The Future of Polytechnic

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Our past and future

Polytechnic has a rich history. As the second oldest, private technical university, Polytechnic has not only witnessed the industrialization of America, but provided many of the scientific and technological leaders who forged gains of the 19th and 20th centuries. The accomplishments of Polytechnic were so profound and the careers so robust that these stories require over 300 pages to be summarized in Poly’s history, Changing the World. We have graduated over 35,000 scientists and engineers, over 200 Poly graduates are CEOs, five graduates are currently serving as university presidents, and three Nobel Prize winners have been closely associated with Polytechnic.

Polytechnic’s recent years are equally significant. We have built a vital campus with new academic, athletic, and residential facilities; we have trimmed our expenses dramatically; we have invested in two major workshops on our future; celebrated our 150 year history with style; welcomed the arrival of new world-class faculty with more to come soon; appointed a new President, and branded our unique style of education and research as “The Power of PolyThinking.”

In this coming year, we will begin enrollments in our new undergraduate Integrated Digital Media Program, graduate our first class of the Honors College; introduce new ideas to increase undergraduate enrollment and retention; open three new joint Masters Degrees programs in China; expand our program in Israel; intensify our pursuit of research funding with two new lobbying teams; sell a block of patents for over $1 million plus royalties; negotiate the development of 800,000 square feet of new “air rights” on our campus; spend over $2.5 million a year on branding, marketing, and recruitment; and begin the first-phase of a new $75M Capital Campaign.

To build on our investments and progress, we must increase our ability to successfully execute the actions for our future outlined in this paper. To leverage our past accomplishments and current assets, we are reorganizing, focusing on execution, and expanding the university’s leadership team. These include a new Provost, a new VP of Research and Technology Initiatives, a new Dean of Undergraduate Enrollment, a new Capital Campaign Director, at least four more named-chair

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1 Last fall, the Chief Technical Officer of Microsoft, Ray Ozzie, published a key strategic document for Microsoft, called The Internet Disruption. It’s a paper worth reading. In this working document for Polytechnic, I will employ Ray Ozzie’s format to describe the era that Poly is entering and also the challenges we face.
professors\(^2\), and other faculty and administrative positions. To provide enhanced strategic oversight, we are strengthening the Board of Trustees by recruiting new directors who bring fresh insights and broad relationships from around the world.

But the fundamental change needed for this university to succeed is to identify and develop the priorities that give us meaning and passion. Over the next decade, Polytechnic will become a new university for a new age. In accomplishing this, we will use education, research, and invention – and the power of PolyThinking – to solve and respond to some of the highest-priority challenges and opportunities\(^3\) facing human-kind in the 21st Century.

**Foundation Priorities**

These three priorities will be the core, long-term priorities that define our institute-wide education, research, and invention. Each of these priorities has the power to leverage our unique attributes; distinguish us in the regional, national and global marketplace; and provide the compelling reason for being that gives us substance and passion.

1. **Urbanization:** To markedly increase the efficiency, effectiveness, and quality of life of modern cities as they are impacted by technology and the effects of globalization. Do this through systematic application of science, technology, management, and the humanities and social sciences in specific areas of our urban expertise including urban infrastructure (transportation, water, buildings, waste management, power, and communications), urban security, economic development, entertainment and media, and technology policy.

2. **Health and wellness:** To improve dramatically the quality of human life, especially health and wellness, through education, research, and invention using (a) bio / chem / med, science and technology (b) computing and communications related science and technology and (c) nano-science and technology.

3. **The delivery of services and the operation of organizations using information-based technology:** To improve the efficiency and effectiveness of large, complex systems and organizations (government, healthcare management, defense, homeland security, and R&D for pharmaceuticals and medical devices) through the application of networks, information systems, and a new science of services.

\(^2\) These four are the Eugene Kleiner Chair for Innovation in Mechanical Engineering; the Dibner Family Chair in the History and Philosophy of Technology and Science; the Joseph J. & Violet J. Jacobs Chair in Chemical Engineering; the Donald F. Othmer Chair in Chemical Engineering.

