expected influences in our environment.

Carlson, Kevin
Associate Dean for Research and Faculty Affairs
kevinc@vt.edu

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INTRODUCTION

As the first step in our strategic planning process, we sought input from a wide range of college stakeholders to identify environmental forces likely to influence the Pamplin College in the years ahead. We distributed an environmental scan survey to more than 700 stakeholders, including Pamplin administrators, faculty, key student leaders, Pamplin Advisory Board members, and representatives of employers who hire Pamplin graduates. From that survey we received 230 individual responses with 623 unique comments. The content of these comments highlights a number of continuing and emerging characteristics of the world in which we live, work, and learn.

An objective of the environmental scan is to identify a comprehensive set of the most critical factors likely to impact Virginia Tech, our students, and the business community during the period covered by the next strategic plan (2019-2024) and beyond. This document begins the process of defining these influencing factors and understanding the implications of these expected influences in our environment.

Based on a review of the comments, we have identified a set of 38 issues that we believe emerge from the data. For each of these issues, we have constructed a narrative that defines the issue and we provide an assessment its expected trajectory (increasing, decreasing, or how it might be expected to change). Then for each issue, we identify how that issue might impact the college. For each issue, we have identified one to four expected impacts and provide a brief discussion of each. We also estimate how significant we think that issue is likely to be for Pamplin during three time periods (0-5 years, 5-10 years and 10+ years).

This is a living document. As this environmental scan will establish a foundation for Pamplin's strategic planning, we are interested in your thoughts about how we can further enhance our understanding of issues critical to our strategic planning. We are particularly interested in whether (a) you believe we have left out critical issues, (b) whether our framing of critical issues—definitions or trajectory statements--can be enhanced, or (c) whether we have neglected or could enhance our discussion of the expected impact statements for any of these issues. Further, we close each issue with a question seeking to identify "what do we not know?"). Your contributions here can help us expand our thinking. If you are a part of one of our subcommittees, we will provide an avenue for you to provide these comments. But you can also feel free to direct any thoughts or comments to me directly at kevinc@vt.edu .

Thank you for the quality and thoughtfulness of your current and future contributions to building Pamplin's Strategic Plan 2019-2024.

I. ECONOMY
A. CHANGING NATURE OF WORK

Description: The underlying pace of technological change in society is increasing. Trends in workforce demographics and the evolution of the "Internet of Things" will continue to change the nature of the future workplace our students will be required to navigate.

Trajectory: A number of long term and new emerging forces are coming together that will accelerate change in the workplace of the future. The pace of technological change continues to increase, driven by the evolution of computing technologies and the capacity to connect to the Internet from anywhere at any time. This is dramatically disrupting business models and creating tremendous new opportunities. With this change comes increasing access to data and the evolution of big data analysis and artificial intelligence, which has been estimated to have the capacity to automate up to 30 or 40% of the current jobs in industry, including many existing white-collar jobs. The aging baby boomer population, multi-generation workforces, the capacity to mitigate distance and time with technology, and increasing numbers of contingent employees are changing and will continue to change the definition of work.

Expected Impact: The "half-life" of education will continue to decline.

Timing and Significance: Half-life is a term coined from the process of carbon dating fossils and other organic material. It is based the rate at which radioactive Carbon-14 which is continually embed in live organic material decays, in successive fixed periods exactly half of the remaining amount of that carbon isotope is lost. The amount of Carbon-14 that exists in fossil material can be used to estimate its age. That period is the half-life. Useful knowledge can have a similar behavior where some knowledge, particularly that associated with the use of specific processes or tools, becomes less useful over time (think slide rules), while other knowledge remains useful. The more rapidly technology changes, the more quickly the value of specific forms of knowledge become less useful. So as technology change increases, we can expect that the useful life of some types of knowledge will be shortened, meaning that students will likely benefit from three types of learning. The first is ongoing educational opportunities that meet immediate emerging learning needs. Second, an education that helps them anticipate changes in technology and understand those technologies' implications for work, disruption of business models and entrepreneurial opportunities. Third, they are likely to benefit from developing the skills necessary to be competent, self-guided learners.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Expanding adoption of artificial intelligence will result in automation of many decisions currently made by workers.

Timing and Significance: Artificial intelligence and machine learning are very important emerging technologies, where the state of the science is only beginning to tap its potential. However, true "intelligence" or very high-end applications of intelligence or machines that truly learn are not yet available. That said, even though current applications represent the less advanced capabilities of these tools, they can and are having dramatic impact, disrupting many current industries and business models

and creating many new opportunities. These technologies are most frequently used to develop algorithms that can perform complex (in that they may involve many input elements), high volume decisions quickly. With effective development and tuning, these algorithms can almost always reproduce the level of performance of the best decision makers. But these algorithms outperform human decision makers because they apply the same best model each time—they do not have variance in the output that drives decisions. So, in high volume decision contexts, even small dollar value improvements in average decision performance can add up to big results. Thus, algorithms will in most cases be able to produce a higher percentage (though sometimes only marginally so) of correct or more optimal decisions. In high volume contexts, computers can make the calculations driving these decisions much more quickly, frequently allowing companies to automate these decision processes. Further, once the algorithms are deployed, new decisions can occur for near zero marginal cost. This has led many AI specialists and futurists to argue that a large number of jobs in today's economy are likely to be automated out of existence—and that is potentially true, if all else remains equal. Fortunately, that is rarely the case, but the emergence of AI will likely have dramatic effects on the nature of work. What is important to remember is that not all decisions in organizations are high volume—if you do not repeat a decision many times, the capacity to build algorithms to automate decision-making is limited. So, while nearly every job likely has some decision tasks that can be improved and automated using AI, current technologies cannot yet reach all of them. Thus, while much current work will be automated, in many cases it will not remove whole jobs. Work could be rearranged to eliminate workers; however, the more likely and more effective results will come from employers and workers understand AI and identifying how to leverage AI to make individual workers and their organizations more productive. Understanding what AI can do and how it may transform business can prepare managers to effectively transition to a world that will rely increasingly on big data, AI, and machine learning. Further, AI and machine learning are tools that represent their own growth industry with the emergence of companies and consultancies designed not only to build artificial intelligence tools, but to help companies understand how and where to leverage those tools effectively.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Increasing numbers of contingent employees.

Timing and Significance: Contingent employees are those individuals who do work for an organization but do not have a traditional full-time employment agreement with the company. In many cases, these workers are contractors who work for the company for a limited time-period to complete a specific task for a given level of compensation and then leave, typically to pursue another contingent relationship with another company. Contingent employees may also be part-time employees who work a limited number of hours at regular times or "on demand." The number of contingent employment relationships are growing. This growth is likely a consequence of rapid technological change that can cause organizations to reach outside their boundaries for specific capabilities necessary to guide transitions. There are also cost drivers—contingent employees in most cases do not receive benefits, which for some companies can total as much as 40% above base salary and contingent employment relationships are easier to terminate. Employees also encourage contingent employment relationships due to the

greater control it provides them over the amount and timing of the work they wish to perform. This is particularly true for employees considering the transition into retirement, or families with significant child or elder care needs. Contingent employment relationships have several potential advantages, but also potential limitations. Contingent employment is growing and future business leaders need to understand how to leverage these types of relationships effectively.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

What do we not know? What key questions do we need to address?

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B. **LOW UNEMPLOYMENT**

Description: Unemployment rates in the US are near historic lows of ~4 percent. Unemployment rates indicate the number of individuals holding employment as a percentage of all individuals working or seeking employment. The size of the workforce is approximately 158 million, out of a total population of 327 million. While unemployment is low, wage rates have only recently begun to increase.

Trajectory: Unemployment rates have remained low. Low unemployment can slow economic expansion. Low numbers of unemployed, or employable adults, can be mitigated by converting some of the 169 million people not currently in the US workforce to come back in and take jobs, particularly retirees. In addition, low unemployment can be mitigated by increasing immigration. Low unemployment rates can also be reversed by slowing down the economy—as current trade disputes have the potential to do.

Expected Impact: Low unemployment should continue to signal strong job markets for college graduates, keeping current high rates of employment of Pamplin graduates high and maintaining upward competitive pressure on starting wages.

Timing and Significance: While employment is good, now is an appropriate time to be gauging where job growth will come from if new capital investment begins should clearer indications of the direction of US policy emerge in key areas of the economy including infrastructure, health care, and energy.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Moderate	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

What do we not know? What key questions do we need to address?

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C. **INCREASING FEDERAL BUDGET DEFICITS**

Description: The federal budget deficit has ballooned to more than $20 trillion and proposed federal budgets increase that amount. An increasing budget deficit potentially puts competition on the credit market and downward pressure on the possibility of using increasing government spending to further boost the economy or provide additional funds for other budget priorities. This includes increased federal spending on research and higher education.

Trajectory: While there are consistent voices calling for fiscal conservatism, traditional conservative voices have gone quiet. As a result, there seems to be little stomach for a more conservative spending policy. Thus, at least in the short term, budget deficits can be expected to grow with government essentially "kicking the budget deficit problem down the road" for the next generation to solve.

Expected Impact: Under the current administration, there appears to be a strong interest in dramatically reducing federal spending on research. In the face of rapidly expanding budget deficits, it is unlikely that federal spending on research will increase, and there is a strong likelihood that federal research spending through NIH and NSF will decline. Significant funding going to defense offsets some of these declines.

Timing and Significance: Because the college of business has not relied significantly on federal grants and contracts for its budget, it is unlikely that these reductions will have a significant impact on the college in the near future. Even if the college were to choose to begin a limited program of sponsored research.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Two secondary effects are also possible. First, if the college seeks to increase its grant and contract work with industry, the reduction in federal spending may result in greater interest and competition for corporate sponsored research dollars. Second, if the university is not able to replace federal sponsored research dollars with its full overhead cost coverage, this may squeeze the university budget, making additional resources from the university more difficult to come by and reducing year over year increases in base budget allocations to the college.

What do we not know? What key questions do we need to address?

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D. **CLIMBING HEALTH CARE COSTS**

Description: The US spends more per capita on health care than just about any country in the world and achieves health outcomes that are in the lower half among industrialized nations. These costs are now over $3 trillion per year and increasing at above annual inflation rates. Health care costs are now nearly 16% of GDP. That is combined with an estimated 6-10% of American's having no, or minimal health care coverage.

Trajectory: Given the lack of legislative progress, it is a difficult situation to change. While budget hawks look to reduce deficits by limiting coverage, the large baby boomer generation enters retirement and those costs are likely to continue to increase, and the efforts to deny benefits to seniors are unlikely to succeed politically.

Expected Impact: Efforts to increase Commonwealth spending on education will face competing pressures to cover rising health care costs, particularly if federal spending is decreased.

Timing and Significance: Expect this problem to take at least a generation to solve, even if there are meaningful legislative and leadership efforts to try to fix the system in the next five years.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Ongoing opportunities to conduct research and education in the health sector.

Timing and Significance: At an annual cost of $3 trillion in the US, there will continue to be tremendous opportunities to improve health care in the areas of treatment, prevention of disease, improvement in lived health, and management of the health care system. Pamplin has faculty engaged in health care related research, but with the addition of the Medical School as a separate college there are more significant opportunities for Pamplin find partners in this space in both research and in education.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Because Pamplin has not been activity engaged as an entity in this area to date, any actions or investments by Pamplin would likely be in the form of initial investments to build talent, expertise, and systems during the next five years with payoffs beginning in 5-10 years down the road. There are already other players in the state that have made significant investments in this space and have well regarded curriculum in place. However, given the massive size of this market and its many opportunities, it is very likely that the college and its faculty could identify and exploit important niche opportunities.

Expected Impact: Increasing cost of health care for university employees and increasing costs for doctoral students.

Timing and Significance: Universities are unique from businesses in that they receive a salary and a position allocation from the state. When the college hires beyond the number of positions allocated to it

by the state, the college becomes responsible for the cost of benefits provided to the employee—that number is typically depicted as a percentage (currently about 37% for tenured/tenure track faculty). Benefits for allocated positions are covered by the university. Currently the college is spending more than $1.3 million annually on benefits for positions beyond our allocation. As health care is a significant portion of this annual expense, ongoing increases in the costs of health care will put upward pressure on these numbers.

For doctoral students, the university has paid 90% of the cost of individual health care for students, with an intent to cover 100% as funds become available. However, if doctoral students require family health care coverage, the additional cost of that coverage is paid by the student. Currently that differential is approximately $6,000 per year. For doctoral students who receive a $24,000 annual stipend as part of their graduate assistantship, along with a tuition waiver (each year for 4-6 years depending on their research progress) the cost of family health care can be a barrier for many students.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

The college currently has approximately 55 full-time doctoral students on the Blacksburg campus, and we expect that number to stay relatively constant for the next year or two, but to eventually grow to 65.

What do we not know? What key questions do we need to address?

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E. **INCREASING PERSONAL DEBT**

Description: Debt is increasing on many levels. The national debt is reaching new highs, trade deficits with foreign countries continue to increase, and personal debt continues to increase. The Virginia state budget remains healthy but increases in health care costs in the foreseeable future will continue to place pressure on state budgets, as will the continued aging of critical infrastructure in the state. Personal debt, including student loan debt, continues to run at high levels. US household debt rose to $13.3 trillion in the second quarter of 2018, up $454 billion from the year before.

Trajectory: While there will be pressure to reduce the national debt, the need to spend money to pay for critical infrastructure and to cover continually increasing costs for health care will make this difficult. While increased spending on education may become a political priority, the amount available to spend, given other super-ceding priorities in the next 10 years, may be limited. This is consistent with current administration plans to reduce federal funding for research.