\(^3\) There are certainly other challenges and opportunities of equivalent importance. By naming three primary priorities and two developmental priorities, I am abiding by the caution that we not be “all things to all people” and that we recognize the inherent limitations imposed by our size and resources.
Emergent Priorities

Concurrently we will begin the exploration and development of two new, prospective priorities with the objective of more fully understanding and appreciating their merits and benefits. Our objective for these two emergent priorities is to confirm in the next three years that each is fit to serve, on an equal footing, with the three core institute-wide priorities named above.

4. **Complexity:** To further the deciphering of complexity in different aspects of the world through the use of super-computing, complex decision making, stochastic mathematics, risk analysis, and other expertise. The opportunity for applying these techniques is rapidly expanding, including brain topography, genomic medicine, and financial risk-analysis.

5. **Science, Technology, and Humanity:** To more fully understand and influence the intersection of science and technology with the human condition, including the ramifications of science and technology on learning, ethics, religion, human behavior, privacy, and the quality of life.

If our goal is to define the new university for a new age, then what are the forces and factors that will influence our priorities and our related plans and operations? What follows, first, is a discussion of the environment that will shape our future; and, second, an action plan for successfully becoming a new university for a new age and for achieving our priorities.

**Five disruptions**

We will define a new university and pursue our priorities during a time when major disruptions are generating turbulence for society and higher education around the world. While we must attend to other factors and trends discussed in this paper that also affect our decisions and actions, these five disturbances represent major forces that fundamentally shape our goals and destiny.

- The potency of the global economy, open markets, and democracy
- The exploding promise of biological-chemical-medical science and engineering
- The proliferation of information and services
- The deciphering of complexity
- The impact of science and technology on society and values

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4 For instance, during this period, we will explore the educational and research opportunities and benefits of each, verify the ability of each to secure financial and philanthropic support, and determine the level of interest of students and society in these priorities.
1. The potency of the global economy and the appeal of open markets and democracy

The global economy of the 21st century is rapidly transforming the way the world produces and consumes goods and services. This “the world is flat” transformation will be in full bloom in twenty years, at the same time that many of our current undergraduates will start to be offered leadership positions of significant responsibility. To meet the challenges of this new era necessitates a fresh look at the scope and content of our curriculum and research, so that global cases and problems pervade all we do. Second, it fundamentally alters the expectations of young people about the value of college education in enhancing earnings and achieving success in their careers, thus producing enormous pressure on Polytechnic to increase the perceived value of attending Polytechnic. Third, the rise of the global economy leads to our recruiting students, researchers and scholars from around the world to join Polytechnic and building alliances with universities around the globe to be our partners.

Open markets and democracy make room for the rapid exchange of information and ideas, on the one hand, putting pressure on universities to provide greater value and, on the other hand, opening up opportunities to deliver new products and services that more fully meet the needs of customers. This is a world where brand value, real benefits, flexible pricing, and rapid response to opportunities will create new winners and losers.

2. The extraordinary promise of biological-chemical-medical science and engineering

Remarkable advances in science in the bio-chemical-medical arena are so well known and have reached such a level of sophistication that people everywhere are anticipating a stunning new age filled with products and services that greatly extend the duration and enhance the quality of life. As Polytechnic Professor Steve Arnold says, we are entering an era where one will be able to pay a fee to extend one’s life by years.

The scientists and doctors of this new bio-chemical-medical era are seeking partnerships with engineers who are capable of turning such science into marketable products and services.

This world of bio-medical engineering – for instance, wireless transmission of bio-sensor data from a micro-chip inserted within one’s body – will expand in turn the demand for better healthcare delivery, finance, and management systems based on improved data storage, privacy, security, and resiliency of medical information systems.

At an even smaller scale, is the pursuit of knowledge at the nano-scale. We now have sensors and techniques that open this world to our insights. As our understanding expands, the call for devices that exploit our knowledge of nano-scale science and the opportunity for developing new sensors, products and services will multiply.