Expected Impact: Expect yearly funding increases in higher education to be positive, but modest, over the next five years. Expect continuing reductions in annual inflation-adjusted spending per student in Virginia. While there may well be increased interest in spending to position the workforce for the realities of an "Internet of Things economy," the amount of funding available for base budget increases in higher education is likely to be limited.

Timing and Significance: At this point in time the state contributes less than 20% of the University budget which helps insulate the impact of budget reductions on university and college activity. Further, the university conducts around $300M in extramural funding, which will be difficult to grow in the face of reduced federal funding for research. While it is likely that we will receive inflation-balancing increases in funding for the university, true increases in base spending are unlikely in the near future.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Continued pressure to make higher education affordable by eliminating or reducing increases in tuition and fees.

Timing and Significance: The forces to hold tuition and fee increases to minimums are already significant and are likely strengthen over the next 10 years. The need to continue to balance higher education budgets will likely preclude severe restrictions on tuition increases in the next five years.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

During the last 20 years, the university has been able to increase tuition in order to balance the budget. While that is likely to increase for at least the next five years, expect pressures to reduce or eliminate tuition increases to become stronger. The result is the need to diversify sources of resources and/or reduce the costs of delivering education.

Expected Impact: Decreasing access to education for lower income students and families.

Timing and Significance: These forces are already having impact, particularly in areas requiring marginal fees. In many cases, where study abroad programs require additional fees beyond tuition, students from lower income, underrepresented minority, or first-generation students, these fees reduce participation. This also influences Virginia Tech and Pamplin's capacity to meet student diversity targets.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

In many instances, scholarship dollars are available to mitigate these effects for some students, but there is already significant unmet need for these funds, and the funding gap is likely to increase as time goes on.

What do we not know? What key questions do we need to address?

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F. **LARGE CASH BALANCES**

Description: Many major corporations have significant amounts of cash on their balance sheets. These high cash balances are due to the effects of a strong economy, short-term changes to tax policy that significantly reduced corporate tax liability, and an uncertain policy future that makes it difficult for organizations to willingly undertake large-scale capital development.

Trajectory: These large cash balances will exist until corporations can determine how to best invest in the future. Investing these monies has the potential to bolster the economy, increasing wages and job growth. Until that point, as cash balances sit idle on balance sheets, there may be potential for corporate philanthropy (they have the cash; and may be interested in using some of it), or distributing those cash balances to shareholders and increasing their potential for more individual philanthropy. A significant uptick in the number and size of major philanthropic gifts to higher education have occurred in recent months, including a number of gifts in excess of $100M.

Expected Impact: Short-term opportunities exist to increase philanthropy while companies and individual investors are cash flush.

Timing and Significance: Major gift opportunities exist; however, donor interests appear to be shifting from providing funds to build buildings, to providing funds to build programs with the potential to significantly change an industry, solve a major problem, or fundamentally change education in order to realign higher education with new and emerging realities.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Marginal	Marginal

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Increase investment in corporate support for research and development

Timing and Significance: Short term opportunities exist for organizations to do preliminary research in business areas that may be the focus of future investment, including business recovery, cyber-security, data-analytics, and others.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Increase investment in education and reskilling employees

Timing and Significance: Short term opportunities exist for organizations to engage in reskilling current employees and preliminary research in business areas that may be the focus of future investment, including business recovery, cyber-security, data-analytics, and others.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

What do we not know? What key questions do we need to address?

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II. POLITICAL

A. **INCREASING NATIONALISM**

Description: Increasing shifts in government policy that put US interests above global interests reduce interest in multilateral agreements on defense and trade, attempt to shift jobs back to the US, or increase incentives to keep US jobs from being move to other countries. The US is seen as a less friendly and safe environment for foreign visitors, and there are increases in nationalist rhetoric and components of hate speech. China has an increasing influence in areas like South America and sub-Saharan Africa as the US disengages.

Trajectory: Expect Nationalism to expand in the US other countries during the current administration, with a significant rebound in support for globalization under the next administration.

Expected Impact: There will likely be decreases in international student applicants to Virginia Tech, particularly from China and Muslim-majority countries.

Timing and Significance**:** With reduced immigration and negative perceptions of US safety and security, the number of non-US citizens applying to graduate programs has and will likely continue to decline. Recent national numbers show a 6% drop in graduate applications nation-wide. Expect these reductions to continue under the current policy regime, though increasing educational infrastructure investments in China in recent years would likely have led to reduced enrollments anyway.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Dampened Interest in Study Abroad Programs

Timing and Significance: At least in the short term, there is likely to be reduced interest in study abroad programs resulting from concerns about safety in some areas of the world. A significant safety event for a study abroad group from the US would likely have a dramatic downward effect on study abroad enrollment.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Reduced interest from international partners in developing joint programs

Timing and Significance: With increased nationalism worldwide and nationalist immigration policy in the US, the environment for developing international student programming may be less favorable in the short-term. However, given the likelihood of a rebound in globalism under a new administration, which may attempt to undo many of the policy initiatives of the current administration, laying the ground-work for increased international programming beyond the current time period may be appropriate.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Increased potential for hate speech on campus

Timing and Significance: College campuses have become a possible flashpoint for hate speech. Further, interest in assuring a place for free speech in campus discussions has become a political issue that is gaining traction. Research and other funding for schools is being tied to the issue, in addition to ill-defined definitions of what is appropriate free speech. As political rhetoric becomes more rancorous, there always exists the potential for extreme elements and protest speech to turn to violence. This is not just a concern in the US, but around the world.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Moderate	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Providing a forum for meaningful discussion of important societal issues has been a need that universities and places of learning have attempted to fill as part of our mission to educate and train future generations of citizens. What is critical is not what students are exposed to but developing their capacity to think and engage with others in these types of conversations. Teaching our students how to engage in meaningful conversations about difficult issues is a significant, and important challenge. To do so, as faculty and staff we need to be able to demonstrate, practice, and learn how to effectively teach those skills.

What do we not know? What key questions do we need to address?

B. INCREASING ECONOMIC DISPARITY

Description: During the last 100 years, the disparity between the incomes and wealth accumulated by the richest and poorest people in many developed countries has continued to expand. The magnitude of these disparities and the ineffectiveness of efforts to reverse them builds the potential for civil discord in society. As noted by Charles Murray in "Torn Apart: A History of White Class Structure in America," these differences have become embedded in society altering mobility opportunities for individuals in the least income earning segments of society. The physical separation of these communities are creating significant segments of society that do not believe their government or institutions care about them and feel helpless, forgotten, and angry.

Trajectory: During the industrial revolution and the development of mass production methodologies, working men no longer owned the tools (physical capital) needed to produce goods and services—they individually could not afford the large capital outlays necessary to create economic efficiencies. As a consequence the profits gained by the combination of man and tools were divided among the individuals who owned the tools (entrepreneurs, wealthy capitalists or large corporations through their stockholders) and the workers through their wages. The profits generated then went to those who owned stocks of capital, while workers' wages lagged, driven by competitive labor market forces rather than the productivity and profitability of individual firms. Over generations, this has led to only marginal increases in market value of unskilled labor, while entrepreneurs and wealthy capitalists (those that have money to spend to accumulate the capital needed for production) create tremendous wealth. These differences are a defining feature of the separation between rural and urban American, including here in Virginia. There does not appear to be any easy fix to this situation, and these disparities appear to have accelerated particularly in the internet economy.

Expected Impact: Increasing interest in enhancing economic development and economic opportunity in rural (southside and southwest) Virginia.

Timing and Significance: Economic educational trends over the last 75 years have led to a systematic reshuffling of human capital and the businesses that drive economic development and jobs in ways that further drive regional income and opportunity disparities. Expect to see continued interest in identifying efforts by state and local governments to look for ways to drive economic development in Southside and Southwest Virginia. This may come in the form of funded research opportunities.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Moderate	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

The location of Virginia Tech's Blacksburg campus in southwest Virginia, its system of satellite facilities around the state, and its system of extension agents throughout the state create a powerful embedded presence in the state to help study potential opportunities and drive improvement. Virginia Tech as a research university, through its entrepreneurship center, could partner with other entities to look for holistic solutions.

What do we not know? What key questions do we need to address?

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C. #MeToo

Description: #MeToo refers to a movement representing a rapid shift in awareness, recognition, and willingness to discuss sexual harassment and sexual violence, particularly toward women, and of society's willingness, in this new spirit of openness, to demand accountability by those who are now or who have previously engaged in this activity.

Trajectory: The rapid lowering of the stigmatization and the willingness of women who have been victimized to come forward and tell their stories is rapidly shifting societal norms and expectations about behavior.

Expected Impact: Society, including universities, will demand higher accountability for all members of the university community to adhere to a strong standard of conduct and greater accountability for individuals who have or engage in inappropriate conduct.

Timing and Significance: Universities have always taken a strong stance against sexual harassment and violence when identified. However, college campuses, given the age and stage of life of a majority of is community can be highly sexually charged creating the potential for more questionable behavior. With changing standards, there is an onus on universities to provide leadership to assure the safety of all students through appropriate policies, necessary education, and a willingness to hold the members of our community accountable.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

What do we not know? What key questions do we need to address?

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III. Social/Behavioral

A. TECHNOLOGY-MEDIATED COMMUNICATIONS AND INTERACTIONS

Description: Technology-mediated communications and interactions refer to the growing reliance on technological interfaces such as the smartphone and increasingly AI-powered robotic tools in our everyday communications, social interactions and business transactions. Relationship and communication skills that have distinguished successful business relationships and service interactions will still be required. However, it will be important to relearn these increasingly salient human, intuitive and empathic skills in the context of available technological interfaces. Some argue that interpersonal, trust-building capacity will become even more important in computer mediated contexts and a skill set that digital natives may need more education and training to master. Virtual reality and augmented reality are just two examples of an increasing number of circumstances were individuals interact with environments that are constructed to a significant extent with computer hardware and software. These interactions include computerized simulations, online gaming, as well as interactions with holographic entities and bots.

Trajectory: While the Internet and the more recent Internet of Things have fundamental impacts on connectivity and access to information, the reliance on the smartphone and AI-powered tools is dramatically changing our interactions and communication with each other and with the socio-technical world. This trend is particularly salient among the millennials and generation Z, who are digital natives and quick adopters of new technologies. Despite this strength, efforts will be needed to promote the "soft" skills required to manage the multicultural and interpersonal communication needed to lead and manage teams, foster effective persuasion and motivation, and effectuate business decisions. In short, "big data" and AI-powered efficiencies will enhance but not duplicate or replace the human element required.

Expected Impact: Need a better understanding of the role of mediating technologies and their effects

An increasing variety of technologies mediate much of our everyday life and our social interactions. New technological interfaces not only provide new ways to access information but also will influence and even dictate how we interact with each other.

<u>Timing and Significance</u>: Various forms of computer technologies have influenced social interaction for almost 20 years. What is changing is the extent to which technology affects daily life and interaction. Computing technologies are becoming the dominant platforms through which we conduct an ever-increasing proportion of life's activities. Understanding the impact of these technologies on social interaction and human effectiveness is important in order to prepare our students to effectively manage and leverage these technologies in the future.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Need to learn how to best leverage mediating technologies

Various technologies are increasingly the dominant pathways through which we interact with our environments and each other. This will give rise to new needs to develop curricula that reflect these new modalities of interactions and how we can leverage them to create business value, to access and manipulate data, to influence and persuade, and to learn.

Timing and Significance: We already have some insight into how computing and social interaction platforms influence the nature and quality of human interaction. Other forms of computer inaction including high fidelity simulations and virtual and augmented reality are less well understood but have significant potential to impact how we interact with and learn about our world, its systems and each other. This includes leveraging human interactions required for successful business and business-client engagements.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Changing Landscape of Research and Scholarship

Different "business models" of research funding and publishing, the increasingly important role of technology in knowledge creation and dissemination (e.g., dominant databases such as Elsevier and search engines such as Google Scholar), as well as society's pressure and growing needs on open data and open access to research. This is creating major impacts on how we see academic research as an intellectual activity and as public goods.

Timing and Significance: The internet is opening avenues for creating and sharing data and with it come new questions concerning intellectual property ownership and rents generated by them. As we gain greater access to data, data ownership, sharing and the capacity to monetize formatted data sets for built for specific purposes are likely to have significant effects on future scholarship.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

- **What do we not know? What key questions do we need to address?**

B. MENTAL HEALTH

Description: Mental health refers to a wide range of issues that influence an individual's mental well-being. These can range in severity and longevity and can result from organic failures of one or more neural systems to responses to contextual stimuli.

Trajectory: Instances of mental health issues appear to be increasing. This is evidenced in increasing attention to acts of violence against others as well as increases in self-reported mental health issues. This increase may be the result of systematic changes in society that are leading to greater instances of mental health challenges in the population, include college age students. It may also be related to reductions in stigmatization of mental health issues in society making it more likely that individuals will self-report mental health issues.

Expected Impact: Increasing need to assure adequate support for individuals facing mental health issues

If mental health issues are increasing, we need to make sure that there are adequate systems in place to support the needs of faculty, staff or students who face these challenges. This includes adequate capacity in the systems and appropriate education to assure early diagnosis of challenges and provisions for mental health care.

Timing and Significance: Virginia Tech has systems in place to provide mental health care for individuals struggle with severe mental health concerns. However, it is not clear whether all members of the college community are aware of available resources and how they can appropriately assist (without violating an individual's rights) to provide individuals who may be struggling to gain access to the resources they need.

Timing	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Moderate

Expected Impact: Design education practices that optimize mental health and learning

It is not clear that we understand how current educational practices influence the mental health of students. We know that 18-22 year olds are undergoing significant life changes that can affect their mental health. It likely is important that we understand the scale of potential mental health risks in educational environments so that we do not exacerbate potential risks or introduce new mental health risks in educational systems. Further, it appropriate, there may be reasons to teach mental health best practices, including mitigation strategies, as part of our curricular, co-curricular or extra-curricular programming.

Timing and Significance: It is difficult to judge how significant this problem/opportunity is. We do not have detailed data about the nature of mental health challenges or the distribution of faculty, staff and students who face various types of challenges. Without better data it is difficult to judge the magnitude of the opportunity to mitigate existing challenges or to understand and identify mental health risk factors in future educational designs or how they might change in the future.

Timing	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Marginal	Significant

- **What do we not know? What key questions do we need to address?**

IV. DEMOGRAPHIC
A. INCREASING DIVERSITY

Description: Diversity includes an attribute or characteristic that can differ across people. While much focus has been placed on ethnic and racial diversity, broader perspectives also include differences in nationality, sexual orientation, religion, perspective, knowledge, skills, values, and worldviews.

Trajectory: The internet, globalization, reduced costs, and increased availability of international travel have permitted people to interact with others who differ from themselves. Diversity of all types is increasing, and society recognizes the capacity to work effectively with and through others that are different from ourselves as a critical skill set for individuals today. In the US, labor and employment law has placed a significant emphasis on racial diversity as historical labor and employment outcomes suggest the potential for systematic bias. While developing diverse communities is seen as important and widely valued, building inclusive diverse communities is more challenging.

Expected Impact: The need to enhance demographic and other forms of diversity in the college.

Timing and Significance: As populations grow and become mobile, interaction with diverse others is increasing. Organizations that recruit at college campuses are looking for applicant populations that mirror the ethnic and racial diversity of their markets. In order to provide an environment where the college community can learn how to interact and work effectively with diverse others, the college itself needs to become more diverse.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

The college has made substantive progress to increase the racial diversity of the student population and of our faculty. While racial diversity in the university and college is similar to that of southwest Virginia, the university and college are less diverse than the commonwealth as a whole.

Expected Impact: The need to build truly inclusive communities**.**

Timing and Significance: While many long-time and majority-group members of our community view the university and college as inclusive, those views are based in foundations of interaction that have occurred in less diverse environments than those than should be expected in the years to come. Significant work needs to be done with our faculty, staff, and students on how create safe environments and have conversations about how to interact in a meaningful, caring, and productive manner.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

As we deliver on our commitments to become more demographically diverse, we will need to build systems and patterns of interpersonal practice and share those within our community to become more truly inclusive.

What do we not know? What key questions do we need to address?

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B. DECLINING DOMESTIC BIRTHRATES

Description: Birthrates began declining in the US beginning in the 1990s. This is leading to smaller numbers of high school graduates whom may enroll in colleges and universities.

Trajectory: The number of college-aged individuals will continue to decline slightly over the next decade. While birthrates in many developed countries are already below replacement values, birthrates in many developing countries remain high leading to a climbing world population of almost 8 billion people.

Expected Impact: Increasing competition for high school graduates.

Timing and Significance: The lower numbers of high school graduates will put increasing pressure on recruitment efforts of major universities. Combined with initiatives at major universities to increase enrollments, the smaller number of high school graduates available to enter institutions of higher education has already ramped up competition and placed extreme financial pressure on many small private colleges dependent on tuition revenue.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Virginia Tech, and most upper tier institutions of higher education will be able to weather the reductions in the size of the applicant pool much better than small private schools. Further, more effective recruitment can permit Pamplin to increase the size of its applicant pool (number of individuals with a first choice of Pamplin) and continue to increase student yield (acceptance of offers extended).

Expected Impact: Increasing interest in non-traditional students.

Timing and Significance: A non-traditional student can be someone beyond the age of 22 that has not attempted nor completed a bachelor's degree or a working adult seeking a master's degree or doctorate. It also could be someone who has one or more degrees and is seeking non-credit educational opportunities to reskill or develop additional new skills to enhance their position in the workplace. The number of non-traditional students greatly exceeds the number of new college entrants each year. Colleges who want to continue to grow tuition revenue will likely need to look beyond traditional student populations to meet enrollment targets. These students have different needs. Educational offers targeted to these populations must meet their education, cost, accessibility, and lifestyle requirements

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Increased interest in international students to balance budgets**.**

Timing and Significance: In order to meet growing enrollment targets, many institutions may begin looking for larger numbers of international students. Some institutions have established additional fees for international students. This approach is attractive because international students also pay higher out-of-state tuition rates making it easier to balance tight university budgets. This pressure is likely to be greatest among private schools, whose budget depends more heavily upon meeting enrollment targets.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Virginia Tech is already examining the potential to increase the percentage of students who pay out of state tuition. The challenge introduced by this strategy is, should those out of state student be international students who are not fluent English speakers, accepting larger numbers of non-English speakers can place a greater burden on university teaching and student support systems. Providing that additional support must be a component of such strategies to accommodate larger numbers of entering students who may not be native English speakers.

What do we not know? What key questions do we need to address?

C. AGING BABY BOOMERS

Description: In many developed countries, including the US, a bubble in birth rates from the late 1940s to the early 1960s, call the baby boom, created a generation of individuals who due to their large numbers have had several important effects of social, political, and economic outcomes across the globe.

Trajectory: The baby-boomer generation is now reaching their retirement years. They will begin to reduce the amount of time they spend in the workforce. They may begin to consume retirement savings and will shift from paying in to major social programs like social security and Medicare and begin to draw dollars from those same systems. They are also reaching the point in their lives when they are likely to incur the greatest portion of their lifetime health expenditures.

Expected Impact: Retirement of a significant proportion of the professorate.

Timing and Significance: To a great extent, this has been going on for more than a decade, but there are a number of senior faculty members that will retire in the next five years, though these numbers are likely similar to those that have retired in the previous five years. The departures of these faculty has a significant cost effect on the college as many retiring faculty are earning wages that are significantly below the market value for new or mid-career faculty in their given disciplines.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

New faculty salaries are increasing due to an ongoing war for talent among colleges and universities who seek to hire high potential research faculty because all major universities use many of the same markers of research excellence. The markers are difficult to achieve, so the pool of high potential talent is small relative to the demand resulting in rapidly escalating salaries in our key disciplines over the last decade.

Expected Impact: Increase in numbers of retired professors availability as adjunct and visiting researchers

Timing and Significance: Many people are aging and reach retirement age in better health than in previous decades. As a result, many faculty choose to continue to work full-time well into their 70s and some beyond. Others choose to retire because they no longer wish to manage the rigors of full-time teaching, research, and service loads. However, many of these faculty do not stop working, but shift their time to other interests. As with many retirees in other areas of the economy, the potential to engage these faculty in part-time capacities may be beneficial, particularly when they possess unique areas of expertise that can be useful in specific research, teaching, or service activities.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Moderate	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Increased opportunities to study the effects of aging and work

Timing and Significance: As the number of individuals who continue to work beyond the age of 65 increases, there are opportunities and a need to study the effects of senior work, how and why they choose to engage on the workforce, and the effects of today and tomorrow's workforce on these individuals. In every instance, there is value in attempting to study how best to create value through working relationships. These include influences of work on health and quality of life, style of work arrangements that maximize value for both parties, or how older individuals can be utilized effectively as contract and online, or teleworking, professionals.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

This work could be in partnership with the center for gerontology.

What do we not know? What key questions do we need to address?

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E. THE INTERNET-NATIVE GENERATION

Description: The internet has become an important part of how people engage in any number of life activities from social interaction, information gathering, and a host of economic transactions. The generation born in the 2000s has never known a world without the Internet.

Trajectory: Over the last decade an increasingly large percentage of the population has engaged some aspect of their life on the Internet. To a great extent, the number of individuals who can be connected to the Internet in developed countries is nearing saturation, but the number of activities and the percentage of one's life conducted through internet applications continues to increase, as does the number of devices an individual controls or has access to that are connected to the Internet.

Expected Impact: Most students entering the university are internet natives.

Timing and Significance: Students entering the university out of high school have grown up in a world that has always had the Internet. As a result, they are familiar with, and often expect to use Internet-enabled apps to gather information, communicate, socialize, and purchase. This creates an opportunity for the college to create applications that leverage this expertise to enhance a wide range of components of the student experience. Potentially enhancing curricular, co-curricular, and extra-curricular learning outcomes.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Because university systems are in transition, this holds near term urgency. Components of the student experience that are not mobile friendly may hinder that experience. These could reduce interest in attending the university or college (e.g., reduced applications or acceptances), reduce retention rates, or hinder learning outcomes, and many things that reduce effectiveness, would do so differentially.

Expected Impact: Ubiquitous presence of student owned technology on campus and in the classroom.

Timing and Significance: Because students are used to living in a world of mobile connections, they bring with them a number of those devices, which in almost all cases involves a cell phone, but also includes laptop computers, and third party internet connected devices like online digit assistants. Identifying ways to leverage these technologies for common functions could further reduce the universities required technological footprint that must be purchased, maintained and upgraded.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

In some ways this has already been underway. The addition of the universal computer requirement for all incoming students reduced the university's need to purchase and maintain equipment for student use. This significantly reduces the breadth of technology to be maintained at one time when both the

number of computing devices used per person, and the total amount of activity conducted online were escalating.

Expected Impact: Increasing university data storage and data transmission requirements.

<u>Timing and Significance:</u> We continue to move toward a world in which we can use any application from any device at any time from any place in the world. The percentage of life's activities that happen online are increasing as is the fidelity of communications and information transmission improve, moving from digitally lean text to digitally heavy full-motion video. The result is an ever-increasing need for safe digital infrastructures that can provide the mobility, bandwidth, and security necessary to support research and teaching that are both becoming more digital.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

This, and its associated security issues, is something that Virginia Tech's IT services would address. However, these accelerating needs should be a part of the planning for GBAC.

What do we not know? What key questions do we need to address?

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V. ENVIRONMENTAL
A. CLIMATE CHANGE

Description: Increases in the earth's average temperature are caused by increases in greenhouse gases that trap heat in the earth's atmosphere. A large portion of the greenhouse gases are produced by the industrial operations of human societies, particularly the burning of fossil fuels, and are enhanced as populations and industrialization of those populations increases. Climate change is expected to result in increased in sea levels and increases in extreme weather events, placing coastal populations around the world at greater risk. This can lead to increases losses of life and property due to storms and greater disruption of commerce resulting in negative economic impact.

Trajectory: Perceptions that climate change research and its projected effects are not credible have led some countries, including the US, to be slow to take significant action to halt or slow its effects. As the physical manifestations of climate change become more prevalent, incentives to take significant policy action increase. However, in the view of most experts, if we wait until the physical manifestations of climate change are apparent, it may be too late to intervene, and the resulting effect may take hundreds or thousands of years to reverse. Current levels of CO_2 are already setting off amplifying effects, like the thawing of artic permafrost, which on its own will release tremendous amounts of currently trapped greenhouse cases and which are not included in most climate change models. Most experts agree that aggressive action is needed to reduce greenhouse gas emissions, by as much as 80% if we are to avoid a reaching the 2^oC temperature rise target above which negative and potential irreversible effects may occur.

Expected Impact: Increase growth of and demand for new energy economy jobs.

Timing and Significance: Green energy production methods have been improved over 20 years, and the marginal cost of wind and solar energy production are nearing the point where they represent a cost-effective alternative for rebuilding this country's (as well as other country's) energy infrastructure. As a result, expect significant growth in employment in these companies in the coming years to help build this infrastructure.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Many of these companies are currently small, by current industry standards. As they grow, they will become the employment homes for an increasing number of skilled laborers and college graduate engineers, marketers, accountants, and managers.

Expected Impact: Increased demand for sustainable infrastructure and disaster recover

Timing and Significance: Disaster recovery efforts are likely to be more important in the upcoming years and may represent an area of emerging growth for jobs and a focus of applied research. The increase in the number and severity of extreme weather events will require both the ongoing development of infrastructure with high tolerance for extreme weather, and for greater and more capable disaster mitigation and recovery planning. Losses associated with extreme weather events (so called "hundred"

or "thousand" year storms) can be in the $10s of billions of dollars or more. The insurance industry and most economies cannot withstand frequent events of this magnitude. Preparing infrastructure and systems to mitigate the effects of these storms will dramatically reduce costs and as business opportunities represent significant returns on investment whether paid for by insurance companies with dramatically expanding risk or by individual companies.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Increased interest in environmental sustainability in response to climate change.

Timing and Significance: Climate change has the potential to dramatically and negatively influence existing social systems. Long term droughts that could make significant portions of arable lands uninhabitable and the resulting effects on food security for large sections of the population create the potential for mass migration and political unrest. Political changes in the US under a new administration, could value a "new green deal" to the forefront of policy issues in the US.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

There are significant opportunities for Pamplin to engage in research efforts that combine business frameworks to reduce carbon footprints associated with global warming and address policy change. There are also opportunities to engage in business processes aimed at improving economic development, food security, and health in a world impacted by global warming.

What do we not know? What key questions do we need to address?

- Are there currently any competing disaster recovery degree programs in this space on the east coast?

B. INCREASING WORLD POPULATION

Description: The number of people in the world has grown dramatically and is currently estimated at around 7.5 billion.

Trajectory: In 1950 there were approximately 2.5 billion people on the planet. By 2000, that number ballooned to 6.1 billion people. In 2019, the world population is estimated at 7.5 billion and, based on current trends, it is expected to grow to 9.8 billion in 2050. While birthrates in many developed countries are already below replacement values, birthrates in many developing countries remain high. The education levels of women are negatively associated with birth rates. Climbing world populations are associated with pressures on the environment and increases in food insecurity.

Expected Impact: Increased interest in sustainability and other responses to population increases that threaten the environment and food and water safety (continued availability). Overpopulation is also likely to influence the sustainability social, economic and health and welfare systems and the capacity of any of those systems to recover as a result of natural disasters or political upheaval.

Timing and Significance: A significant percentage of the world's population faces severe problems with food safety and hunger, and these numbers appear to be increasing. Overpopulation is causing significant health risks in developing countries where good air quality and clean water are not readily available. While these issues exist in the US, and in some cases are acute, they are not currently top of mind for most Americans. As these problems increase, their potential impact on the US, through demands for higher levels of immigration or sanctuary, spread of disease, or calls for humanitarian aid will increase. Unmitigated, these problems will only continue to grow.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

There are significant opportunities for Pamplin to engage in research efforts that combine business frameworks with efforts to improve economic development, food security, and healthcare in many areas of the world affected by overpopulation.

What do we not know? What key questions do we need to address?

C. RENEWABLE ENERGY

Description: Renewable energy refers to methods of producing energy (frequently in the form of electricity) through means that do not rely on resources that cannot be readily created (i.e., fossil fuels).

Trajectory: The dominant form of energy that has driven most of our economy during the industrial revolution was based in fossil fuels (e.g., coal and crude oil). While tremendous deposits of fossil fuels have been identified and extracted from the earth, these fuels are being used rapidly and require millions of years to be produced naturally. Thus, while we are not likely to run out of fossil fuels in the lifetime of any currently living person, we will eventually exhaust all fossil fuels. Access to large amounts of fossil fuels at relatively cheap prices, decreases incentives to produce other sources of energy from sources that can be renewed. Renewable sources of energy include solar, wind, water, and biomass. Research and evolving practices have driven up the efficiency of each of these energy sources, so in a relatively small number of years the cost of energy from renewable sources will rival that of fossil fuels. This will make them more competitive and allow an expansion of the share of the power generated in the US to be based on renewable energy sources. Further, the relatively low marginal cost of adding renewable energy sourcing to the electrical power grid is already influencing decisions about expanding electrical generation based on non-renewable energy, leading to less decisions to make large, long-term investments in power generate capabilities not based on renewable energy.

Expected Impact: Increasing number of jobs in renewable energy companies.

Timing and Significance: As the percent of power generated with renewable energy increases, there will be new business opportunities for individuals who want to work for renewable energy companies.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

What do we not know? What key questions do we need to address?

VI. EDUCATION

A. ACCESS AND AFFORDABILITY

Description: As the number of people in the population who want or expect to receive higher education increases, the total cost of education increases, in many cases surpassing the capacity of state support for higher education. As a result, tuition has been the primary source of funding. Year over year increases in costs can make the total cost of education unaffordable or a questionable investment for lower income families.

Trajectory: While dollar valued support for higher education has increased, and enrollments grow, that growth has not kept pace, resulting in consistent year over year reductions in state support per student on an inflation adjusted basis. Tuition increases of 3-6% per year are common across institutions and premiums for out-of-state tuition are growing. Total cost for tuition, room and board, fees, and miscellaneous expenses can range from $100,000 to more than $200,000 for a four-year college degree. At current rates of increase, these costs could grow by another 20% in the next five years.

While a fair number of families can bear the full cost of college educations, for those students without significant savings or financial support networks the cost, even with some aid, can leave students with large loan balances. For graduates of four-year institutions, loan balances averaged at $18,000 in 2018.

Expected Impact: Reduced access to first generation and underrepresented students.

Timing and Significance: These pressures already exist. In many cases, they occur most strongly in instances were additional fees for programming are required (i.e., study abroad, ability to accept unpaid internships or experiences). Further, first generation and underrepresented minor students feel these financial pressures more often than majority students. Thus, increasing costs of attendance make it more difficult, and more expensive to increase diversity in our student body.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Also, given that that the best of first generation and underrepresented students can be rare, there is significant competition among top students to gain their attendance, increasing university costs of financial aid support packages used in recruitment.

Expected Impact: Pressure to assure the cost of education represents a good investment.

Timing and Significance: As the cost of education increases, students will be evaluating the financial costs of gaining an education (both in real and opportunity costs) versus the benefits of having received that education. One of the most immediate determinants of educational value is access to and maintaining high paying employment. As tuition increases, pressures to continue providing value for the cost of education will grow. These include: (a) access to high paying jobs, (b) high retention, success, and promotional progress by graduates, and (c) reduced opportunity cost for receiving an education by reducing the time required to achieve a degree.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

While business and engineering colleges still provide strong value propositions, pressure will continue to mount to justify value for the costs. Evidence of this pressure will occur in universities in a number of other degree programs before they impact business schools directly, but because business schools are part of university systems, indirect effects are likely.

Expected Impact: Increased demand for online education.

Timing and Significance: Two significant sources of cost in education are the direct costs of transportation required to attend courses in person and the opportunity costs associated with the time required for transportation. An advantage of online education is that it can be delivered to any location with a relatively high bandwidth Internet connection. Access to online education can dramatically reduce costs of attendance not associated with tuition and fees and can provide access to education for those individuals for whom the direct and opportunity costs of in-person attendance are problematic.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

An issue to understand in online or blended classroom education is how this modality effects education so we can leverage its benefits and mitigate its limitations.

Expected Impact: Pressure to reduce the cost of education will increase.

Timing and Significance: Many of the primary inputs to education have increased in cost over the last 20 years. Faculty salaries are increasing, the costs of building and other related infrastructures, including computing technologies and supporting systems, have grown. Further, the size of these supporting systems have grown to meet the needs of larger student populations. For the costs of education to decline, substantive changes in the structure and practice of education must be adopted to increase the productivity of educational systems (i.e., the cost to produce given learning outcomes). It is likely that new educational products that fit specific markets and that have lower price points, but still offer high value per dollar, will emerge to meet some of these needs.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

A critical factor here is to develop a strong understanding of both parts of the productivity equation. We have very developed systems for tracking costs, but we do not have equally sophisticated systems for understanding gains in learning. A risk at this point in the evolution of education to increase affordability is that we make changes to reduce cost that meaningfully reduce desired learning outcomes.

What do we not know? What key questions do we need to address?

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B. COMPETITION IN HIGHER EDUCATION

Description: There is increasing competition to fill a wide range of educational needs. This occurs among traditional institutions of higher learning in recruitment of faculty and student talent, competition for research grants and philanthropy. There is also increasing competition from for profit colleges and education providers who are using online technology platforms to change business models and provide education at lower costs while increasing access around the world.

Trajectory: New technologies are providing both for-profit and non-profit players a foothold in the higher education market, particularly given the slow rate of adoption of new technologies among faculty in many traditional institutions of higher learning. Online universities typically offer lower costs of admission and reduce faculty costs of delivery by employing non-tenured full-time and adjunct faculty. Because online platforms provide lower cost and greater accessibility to education, key players in this space have be able to develop large enrollments (e.g., Liberty University [110,000], Western Governors University [84,000], Southern New Hampshire University [83,000]). Cost and accessibility have been the dominant drivers of enrollment growth as these players tap into new markets and students unable to afford the cost or time necessary to attend traditional universities. However, a number of traditional universities are also developing significant online educational offerings (e.g., Arizona State, Florida, Purdue, Alabama).

Expected Impact: Increasing pressure to build online education platforms and offerings.

Timing and Significance: There are several forces driving this trend. The first is the evolution of online technologies and increasing access to high bandwidth connections to the Internet. The second is the success of competing players in this market and their potential to generate profit by leveraging online platforms to thousands of users. Third, online education increases access and mitigates distance and place differences. A fourth opportunity factor is that online environments provide greater potential to experiment with new pedagogical tools, particularly because many of the traditional instructional methods faculty use are often not available to them in online environments. Once faculty create instructional content in electronic platforms, it enable colleges to automate a number of assessment and administrative activities or supplement delivery in order to enhance faculty productivity and student learning. The fundamental challenge is that it is not clear in what ways and to what extent online learning influences educational effectiveness, or what components of the infrastructure used to develop online education are most responsible for enhancing learning.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Those schools and organizations already involved in significant online learning programs have a head start in learning those lessons and have already made the substantial investment needed to offer significant numbers of online programs.

Expected Impact: Increasing pressure to show that our education and programs add value.

Timing and Significance: The greatest pressure on institutions of higher education is that associated with cost. Tuition costs are rising. Given rising costs in other sectors of the economy (e.g., health care,

infrastructure, debt load) and increasing competition, pressures are going to grow to produce greater efficiency. Compared to other institutions, traditional research universities will typically never be low cost providers. As a result, research universities like Virginia Tech will need to monitor costs and continue to understand and enhance the value of the activities in our three missions to justify our higher cost structure.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

What do we not know? What key questions do we need to address?

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C. INCREASED TECHNOLOGY IN AND AROUND THE CLASSROOM

Description: Internet native students bring an increasing number of Internet-connected devices with them to campus.

Trajectory: The number and types of internet-connected devices will continue to grow beyond computers and cell phones. In the very near future, Internet-native college students are likely to own or have access to more than 10 internet-connected devices each.

Expected Impact: Increasing Internet bandwidth requirements and cybersecurity threat surfaces.

Timing and Significance: While students will bring more devices to campus, the university will not own these devices. As such, they will require greater levels of connectivity and requirements for internet bandwidth. In addition, the cybersecurity threat surface will expand in with increases in the total number of connected devices, and the total number and types of hardware devices and applications using the network.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Virginia Tech's IT department will manage these demands. The college must be a good partner.

Expected Impact: Opportunity to leverage student technology.

Timing and Significance: As students bring more technology on campus, there will be opportunities to leverage these technologies to enhance quality of life issues for students and to potentially enhance learning and/or education administration.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

What do we not know? What key questions do we need to address?

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D. LIFELONG LEARNING

Description: Lifelong learning reflects expectations that the rate of change in technologies, processes, and procedures in society in the coming decades will cause the half-life of a college education to decline. This will require individuals continue to engage in learning activities to ensure access to employment and effectively engage in society throughout one's life.

Trajectory: The notion of life-long learning has existed as a personal charge—something we should all be prepared to do—but has primarily been considered an individual responsibility. With the advent of increased educational opportunities beyond traditional for credit-degree programs, the potential to develop lifelong learning platforms that can aid learning across a wide range of life issues is more plausible today, and because it is seen as good for society and there is a unique, new revenue model for this type of education, it likely will continue to expand in the future.

Expected Impact: Increased opportunities to offer non-credit executive education courses for working employees looking to upskill and reskill.

Timing and Significance: These opportunities in executive education exist with renewed interest by many players enhancing or increasing their offerings. We do not currently have brand awareness in the executive education space, and it will take some time to develop momentum.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Moderate	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Teaming up with industry partners and developing custom training in areas of unique Virginia Tech and Pamplin College expertise (e.g., cybersecurity risk), rather than offering open enrollment programs is showing some success.

Expected Impact: Interest in being able to package courses into certificates and potentially degrees.

Timing and Significance: Many individuals who have completed one degree and look to add additional expertise and credentials are interested in certificate programs, or any training program that provides evidence of completion of a course of study. Being able to offer individual courses that can be combined to create a credential is gaining momentum in the marketplace. This includes efforts around "badging."

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Moderate	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

This is likely to be most readily offered initially in the National Capital Region.

What do we not know? What key questions do we need to address?

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E. EXTERNAL PRESSURE TO IMPROVE THE EFFECTIVENESS OF BUSINESS EDUCATION

Description: There has been a steady call to improve the effectiveness of higher education, and business schools are not immune to those pressures. Frequently, this comes in the form of calls to adopt curriculum revisions or new pedagogical approaches (e.g., online learning, filled classroom, collaborative/interdisciplinary/experiential).

Trajectory: Pressures on higher education to do better have existed both within and outside the academy since at least the 1980s. In response, a number of pedagogical models and tools are emerging and new entrants to this group continue to grow. While each of these recommendations is often well considered and most have some evidence of effectiveness, the data do not suggest that widespread implementation of these models is having a meaningful impact on the effectiveness of higher education. In addition, the increasing availability and reduced costs of computing equipment and the ubiquity of internet access are ramping up interest in attempts to leverage computers and the internet to enhance education.

Expected Impact: The college will continue to face external pressures to adopt new pedagogical approaches, many based on advancements in computing technologies.

Timing and Significance: Opportunities to adopt new pedagogical approaches are ubiquitous as a number of traditional textbook vendors and new technology-based companies offer new solutions. A fundamental challenge to adopting these new technologies is being able to keep score—to gather evidence of where and to what extent adoption of these pedagogical features impacts learning more positively for a given cost than currently adopted methods.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Having sufficiently detailed data to support these decisions would permit individual faculty to make good decisions about the adoption of these technologies or pushing back and not implementing when reasonable.

Expected Impact: Growing pressure to increase the efficiency of education.

Timing and Significance: This is likely to come in two forms. Since faculty are one of the two biggest costs of education (facilities are the second), pressures to increase the ratio of revenue (tuition and fees) relative to faculty cost is to increase the number of students each faculty members teaches in a given year. This can be done by increasing the number of students in each class. The other is to increase the number of classes taught be each faculty member. The calculus of these efforts makes the implicit assumption that increases class size or the number of classes a faculty member teaches does not affect learning. The general knowledge is that at some point increasing class size or the number of classes taught will reduce student outcomes. However, we do not currently know the extent and nature of the reductions in learning that occur. For a given instructional model (content, pedagogical approach, and student characteristics) there likely is an optimal class size the maximizes aggregate learning for a given cost, but changes in pedagogical approaches influence these points of optimality. Change any one of the inputs and the optimal point of learning may occur at a larger or smaller class size.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Pressure to increase faculty productivity across the missions**.**

Timing and Significance: Depending on faculty category (the college currently uses three faculty categories: tenured/tenure-track, collegiate, professor of practice and instructor) who jointly contribute to addressing the college's three missions—research, teaching and service. As faculty salaries increase, there is a desire to position faculty to generate the greatest value for these missions that is possible for a given faculty member. The vast majority of faculty work hard to complete what is required by these three missions. To increase output in all three of our missions, the college could increase the number of faculty in the college, which it likely will, but only marginally (~10% in total numbers over five years) due to cost. The more significant opportunity is to help faculty work smarter (not harder). It may be possible to increase tenured and tenure-track faculty research output by another 50% by implementing simple changes in practice to make sure that faculty research effort is deployed in ways that generate more research outcomes per our worked. The same is likely true for the practices of teaching. It may be possible to modify practices to maintain or increase the effectiveness using only two-thirds of the effort currently employed to design, teach, and administer courses currently.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

The key for faculty in all categories and in all of our missions is to make sure that we are generating the greatest outcomes for the time spent. This includes service work where we do not want to encourage faculty to engage in increased hours of service, but to generate greater value in the hours they spend. These practices, particularly those geared toward teaching, are also likely to benefit students by engaging them in activities that create the greatest amount of learning for the hours spent.

What do we not know? What key questions do we need to address?

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VII. TECHNOLOGY

A. INTERNET OF THINGS

Description: The Internet of Things (IoT) refers to the shifting of business models, creation of new products and services, and changes in transactions, social interaction, and entertainment caused by a large number of individuals that have consistent, wide-bandwidth connections to the Internet using a wealth of current and emerging devices, and employing an ever widening arrange of new software tools.

Trajectory: Since its beginnings nearly 30 years ago, the peoples' interactions with the internet have consistently moved toward access to the Internet at any time, from anywhere, using any device, to access any application, to perform any activity. In the last decade, an explosion of easy to use devices, widespread adoption of smartphones, and an increasingly useful set of software applications and services has driven an ever-increasing amount of human activity on the Internet. Consequently, the internet is impacting every aspect of how we live and work.

Expected Impact: The need to rethink business education.

Timing and Significance: The existence of the Internet is fundamentally and rapidly changing business practice. Methods of performing work and core organization transactions that were common as little as five years ago are being redesigned and optimized for an "IoT" world. This has dramatic implications for how we transact business. As a result, we need to reexamine the examples of systems and processes we teach to make sure they capture a genuine IoT perspective, since that is the world tomorrow's graduates will enter.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Our teaching will quickly be recognized as out of step with reality by internet-native students. This likely impacts every course in the curriculum, though faculty who are currently engaged with industry may not be sensitive to, recognize, understand, or be able to anticipate these changes.

Expected Impact: Increased need for cybersecurity risk training.

Timing and Significance: The IoT is rapidly increasing the cybersecurity threat surface in all organizations. Organizations are rapidly moving to web-based mobile applications involving a large number of internet-connected devices. This expands a company's cybersecurity risk. New business graduates need to understand the concepts of privacy, security, and confidentiality and consider how decisions about each of these may influence the development of new internet-centric products, services, and business practices.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years

Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

This type of learning will also be critical for existing managers who have worked for years in organizations where few practices involved the Internet.

Expected Impact: Increased access to large amounts of data.

Timing and Significance: As more activity occurs on the Internet, that activity produces extremely large amounts of data. Activity about how people (and employees) conduct activities will provide inexpensive access to process and outcome data that could dramatically improve efficiencies, customer satisfaction, revenue, and generate long term competitive advantage for organizations. It will also likely create opportunities for first movers and those most adept at using data to drive better decisions to fundamentally disrupt existing markets and create new ones.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

What do we not know? What key questions do we need to address?

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B. DATA-ENHANCED DECISION MAKING

Description: Data-enhanced decision-making refers to the systematic use of data to achieve better decisions than would be made without that data.

Trajectory: Greater access to data combined with continuous decreases in cost and ease of use of computing hardware, software, and storage and ubiquitous, easy to use data-analytics software has launched a dramatic increase in interest in and organization expenditures in data science and business analytics. There is strong demand for data scientist with high-level expertise in artificial intelligence and machine learning.

Expected Impact: High demand for business analysts that can use data to drive decisions that improve business outcomes.

Timing and Significance: While there is strong organizational interest in data scientists with strong statistical analysis skills, anecdotal information suggests that data-first approaches to business analytics are less effective than problem-first approaches. Colleges of business have strong problem-first orientations. Combining strong problem-first approaches to analytics with cutting edge statistical tools has the potential to create graduates with the capability of dramatically increasing an organization's return on investment from analytics efforts.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

There are opportunities to work with statistics and computer science to create joint degrees or student training in both sub-disciplines that could provide a unique and valuable skill set in the market.

Expected Impact: Increasing interest in artificial intelligence and machine learning.

Timing and Significance: Early applications of artificial intelligence and machine learning have the potential to improve, and in some cases partially or entirely automate many complex, but finite, decision processes and some that are more ambiguous. The development of algorithms that can find ways to maximize the contributions of massive amounts of data have already been shown to dramatically improve decision making in some areas and create the opportunities to remake processes at low cost in near real time. These efficiencies are not possible with human decision makers except at much higher costs.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

While some of our graduates may be involved in developing and fine-tuning big data algorithms, the vast majority need to be aware of what artificial intelligence and machine learning is and understand that the current development of these technologies is still far from duplicating the complexities of

human thought. However, there are many decisions that humans make where algorithms may improve the average quality of decisions but can almost assuredly make those decisions at less cost.

What do we not know? What key questions do we need to address?

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C. INCREASING CONCERNS ABOUT PRIVACY AND SECURITY OF INFORMATION

Description: As more and more interactions occur online, the amount of information about people that exists in online repositories is increasing. Privacy deals with whether or not a business chooses to store sensitive or non-sensitive information about an individual in an electronic or other form. Security deals with access or manipulation (e.g. hacking) of that information by people who should not have access to it. Confidentiality completes this triumvirate. Confidentiality refers to assuring that people who should have access to sensitive information do not use that access for inappropriate or unauthorized purposes.

Trajectory: As the number of people online grows and the number of transactions and other activity these people conducted online grows, so does the amount of potentially sensitive information about individuals that must be protected. Further, the number of devices each person has connected to the internet is also growing. As the amount of data and the number of devices continue to expand, so does the threat surface that must be protected—that growth is currently exponential.

In addition, while the US has been a leader is cyber offensive activity, a number of actions have allowed individuals and nation-states to become more capable of creating cybersecurity threats, and the automation is driving down the cost of being a bad actor and increasing the amount of activity any bad actor can perform. As a result, the amount of cyber threat activity that must be protected against is also growing exponentially.

Expected Impact: University systems and data are under continuing and growing threats.

Timing and Significance: As some of the most critical and vulnerable systems (energy, finance) improve their capacity to defend against cybersecurity threats and improve their risk management. Bad actors will work their way down the food chain to less lucrative, but more vulnerable targets. While most research universities have moderate to strong cyber defenses, as the threat surface expands and more lucrative targets are taken off the board, university systems may come under increased attack. Therefore, appropriate cyber defenses and appropriate training of actors within the university will continue to grow in importance.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Because Pamplin research tends not to be IP sensitive, this threat may be muted, but we have a significant amount of information about our students.

Expected Impact: Increase in number of jobs in cyber-security physical system defense.

Timing and Significance: Many organizations have not fully recognized the level of exposure they have to cybersecurity threats or have been slow to deploy against them. Many organizations are playing catch-up by seeking to hire staff to begin defending against threats, others are employing contractors to help ensure security. Further, in all cases, threat surface expansion will call for some amount of increased employment in the sector.

Expect employment in this space to remain strong in the next five years with a deficit of 30,000 positions in northern VA estimated to exist now. However, like cyber offensive actions, if cyber defense can also be automated, this will mitigate against some of the very high projections for employment of cybersecurity warriors. Demand for bachelors and master's students that understand cybersecurity are growing and will continue to do so in the immediate future.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Increased need for cybersecurity risk training.

Timing and Significance: While training of cybersecurity warriors, who must know how to use physical and software tools to identify, mitigate and protect systems against threats, there is also a need to increase managers' understanding of how an "internet of things" world changes the risk profile of an organization. Many senior managers in organizations grew up in a world that did not have the Internet. They have been slow to recognize how Internet activity is changing the risk profile facing organizations. They struggle to understand the magnitudes of these threats or how to effectively mitigate against current threats or to project emerging ones as their organizations continue to move toward a connected world in which people can use any device, anywhere in the world, at any time, to access any software application and any relevant data.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

This training will be critical to the future success of current business students, but there is a tremendous need to reskill existing managers in organizations across the economy.

What do we not know? What key questions do we need to address?

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D. PLATFORM ECONOMIES

Description: The 'platform economy' represents a dramatic shift in traditional business models (including first-generation e-commerce models) toward highly integrated business platforms that create 'winner-take-all' markets. Such markets are those a market with a natural affinity for organic monopolies that are highly profitable (Schilling 2002). Such models are facilitated by the Internet, big data, advanced AI techniques, Internet-of-things, globalization, network effects, strong economies of scale, among other factors. Formally, a platform is a nexus of rules and an architecture that allow and actively promote interactions between different partners in a multisided market in which consumers may also act as producers or providers (Rochet and Tirole 2003). Platforms have arisen because the market "increasingly favors orchestration [of third-party content providers] over [in-house] production" (Parker et al. 2017, p. 255). Furthermore, platforms are more likely to enable economies of scale (Bakos and Katsamakas 2008; Krishnan and Gupta 2001), thus reducing the costs associated with finding information, customers, or suppliers (Armstrong 2006; Rochet and Tirole 2006). Rather than searching through multiple locations, one platform can be used to quickly search through a multitude of potential trading partners. This improved process has greatly favored such platforms, leading them to become market leaders in their respective areas.

Several characteristics make platform-based business models unique. First, platforms often have different utility functions for their users. For example, the value of the good or service in the network is increased based on the number of users and is not intrinsically tied to the good or service itself (Katz and Shapiro 1985). This is known as a *network effect*, which is defined as the influence that one user of a good or service has on the value of the good or service for others within the network (Katz and Shapiro 1985). Network effects are crucially relevant for platforms involving social networks, marketplaces, or crowdsourcing. Until the user-base reaches a critical mass, the utility of the platform is nominal. Once it does reach a critical mass, even though the service provided has not changed, the value of that service increases for each user. Accordingly, creating network effects rapidly is one of the keys to "winning" in platform-based markets (Farrell and Klemperer 2007; Katz and Shapiro 1992; Schilling 2002; Sheremata 2004). A platform thus becomes the digital space wherein consumers and producers meet and are able to exchange their goods or services, and the value of this platform will depend on the number of users on all sides of the network. Increased network effects strengthen existing and prospective users' willingness-to-pay (willingness-to-participate).

Second, many platforms also experience network effects from existing related networks, such that the value of a network's goods or services is further increased based on the number of users in a secondary network; these effects are known as indirect network effects. Such platforms are termed *secondary-mediated platforms* or *platforms with indirect network effects* (Boudreau 2010; Dubé et al. 2010; Parker and Van Alstyne 2005; Stremersch et al. 2007). For example, Uber's network would be completely worthless to potential riders if no or few drivers were ever available. Likewise, if there were a lack of potential riders, then the value to the drivers in the network would be greatly diminished. Similarly, the platform would be less useful if peripheral sides of the network, such as financial intermediaries, did not support the platform, thus requiring inconvenient cash or check transactions.

Most e-commerce platforms experience these two-sided network effects, wherein the value of the overall network depends upon having both consumers and producers. Third, and related to network effects, many platforms that exhibit network effects also enjoy s*trong economies of scale*, or returns to

scale, that is, the marginal cost of producing an additional unit of output decreases as the volume of the output increases (Katz and Shapiro 1985). Economies of scale have an important positive effect on platforms that already experience a network effect from the number of users. When a platform has more users, the value of the good or service increases for those users, which strengthens their willingness to adopt the platform and use it. The cost associated with providing the service then becomes lower for each additional entrant (i.e., the marginal cost) into the platform as the size of the network increases. In turn, this increase in demand-side and supply-side network effects often increases the likelihood that, due to the platform's size, its value is much higher than that of competing platforms and its output is less costly (per user) to maintain.

In such cases, the market, favoring a natural monopoly, "tips" toward that platform, according to the principles of "winner-take-all" markets (Liu et al. 2011). Nearly every platform that benefits from network effects is an example of this phenomenon (e.g., Amazon, Baidu, eBay, Facebook, Google, Tencent, Uber, YouTube). Consider the Uber platform: As Uber began to cover more geographic areas, the demand for rides began to grow, resulting in a network effect on the side of the riders. The increased number of riders using Uber led to an increased demand for more drivers—a secondary platform network effect. By having more drivers, Uber also decreased the wait time for a ride (thus manifesting economies of scale), further reducing the cost (not just the price) of using Uber. The decrease in cost led to an increase in demand because the value of the service had increased, but the value of the service had increased due to the decreased wait time, transferring another network effect from one side of the platform to the other. The network of trust in this example affects many sides of the platform, including the drivers, riders, and financial intermediaries, the app/system, and even indirect sides, such as taxi drivers. Crucially, most of these players are both trustors and trustees, challenging traditional views of e-commerce trust (e.g., as described earlier, a rider needs to trust a driver, but a driver also needs to trust the rider, and both need to trust the payment system and the Uber app, among other factors).

The natural tendency of a platform to achieve this near-monopoly status depends upon three conditions (Armstrong 2006; Farrell and Klemperer 2007; Rochet and Tirole 2006; Shapiro and Varian 1999). First, the network effects on the platform must be both positive and strong. Second, the costs of using more than one related platform are high, as are *switching costs*, which are defined as the set of monetary and psychological costs that a user incurs by changing from one supplier, brand, or service to another (Klemperer 1987; Shapiro and Varian 1999). Thus, users are incentivized to stay with one platform. Third, the demand for or benefit of using more than one platform is often limited. When benefits are limited or nonexistent, especially if additional costs are imposed, individuals will naturally limit themselves to one platform. For example, Facebook grew rapidly, thanks at least in part due to strong network effects: users received more value for being on Facebook as the number of Facebook users increased. Growth in the Facebook user population increased the likelihood of finding friends, colleagues, and family on the network, which increased its inherent value as a platform for online communication. It takes a great deal of effort to set up and customize one's Facebook profile and to establish links to hundreds of "friends." Thus, high switching costs reduces the likelihood of users capriciously moving to another social network, or participating in multiple similar social networks. Additionally, the costs of using a second social networking site are increased because the interfaces might differ substantially, requiring work to build familiarity and dexterity with each platform. Also, not

all actions that can be performed on one site are replicated on the other platform, so missing features can cause confusion and dissatisfaction.

The economic consequences of platform-based markets is profound. In fact, in 2015, the four most valuable companies in the world—Amazon, Apple, Google, and Microsoft—fundamentally shifted to operating in Internet-based platform ecosystems with third-party content providers (Parker et al. 2017). These models have become the foundation for nearly all successful Internet-based firms, and these have spread to more traditional but important areas such as transportation, retail, and even healthcare. These platform-based models are revolutionary—they have literally transformed the global economy and upended traditional relationships, interactions, and dynamics among individuals and organizations (Choudary et al. 2016). Now, an increasing number of top firms int the world operate platforms or primarily as platforms. Recently, the majority of the top-20 highest paying firms in the US were primarily based on platform-based business models[1], including, (20) Amazon, (19) Pegasystems, (18) Bloomberg, (16) Netflix, (15) Visa, (13) Zynga, (12) Adobe, (11) PayPal, (10) Salesforce, (9) Intuit, (8) Google, (7) Facebook, (6) E-bay, (5) Microsoft, (4) Apple, and (3) Linkedin. Ironically, the companies in the top-twenty that do not operate as platforms, substantially exist to support platforms, including: (17) Cisco (2) VMware, and (1) NVidai. The only non-platform related business on this list was (14) Chevron. Crucially, a key reason these firms are the highest paying in the US is that they require a highly educated workforce but also because they are exceptionally profitable, as they operate as winners in 'winner-take-all' markets.

Trajectory:

Expected Impact: Exceptional disruption of virtually all traditional retail, such that no traditional player is safe and many will go bankrupt (e.g., Sears, JCPenny, Maceys, indoor malls, strip malls). This likely also includes the disintermediation of traditional suppliers in most supply chains. Businesses need to understand these effects so that they can navigate them effectively. Business students need to be able to identify these effects so that they can monitor and respond to available opportunities made available in markets due to these effects

Timing and Significance: These effects are already occurring and we expect them to accelerate in the near future.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: 'Winner-take-all' infers there will be new monopoly-style effects with many potential unintended consequences because of the size and scope of these unusually large and profitable firms (e.g., tax policy implications, employment shifts away from traditional jobs, privacy invasion, great potential for security exploitation).

Timing and Significance: These effects have already occurred in many markets and we expect these effects to be significant and to exacerbate differences in income distribution, but the existence of these

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[1] https://www.usatoday.com/picture-gallery/money/2019/04/16/americas-highest-paying-companies/39354131/

platforms may also create new entrepreneurial opportunities in new products and services enabled by the lower marginal costs of engagement and delivery made possible by these technology platforms.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

What do we not know? What key questions do we need to address?

- To what degree does traditional business training need to evolve to better explain, support, and generate platform-based business models?
- Platforms often operate like 'mega' supply chains that oftentimes subsume thousands of businesses and independent operators throughout the world (e.g., Amazon); what are the corporate governance, controls, security, and privacy implications of these 'mega' supply chains?
- As mega supply-chains, often connected to a vast IoT network with vast real-time data, platforms generate massive amounts of transactional data tied to highly personalizable information sources; how do we teach business analytics to prepare students for this kind of immersive data environment?
- Do traditional business students need a stronger technical foundation so that they can better understand and compete in a platform-based economy?
- Given their propensity toward 'organic monopolies' will platform-based companies face legal challenges? (There are already such negative headwinds in the EU regarding Google and Facebook).
- Virtually every platform-based company in the US or the Europe has a 'mirror' counterpart in China that operates under different conditions of rule of law and market protections. In many cases these companies compete in the US but their US or European counterparts cannot compete in China.. As China's influence expands, especially through initiatives like the 'New Silk Road', what will be the implications for US-based platform companies?

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VIII. LOCAL/UNIVERSITY INFLUENCES

A. BEYOND BOUNDARIES AND DESTINATION AREAS

Description: Beyond Boundaries is the title of President Sand's charge to the university community to broadly rethink education for the next generation of learners. The Beyond Boundaries challenge is a call to go beyond the boundaries that may limit more localized or time-bound thinking to imagine an optimal future not constrained by current resources, budgets, structures, faculty or students. Destination Areas represent focus areas for investment and development within the university in which the potential for dramatic societal impact is possible through collaborative and interdisciplinary research, scholarship, and education. When framed effectively, these areas become destinations that attract the best and brightest faculty and students to take up meaningful challenges related to societies biggest challenges.

Trajectory: To date, the Beyond Boundaries and Destination Area efforts have permitted a deployment of resources and the development of collaborative infrastructures to support interdisciplinary activity. These efforts have been successful in bringing a meaningful number of new scholars to campus. They also have been effective in fostering the development of destination area curricula, much of which also has fed into the development of pathways curricula (the effort to revise the university core curriculum). While there have been some successes in research, it may be too early to tell how the development of destination areas, as an implementation tool for Beyond Boundaries, will ultimately affect the quantity and quality of research and related scholarship.

Beyond Boundaries created a very compelling vision for the university that connected with the vast majority of the faculty, who enthusiastically engaged in a number of opportunities to engage in discussion and potential planning related to going Beyond Boundaries. Destination area development experienced several stop and restarts along the way. Destination area implementation also requires the development of a separate planning and funding infrastructure that in some respects parallels colleges but addresses topics that are interdisciplinary across colleges, requiring efforts to coordinate planning and resource expenditures.

Expected Impact: Beyond boundaries and destination areas will continue to drive resource allocation decisions.

Timing and Significance: Given that Beyond Boundaries is the President's first signature initiative, it is likely to continue to guide investment decisions across the university. The university has already invested a significant amount of money in destination area hires. We may expect the university to slow the pace of destination area hires to let the initial destination area faculty hire settle in, so we can test the effectiveness of the model at a university level and determine what other supporting structures need to be put in place to assure success.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Destination areas will (eventually) focus on addressing grand challenges.

Timing and Significance: Solving societies' greatest challenges has always been a part of Beyond Boundaries and the Destination Areas effort. However, as currently framed, the destination areas represent important areas of research and scholarship, but they are not inspiring in and of themselves. Data and Decisions, for instance, represents an important area for conducting research and educating future business leaders, but it does may not have the potential to get faculty and students excited about getting up in the morning and going to work, as solving a great challenge might.. It is what you can do with data and improved decision-making that potentially has value—what important thing can I do with it? Identifying the grand challenges and naming them is what can be inspiring. Using analytics to reduce traffic deaths, improve health at lower costs, or reduce economic disparity are more capable of creating the energy needed to sustain and drive progress in these efforts and to make the university a destination capable of attracting the best talent.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

What do we not know? What key questions do we need to address?

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B. PARTNERSHIP FOR AN INCENTIVE-BASED BUDGET

Description: The Partnership for an Incentive Based Budget (PIBB) is the university's effort to create a budgeting approach that matches budgets to revenue sources in a way that is data-driven, more transparent and predictable. This approach creates a budget based on traditional primary sources of revenue (tuition, extramural research and philanthropy) and creates mechanisms for allocating changes in funding to colleges based on changes in these revenue sources. This accounts for approximately 70% of the university budget. The rest reflects separate non-PIBB revenue components representing non-traditional revenue sources. This includes things like the payment received from the state of Maryland representing their support for the School of Veterinary Medicine, special fees and revenues generated from the Enterprise model (i.e., MIT) and other unique tuition models (e.g., BXBR, EMBA), and a number of other atypical sources. Of the PIBB portion of the budget, allocation rules for 68% of that portion of the budget (68% of the ~70% that is PIBB) are based on changes in enrollments, student credit hours, externally funded research, and philanthropy. The other 32% (of ~70%) is based on a number of college-generated indicators of student, faculty, and administrative success. Because these factors are not associated with direct increases in sources of funds, they are set at a fixed percentage of the total PIBB budget.

Trajectory: The budget model provides a clearer path forward for understanding what actions the college can take and what influence that would have on budget dollars coming to the college. Under PIBB, the college receives additional base budget funding for increases in enrollment of majors in degrees within the college, increases in the number of student credit hours taught, increases in externally funded sponsored research, and philanthropy with additional incentives for philanthropy that grows the endowment. The college also receives some additional incentives for improving faculty, student, and administrative success factors, but the magnitude of the coefficients on changes in these indicators have not been determined. Because they are not associated with new revenue, it is unlikely that changes in any of the success factors is likely to be associated with large changes in incremental funding to the college.

Expected Impact: Strong incentive to continue to grow non-PIBB revenue sources**.**

Timing and Significance: Research faculty in the college of business command hire market salaries than what are found in other colleges within the university. Top research faculty are highly desired but limited in numbers, so there is significant competition to attract and retain top faculty. These salary premiums are for faculty's expertise and capabilities to conduct high quality research. Unlike most other colleges, business schools do not rely on grants and contracts to fund research. In fact, in many instances once the thinking and research behind a contract is done, creating the deliverables required in grants and contracts actually takes time and effort away from the work that generates academic reputation for faculty and the college and positions faculty for promotion, tenure, and higher recognition. Thus, in the PIBB, there is no strong base budget element tied to the kind of faculty research conducted by our faculty and thus no base budget incentive to provide the resources to enhance research support and increase reputation. Further, there appears to be little incentive within PIBB to increase faculty numbers as the incremental incentives to increase majors or increase student credit hours barely cover the direct costs of hiring additional faculty. The funds to do this will most likely need to be generated by non-PIBB sources of revenues.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Incentive to increase funding from grants and contracts.

Timing and Significance: Funding from extramural grants and contracts is not an area that the college has activity pursued in the past given the mixed incentives it sends to faculty. However, the PIBBs recognition of extramural base funding and the potential to use grant funding to fund a portion of the cost of advancing the college's research mission may make this attractive. Two hurdles exist to pursuing external funding more aggressively. Given the mixed incentives for faculty about sponsored research on research productivity and promotion and tenure decision, and only a limited number of faculty in the college have significant grant experience, it is likely that the college would need to hire new faculty with specific responsibility for this mission (Pamplin is looking at Collegiate faculty as potentially filling this role). The second is that the college currently does not have the administrative infrastructure to support a robust grant and contract generating enterprise and would need to begin to build this infrastructure.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

This expertise does exist on campus, so it would be possible to either partner with other entities to bridge the knowledge/experience gap for grants and contracts support. Further, the development of Link and its efforts to expand research relationships with corporate clients may provide a "lower lift" avenue for the college to expand grants and contract efforts.

What do we not know? What key questions do we need to address?

C. NATIONAL CAPITAL REGION EXPANSION

Description: Pamplin is looking to expand its educational (and research) footprint in the National Capital region. Pamplin currently administers six master's programs from the NCR campus. These include the Evening MBA, Executive MBA, Professional MBA (taught in Richmond and Roanoke), Masters of Information Technology (MIT; jointly with the College of Engineering), and the Masters of Science in Business Administration with a concentration Hospitality and Tourism. The college is looking to expand the Master of Science in Business Administration with a concentration in Business Analytics (MSBA-BA), which is currently offered in Blacksburg, to the NCR by fall of 2020. Pamplin also offers the Executive Doctorate in Business Research in the NCR and will be delivering its first executive development offering in spring of 2019. Pamplin enrolls over 900 graduate students of which almost 800 are currently in the NCR.

Trajectory: Enrollments in master's programs have been growing at a rate of approximately 10 percent per year. Given the size of the market, we believe with new offerings and continued marketing efforts in the NCR, growth of at least 10 percent per year is possible for the next five years. Once our new degrees are available, the Innovation Campus comes on line, and we expand our NCR faculty there is potential to grow enrollment and revenue by as much as 20% per year. We will continue to use the high rankings of our current programs to build Pamplin's reputation in this market.

Expected Impact: Additional faculty will be needed in the NCR.

Timing and Significance: While we are able to rely on a cohort of strong adjunct teaching faculty in the NCR, continued expansion will require the addition of new tenured/tenure-track and full-time non-tenure-track faculty in the NCR. There are currently twelve full-time faculty located in the NCR. This includes: 10 tenured faculty (ACIS, 1; BIT, 2; FIN, 2; HTM, 1; MGT, 2; MKTG, 2), 1 Collegiate Faculty (BIT) and one Professor of Practice (BIT). The presence of the BXBR program requires research activity tenured faculty, and it is likely that we will seek to add three additional tenured faculty line in the NCR as well as three additional non-tenure track faculty, likely in the areas of cybersecurity, business analytics and entrepreneurship.

How significant will this expected impact be in the near and distant future?

Timframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Offer courses in a BS degree in BIT with a concentration in cyber security in the NCR.

Timing and Significance: While Virginia Tech has not been able to offer undergraduate degrees in Northern Virginia, the college can offer experiential programming as part of existing degrees in Northern Virginia. BIT has developed an undergraduate degree option in cybersecurity, and it will be possible for the college to offer at least the experiential components of this program in the NCR.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Increase Executive Education

Timing and Significance: In the past year, Pamplin in combination with Virginia Tech's Continuing and Professional Education department has offering executive education courses in the NCR. We expect revenue in AY 2020 to increase to $500K (up from $200K in AY 2019). We expect that executive education revenue can grow to $2-5 million per year in the next five years using a custom training-partnership model. This growth will be dependent on our ability to place enough collegiate faculty in the NCR to allow us to leverage them with additional adjunct faculty to develop and deliver high quality custom programs.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

What do we not know? What key questions do we need to address?

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D. INNOVATION CAMPUS

Description: The Innovation Campus is the name given to a signature joint effort by the Commonwealth of Virginia the Virginia Tech to build a campus in northern Virginia. A central objective of that campus is to educate the next generation of computer scientists who can create and apply the next generation of artificial intelligence and machine learning applications in industry. The campus was a significant component of the job-training offering in the successful bid to encourage Amazon to locate HQ2 in northern Virginia. Virginia Tech expects in the future to broaden the disciplinary focus considerably to include degrees related to computer science.

Trajectory: The complete Innovation Campus program will cost around $1 billion dollars and will be built and implemented over the next decade in northern Virginia with approximately half of the funds provided by the state and the remainder provided by or generated from Virginia Tech Innovation Campus operations. The primary deliverable from the project is the creation of a one-year professional master's degree in computer science in the NCR capable of enrolling 750 students per year by the end of the rollout phase (7-10 years from now). In addition, Virginia Tech is committed to increasing the number of undergraduate computer science graduates by 2,000. Much of this growth will occur in the new global analytics building that is part of GBAC, and thus why the $68 million to fund the building has recently included in next year's state appropriation.

Expected Impact: Opportunities to expand graduate enrollments in NCR business master's programs.

Timing and Significance: While no current business master's program is included in the Innovation Campus plan, Virginia Tech and Pamplin believe there will be needs to expand related curriculum offerings beyond the two narrow degree programs that are the focus of the Innovation Campus. Furthermore, while the target for enrollment for the professional master's in computer science is 750 per year, we expect that throughout the program's life there will be attrition. This will create opportunities to provide soft landings for students who do not finish the professional master's in computer science to complete one of our current master's program offerings, the MIT degree, or new degrees in analytics or cybersecurity.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

When the professional master's program is fully deployed, we believe there will be opportunities to help up to 150 students per year complete related master's degrees.

Expected Impact: Enhance technology commercialization in the NCR.

Timing and Significance: While it is not part of the original rollout of the Innovation Campus, there are expectations about increased economic development in northern Virginia both as a result or in support of Amazon's deployment of HQ2 and as Virginia Tech ramps up its technology commercialization efforts. These efforts will be led out of the Office of the Vice President for Research and Innovation, specifically by Brandy Salmon's team through a new entity (Launch) which will be spun up over the next five years. The college, through the Apex Center for Entrepreneurs, is well positioned to provide support in two areas seen as important for enhancing Virginia Tech's technology commercialization. The first is

providing initial market analysis of recently disclosed intellectual property and deep analysis of ideas for commercializing products and services developed from Virginia IP. The second is helping to educate and connect the human capital in our entrepreneurship ecosystem to "bankable CEOs" and IP in order to build highly functioning entrepreneurial teams. Then, connect those founders and teams to mentors with the relevant knowledge and skills needed to help these companies grow and become profitable.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

What do we not know? What key questions do we need to address?

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E. COMMONWEALTH CYBERSECURITY INITIATIVE (CCI)

Description: The Commonwealth Cybersecurity Initiative is a $40 million program funded by the commonwealth designed to increase the number of people trained to take roles in the field of cybersecurity. The CCI involves all colleges and universities in the state that offer programming in cybersecurity, with Virginia Tech, through the Hume Center which provides overall leadership.

Trajectory: The college desires to partner with the Hume center to assist in the development of for-credit master's programs and cybersecurity units within existing master's programs as well as to offer non-credit executive education in the area of cyber security risk management. We will also seek to contribute incrementally to the Hume Centers grant and contract efforts. For these efforts we will are expecting to receive funding in the amounts of $1 million in AY2020, ~$800K in AY2021, $650K in AY2022 and annual base funding of $500K each year after that. For receiving those funds, we are to create a center for cybersecurity risk, hire a director and support staff as appropriate, as well as make initial faculty hires. The long-term goal of this funding is to position all CCI initiatives, including the cybersecurity risk center, to generate $1.5 million per year from extramural sources to compliment the $500K base funding.

Expected Impact: Increased need for additional faculty in cybersecurity in the NCR.

Timing and Significance: This will likely involve hires in three different categories. Tenured research faculty will drive graduate education, the development of master's curriculum, and to support sponsored research activities. Collegiate faculty are likely to be needed to manage some of the external aspects of the center, help develop grant funding, teach masters course, and participate in executive education. At least one professor of practice will be needed to help teach masters and undergraduate courses in cybersecurity and deliver executive education in cybersecurity risk.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Establish a center in cybersecurity risk.

Timing and Significance: Creating a center and hiring staff is a requirement if we are to receive CCI funding. This center is likely to place rolls in three value-adding missions of the center—supporting the development and delivery of cybersecurity related degree programs, supporting the generation of funding through cybersecurity related grants and contracts, and offering non-credit executive education courses.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

What do we not know? What key questions do we need to address?

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F. RAPIDLY INCREASING ENROLLMENT

Description: In order to drive revenue growth to fund necessary change initiatives at the university, Virginia Tech has been increasing enrollments, with a targeted goal of 30,000 students in Blacksburg by 2023 and similar increases in graduate education in the NCR associated with the Innovation Campus and the CCI initiative.

Trajectory: Total enrollments at the university have grown from 31,006 in 2010 to 31,224 in 2014 to 34,850 in 2018. The number of full-time undergraduate students primarily enrolled in Blacksburg has grown during that same period from 23,241 to 23,685 to 27,180. This growth places pressures on student support services as well as teaching and advising systems to maintain quality during the ramp up on the way to our target enrollment.

Expected Impact: Increasing need for faculty office space.

Timing and Significance: With enrollment growth over the last several years, Pamplin has replaced more than 40 tenured and tenure track faculty without increasing total faculty numbers (97 in 2010; 94 in 2014 and 95 in 2018). However, Pamplin has increased the number of full-time non-tenure track faculty (19 in 2010; 21 in 2014 and 40 in 2018). These faculty require access to space within Pamplin to conduct mission related work, particularly engaging with the students in their classes. During this same time period, Pamplin has worked to convert every possible space to faculty and high-value student deployments, including converting closet and storage space and assigning 2-3 doctoral students and up to as many as 7 adjunct faculty to the same office space. There are no further space conversion options in the building. In order to bridge the increasing space needs of the college as we grow enrollments and other programming, the college will need to look for space outside of Pamplin and potentially off campus to provide these space needs until construction of Academic I in GBAC is complete. One estimate is that we may require space for up to 20 faculty offices during that window.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Increasing needs for adjunct faculty and the systems to support non-tenure-track faculty success.

Timing and Significance: Enrollments grow more rapidly than the college can adjust its faculty. As a result, Pamplin like other colleges employs industry experts, such as adjunct faculty, to fill additional class needs. Strong adjunct faculty are critical for providing unique expertise for practice specialties that may not exist in our current faculty and to provide incremental supply when enrollments increase to the point an additional section is needed. Adjunct faculty also play a critical role in providing coverage for faculty who have short term health issues, or to help cover courses when faculty are on research leave. In Academic Year 2019 (AY2019), across all of its programs, Pamplin delivered 820 in-load (part of faculty's required teaching) with nearly 100 of those sections being taught by adjunct faculty. The vast majority of adjunct faculty currently deployed have long relationships with the college and are familiar with our curriculum and with the university systems supporting education. But as college enrollment

grows, curriculum expands, and the potential roll of adjunct faculty increases, the challenge of assuring these faculty are supported in their efforts to effectively deliver the curriculum as intended increases.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

What do we not know? What key questions do we need to address?

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G. CALHOUN HONORS PROGRAM

Description:

The Calhoun Discovery Honors program is the result of a $20 million gift to the university by Pamplin alum David Calhoun to develop a program to train the next generation's innovation economy leaders. The honors program will enroll its first cohort of 50 students during the fall of 2019 drawing students from five core disciplines. The focus of Calhoun's educational model is problem solving for societies major challenges by learning in collaborative cross functional groups. The instructional model involves base coursework in the students discipline (major), required studio courses throughout the degree program to work with industry partners on problems, and a series of one credit hour courses to learn key disciplinary issues from outside the students core discipline. Currently 38 of these one credit hour courses have been designed. Several faculty from the college of business have been involved in the design effort. In addition to the Calhoun Discovery Program, the gift also funds the Calhoun Higher Education Innovation Center (HEIC). The role of the HEIC is to engage in research to study the effectiveness of the Calhoun Discovery educational model and highlight how it can be enhanced, and then leveraged to the rest of the university and beyond.

Trajectory: The program will enroll its first 50 students in the fall of 2019 and then will add additional cohorts of 50 students in subsequent years, reaching a target enrollment of 200 students by fall of 2023. Initial design of the 38 one-credit hour modules is complete. Several of these classes are included on this fall's teaching schedule.

Expected Impact: Increased utilization of college resources

A number of Pamplin faculty have been working with the Calhoun Honors program, in compensated roles, to design the build the program's curriculum. Several of faculty will likely be delivering part of this curriculum, with some beginning in the Fall of 2019. A critical question for the college is the size of the faculty complement to deploy in support of the Calhoun Honors Program and the Calhoun Higher Education Innovation Center (HEIC). While Calhoun is providing release resources for these faculty, there is an opportunity cost to the college of having key faculty working on activities for the Calhoun Honors Program instead of working on other college initiatives. Given the potential numbers of faculty involved, it will be important to monitor the college's total faculty commitment to Calhoun over the next few years.

Timing and Significance: Currently five faculty (e.g., Janine Hiller, Robin Russell, Mark Mondry, Howard Haines and Kim Carlson, as well as Associate Dean Lara Khansa) have been involved in planning and curriculum development leading to the enrollment of the first cohort of 50 students who will begin the program in fall 2019.

Timing	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Moderate	Significant

Expected Impact: Potential to leverage Calhoun's curriculum development and education models

The effort deployed in developing the one-credit Calhoun modules will likely have utility as they are likely able to be redeployed in the college's future programming efforts. In addition, experience

developing and delivering one credit hour modules will also be useful as the college has considered, from time to time, whether to offer courses or course models in units less than three credit hours. Participation will also lead to additional undergraduate enrollments in the BIT and MGT curriculum which are both part of the core curriculum underlying the Calhoun program, though these numbers are likely to be modest (the Calhoun program is expected to grow to 200 students).

The Calhoun Higher Educational and Innovation Center (HEIC) is design to study models of learning and specifically to evaluate the effectiveness of the Calhoun Honors Program. As such, there may be opportunities to learn and leverage best practices from the HEIC as we look to enhance learning effectiveness in Pamplin as we prepare for our move to GBAC.

Timing and Significance: Development of the 38 one credit hour models in the Calhoun honors program has been ongoing. Faculty will teach some of these courses for the first time this fall. It is not clear whether we will learn anything useful from this exercise, but we will be better able to judge the utility and effectiveness of the Calhoun model by participating in it over the next few years.

Timing	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Marginal	Marginal

What do we not know? What key questions do we need to address?

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H. PATHWAYS CURRICULUM

Description: During the last five years, the university core curriculum (the university mechanism for general education—usually completed as part of the first 60 credit hours—has been replaced by the Pathway's Curriculum. The Pathway's Curriculum provides greater flexibilities for students to adapt the general education learning requirements to a student's interests and needs. Pathways courses are designed to contribute to accomplishing three high-level learning goals and each pathways approved course needs to include educational components that address at least two of these goals. These goals are . . .

Many destination areas have worked to build pathways minors that can provide exposure to the foundational disciplines that address each destination area.

Trajectory: Construction of a significant number of pathways minors has occurred in the last two years and the pace of development of individual pathways courses is strong. While many of the initial tier of pathways courses are likely nearing completion, we should expect that development of pathways minors and courses to continue for several years as we transition to this new model and as college and departments evaluate the value of premiums for teaching pathways course available in the PIBB model. Future change in pathways courses is likely to depend on how enrollment in Pathways minors and courses evolves.

Expected Impact: Need to integrate pathways curriculum into Pamplin degree programs

The creation of Pathways minors and pathways courses as options for Pamplin students creates additional level of uncertainty regarding the learning foundations present in students as they enter our degree programs. This uncertainty creates opportunities to identify specific minors and courses that provide enhance development pathways for students in various Pamplin curricula. However, while different course pathways may create challenges for how the college builds on core learning objectives of the Pathways curriculum model, there is the potential that the high-level goals of the Pathways curriculum may create certain synergies or homogeneity in students completing this curriculum that may make building on the curriculum easier rather than more challenging.

<u>Timing and Significance</u>: With the deployment of the new Pathways curriculum beginning with students entering during the fall of 2019, we now be able to begin to understand how, or if, the Pathways curriculum changes student learning trajectories and development. We will likely find it important to attempt to identify beforehand how Pathways may affect student development and seek to confirm those effects so that we can make appropriate adjustments to the college's curricula.

Timing	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Moderate	Marginal

- **What do we not know? What key questions do we need to address?**

IX. Pamplin College Influences

A. GLOBAL BUSINESS AND ANALYTICS COMPLEX (GBAC)

Description: The Global Business and Analytics Complex (GBAC) will be the new home for the college of business. It is composed of four buildings—a new academic home for the Pamplin College, the business and analytics building (which will house interdisciplinary work in analytics bringing together faculty from business with those from computer science, statistics and other related areas of campus), and two living learning communities to be built across West Campus Drive between the Alumni Center and the Duck Pond.

Trajectory: High level visioning for GBAC has been ongoing as has initial fundraising. GBAC has benefitted from state support for the new Innovation Campus. A total of $68 million was allocated in the most recent budget to build the business and analytics building, which will provide some support for increasing enrollment in computer science degrees related to analytics. Further, the university is moving forward with planning the two living learning community buildings, which, because they have their own revenue model, are funded primarily through bonds. The remaining building, housing the new academic home for Pamplin, at a cost of approximately $75 million, still needs to be funded primarily from private sources, though some amount of state support may still be possible. There is an incentive to push private support for this final building to optimize development and rollout of the entire complex.

Expected Impact: Continued strong incentives to complete GBAC fundraising.

Timing and Significance: The college has already outgrown Pamplin Hall and is looking to lease additional space off campus for Pamplin faculty, staff, and/or programs. The sooner we can get GBAC built the less of these types of expenses we may incur. Further, not completing fundraising for the reaming academic building dramatically limits the availability of architectural features and use space that will exist in the area connecting the two buildings and will require additional architecture and construction costs if these buildings are not built very close in time to each other.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Marginal

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

Expected Impact: Need to complete second-level planning about how GBAC spaces will be used to enhance learning and student experience.

Timing and Significance: A key driver of the vision for GBAC is its capacity to enhance student's learning experience. While GBAC provides a template to create a new vision for business education for the next generation, specific planning for how GBAC must be configured to take advantage of these opportunities needs to be completed. This is not simply completing the architectural planning associated with constructing the building but completing a parallel discussion and planning around what it means to learn and how we need to remake the learning/education experience. These two efforts need to happen simultaneously so that the vision of GBAC as a living learning laboratory for transforming business education for future generates can become a reality.

How significant will this expected impact be in the near and distant future?

Timeframe	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Moderate

*This table indicates the level of significance the expected impact is predicted to have during the three timeframes.

What do we not know? What key questions do we need to address?

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B. CHANGING FACULTY STRUCTURE

Description: Over the past five years, the university and the Pamplin College have begun to expand the categories of faculty the university employs to accomplish its missions. In addition to the traditional full-time faculty categories of (a) tenure-track/tenured and (b) instructor, the university has added two full time non-tenure track categories—collegiate faculty and professor of practice. Collegiate faculty hold terminal research degrees and are expected to engage in scholarly activity but are more likely to focus those efforts in applied, translational or pedagogical research. Professors of practice are individuals who possess extensive business experience but may not hold a terminal research degree. Typical initial contracts for professors of practice are one-year, while collegiate faculty contracts can vary by rank (3 years for assistant collegiate professors; 5 years for associate collegiate professors and 7 years for full collegiate professors). The Virginia Tech Faculty Handbook and Pamplin College Policy 450 provide guidelines for hiring and promoting non-tenure track faculty.

As currently deployed in the college Tenured/tenure-track faculty have primary responsibility for the college's academic research enterprise and doctoral education, while contributing to each of the college's other missions. Collegiate faculty will have a focus that is increasingly external, engaging our corporate stakeholders through sponsored research, fostering experiential learning through class projects with corporate partners, or through executive education. They will also contribute to the delivering excellence in masters and undergraduate education. Professors of Practice and instructors have the capacity to deliver excellence in the undergraduate teaching and service missions of the college.

Trajectory: The college has increased the deployment of non-tenure track and adjunct faculty over the past five years. A reasonable target faculty mix would have 50-55% of course sections delivered by tenured/tenure track faculty. Collegiate faculty, Professors of Practice and Instructors would deliver approximately 35-40% of course sections with the remaining 5-15% delivered by adjunct faculty and doctoral students. We will guide deployment of faculty to missions in order to match faculty's passions to missions, to stay within the deployment guidelines identified by our accrediting agency and to match resources to mission needs.

We expect the college's research enterprise and doctoral program goals to drive the number and mix of tenure/tenure track faculty. Growth in the college's translational, applied and pedagogical research, masters programs, and executive education and non-credit programs will determine the numbers of collegiate faculty. Growth in undergraduate programs will be the primary driver of the number of professors of practice and instructors. We expect modest growth in the number of tenure track faculty, with much of the growth to occur in the NCR. We expect doctoral enrollments to stabilize at a level of approximately 80-85 student, then growing to approximately 100 as more senior faculty are available to supervise dissertations. Increases in the number of tenured research faculty in the NCR will contribute to a strengthening research culture and provide direct support to Executive PhD students. We expect the number of collegiate professors and professors of practice to continue to grow as university undergraduate enrollments increase and the college expand masters programs, extramural funding and executive education programs.

Deploying non-tenure track faculty is attractive in that it provides greater flexibility to respond to fluctuations in teaching demand and they offer a more attractive price point. Faculty who have great passion and expertise in academic research are expensive. Faculty also exist who have the passions in

translational and pedagogical research or in teaching (who may not have a passion for scholarly research) and who provide excellent education at lower salary levels. Effective hiring and balancing of faculty types to missions gives the college the opportunity to optimize our teaching, research and service missions at best cost.

Expected Impact: Increased development needs for non-tenure track faculty.

As their numbers increase, non-tenure track faculty will assume a bigger role undergraduate education, will play a stronger role in faculty governance and support processes, and will assume a stronger role in other service roles. If non-tenure track faculty are going to be delivering a significant portion of our curriculum, we need to make sure they have the skills, training and support necessary to assure success in our missions.

Timing and Significance: Non-tenure track faculty already deliver a significant number of courses and those courses are typically among those with the largest enrollments, giving these faculty an inordinately large collective impact on the education of undergraduate majors in the college.

Timing	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Significant

Expected Impact: The need to create balance in incentive systems across the college's three missions

Currently the incentive systems for faculty are dominated by incentives targeted toward the college's academic research mission. The Summer Research Grant program rewards faculty for publishing in their field's elite journals. This incentive system allows faculty to earn up to 2/9ths of their salary in summer pay (most faculty are on 9-month contracts). In combination with guaranteed summer funding typically offered for the first three years for new hire, we expect this incentive system's annual cost to run between $2-2.5 million per year when the academic research enterprise reaches target steady state (the college ranks in the top 50 worldwide). In addition, the college offers a career award for research excellence ($5,000) and an annual research excellence award (recognition but no money). Further, the college offers the opportunity tenured faculty to participate in a research leave no more than once every six years. These leaves can be for one semester at full pay or for a full year at 50% pay.

Awards for excellence in the other missions (teaching and service) are currently limited. The college presents an undergraduate teaching excellence award in each department each year ($500), an award for excellence in masters teaching, and an award for excellence in doctoral teaching. The puts forward the names of two individuals each year who are eligible to submit applications for the University's Wine Award for teaching excellence. Other teaching awards are available at the university level for teaching and service, however, the college currently offers no award for service.

Timing and Significance: The current system incentivizes tenure track faculty who have the capacity and interest to conduct top tier research to do so—that is, to have them emphasize the college's research mission. However, the imbalance created by the emphasis on incentives for elite research, while being very effective in increasing elite research journal acceptances, have the potential to discount the importance of the college's other missions. Further, as the number of non-tenure track faculty increases, similarly meaningful incentives for the missions on which these faculty focus do not exist. This creates

the potential for fostering perceptions of a class system where non-tenure track faculty are under-respected and under-valued.

Timing	0-5 Years	5-10 Years	10+ Years
Significance	Marginal	Moderate	Significant

Expected Impact: Increasing need for systematic support of adjunct faculty

Adjunct faculty are hired to teach a limited number of sections (no more than three per semester) and to fill expertise needs not currently available in the college's full time faculty ranks. These needs may occur as a result of unexpected increases in student enrollment requiring additional sections of courses, covering faculty for modified duty requests or during research leaves. Because they offer flexibility, adjunct faculty often increase in numbers during periods of enrollment growth, and likely decline when enrollments decrease. Often adjunct faculty do not have a deep understanding of university systems or the college curriculum within which they are teaching and they often are hired with less lead time to prepare for courses. The college will always have needs for some number of adjunct faculty on an ongoing basis.

Timing and Significance: We are currently in a period of sustained growth in undergraduate programs. College enrollments will grow to approximately 4,700 for fall 2019, up from 4,405 in fall 2018. The university is currently enrolling 27,500 students, with expectations to grow 30,000 students by fall of 2022. If the college holds to current expectations of enrolling 18% of undergraduate students, then we can expect a targeted enrollment of 5,400 undergraduate students by 2022. During this period, we can expect adjunct faculty to play an important role as we work to increase numbers of fulltime faculty. Some departments have systems in place to onboard adjunct faculty, but not all do and the challenges faced by adjunct faculty teaching a course for the first time can be intimidating for faculty and can result in problems for students in adherence to university procedures and in learning. While many adjunct faculty do very well, we do not currently have systematic collective information about the distribution of the effectiveness of our adjunct faculty and doctoral students.

Timing	0-5 Years	5-10 Years	10+ Years
Significance	Moderate	Moderate	Significant

What do we not know? What key questions do we need to address?

- We need better data on the teaching effectiveness of adjunct faculty
- We probably need to be doing after action reviews with adjunct faculty to understand the typical problems and challenges they are facing so that we can better understand their impact on student learning and administration.

C. SPACE MANAGEMENT

Description: The Pamplin College has outgrown Pamplin Hall. Currently only five of the college's six departments are housed in Pamplin Hall (Hospitality and Tourism has remained in Wallace Hall since the Department joined the college in 2002. In recent years the college has converted classroom and storage space to faculty offices and increased the number of adjunct faculty and doctoral students assigned to offices. The advancement team is currently housed outside Pamplin Hall. Further, there is limited student space in Pamplin. Four offices are currently used to house key student committees (i.e., Business Horizon's, PRISM, SEED, BASIS), but the college has 33 student organizations. In addition, the college has no student breakout rooms. Furniture and lighting was added to the Atrium four years ago to provide more space for faculty and students, but this space does not offer heating or air conditioning.

Trajectory: We expect the number of faculty and staff in the college to continue to increase to cover the demands for teaching resulting from increasing undergraduate enrollment of approximately 1,100 students by fall 2022. Further, enhanced support staff will increase demands for space in Blacksburg and the national capital region. Based on current growth, we are likely to need the equivalent of 22-27 additional offices in Blacksburg and 5-7 offices in the NCR to meet faculty and staff growth projections. A part of GBAC is the construction of a new home for the Pamplin College, however, this funding raising for this building is ongoing and we do not expect this building to be available until fall of 2024 at the earliest.

Expected Impact: Pamplin will require substantial space outside of Pamplin Hall through at least 2024.

The college needs to identify additional space and placement of programs to provide for a minimum of disruption of operations between now and redeployment into GBAC. Few options exist for redeploying existing space in Pamplin, therefore moving some faculty, students or operations outside of Pamplin Hall will be necessary. No alternative for moving operations is "non-disruptive." Therefore, identifying a game plan that creates the least disruption over the next five years is important. Further, because growth in Pamplin programming projects expects to outgrow the space created by GBAC, extending at least some relocations of programs may be necessary.

Timing and Significance:

Timing	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Moderate

Expected Impact: Opportunity to study and pilot test methods for shared office space

Given the cost of office space and the likelihood that many faculty are not in their offices for some portion of the week, there exists an opportunity to identify ways to meaningfully increase the number of faculty, staff and students who are able to effectively use a given number of offices or amounts of space. Possible approaches include: (a) reconfiguring space so more people can simultaneously share it, (b) creating systems to permit "hot desking" or other forms of non-simultaneous use, (c) using tele-work and enhanced point-to-point visual electronic communications to reduce required on-campus workspace, or (d) creating reconfigurable commons that can be used by individuals who move between rolls, campus regions and campuses. An additional opportunity is to maintain individuals' applications, data, and workspace configurations on the cloud and then reconfigure whatever workstation the person

swipes in or signs on to their most recent settings. This could also extend to automatic configuration of other workstation appliances connected to the web.

Timing and Significance: To the extent that learning about the potential use of space sharing technologies and procedures, these would need to be tested in time to allow any learning about these techniques that might influence physical configuration of GBAC to be incorporated in the building design.

Timing	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Moderate

Expected Impact: Encouraging faculty to embrace space sharing

Current space expectations within the college have been that all faculty have their own office. Moving to a shared-space model, therefore, will require significant shifting of expectations among faculty. A significant factor in shifting space will be providing appropriate incentives for faculty to help encourage expected behavior.

In addition to efforts to engage faculty in the decision making and economic trade-offs indicating the potential costs of building less office space for faculty, it may be useful to provide incentives to faculty who willingly choose to participate in office sharing configurations. Ideally, faculty expectations would be availability of an office for their person use. But for faculty who are willing to engage in various forms of sharing or avoiding the need for a full time office, providing a schedule of incentive payments may be appropriate to help determine price points at which various alternatives become attractive to faculty and faculty's preference for specific types of sharing arrangements. For new non-tenure track faculty, it may be reasonable to set an expectation for a default setting of a shared office arrangement and then allow faculty to purchase upgrades, or receive incentives for choosing increased density sharing options.

Timing and Significance: The space crunch is already effecting the college. Moving to a system that gives individual faculty choices may help more optimally utilize available space and help the college understand how best to manage moves to higher density space utilization.

Timing	0-5 Years	5-10 Years	10+ Years
Significance	Significant	Significant	Moderate

What do we not know? What key questions do we need to address?

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