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5 For instance, engineers and managers will need skills to manage virtual teams, to run projects spread around the world, and to invent innovative new products and services using global R&D, manufacturing, and marketing.

6 Polytechnic already has a close relationship with SUNY Downstate to pursue new products and services in this arena. Indeed, based on joint research led by Poly’s Dr. Richard Gross, the Poly/SUNY Downstate consortium announced in January 2006 a new treatment for sepsis.
3. The proliferation of information and services

All kinds of information and services are being delivered over the web. Soon, the books of the world will be available on Google and Yahoo, in a system that puts a series of related ads alongside the text of the book you are reading. The result: a virtual library bigger than any in the world, available to every student and faculty member. The risk: a Faustian bargain with the commercial world of advertising.

eBay and Craigslist have created virtual flea markets that trade not just in trinkets and hand-me-downs, but goods and services of substantial value. e.Lilly is using the web to buy solutions to its most daunting scientific puzzles. To compete with Google and Yahoo, Microsoft is changing from a packaged sales model to a web-delivered subscription model, says Microsoft’s Chief Technical Officer, Ray Ozzie.

We face the same challenge. We should test whether learning episodes can be delivered successfully with a subscription model. The benefits from such an expansion of our market could be enormous: high school students taking Poly mini-courses; current students attending classes that focus on experiments, projects, and discourse, not lectures; recent graduates brushing up on subjects that eluded them in college; and middle-aged alumni learning the skills needed for new second and third careers; elderly alumni enriching their lives with insights and ideas. Using such techniques, we can transform our relationship with prospective students, our enrolled students, and our 38,000 alumni.

Indeed, all services are being transformed and this provides Polytechnic the unique opportunity to create a new “science of services,” of which I have more to say later in this paper.

4. The deciphering of complexity

For centuries, mankind has sought to understand the complexity of life. In the twentieth century, our scientific research and technological developments have penetrated deeply into this complexity, but still many problems remain beyond human comprehension.

The opportunity for understanding complex systems such as human behavior, organizational effectiveness, astrophysics, nano-scale behavior, network security, market operations, environmental systems, and human wellness and disease will be remarkable, as the amount of information obtained by sensors, transmitted by wireless devices, and recorded in vast storage systems will eclipse the present volume and penetrate to levels of scale previously unobtainable. The challenge of the next fifty years is to expand our sensing capacity, build computing power and information, and improve our analytical tools sufficiently to fathom the simple patterns hidden within the complexity of life and the universe.7

7 What I have in mind here is not unlike the challenges that the Santa Fe Institute has made their passion; they are a candidate for partnership. In their words, the Santa Fe Institute is devoted to creating a new kind of scientific research community, one emphasizing multidisciplinary collaboration in pursuit of understanding the common themes that arise in
5. **The impact of science and technology on society and values**

The breakthroughs of the last fifty years in science and technology – astronomy, physics, psychology, bio-medical science, nano-technology to name just a few – have dramatically changed our perception of the world at every scale.\(^8\) Science and technology have made much of life better, but also permitted new forays into our privacy and challenges to our quality of life.

The response to scientific and technological advance has not always been accommodating, but quite the opposite. We ignore at our risk the visceral reaction by many around the world to the expanding intrusion of science and technology into, what were for centuries, matter of faith. As citizens of the science and technology community, we can take an important role in encouraging dialogue with those who find science and technology distressful.

Nor can we ignore the importance of honesty and ethics in the worlds of science, technology, and business. The business failures in the United States – Enron, Tyco, WorldCom are current examples – plus the recent cloning scandal in South Korea, demonstrate how the lure of fame and fortune can lead people in positions of prominence and power to abandon their personal integrity and honesty.

We need new ways of helping individuals understand how their lives can have meaning and integrity alongside the advances of science and technology that will dominate the coming century.

**The Current Landscape**

In addition to the five disturbances just discussed, there are many other factors at play in shaping the education, research, and invention of the modern university. Each of the following adds additional opportunity or caution to our deliberations and actions.

- **Urban**

New York City has a unique urban milieu with its powerful, fast-paced, glitzy combination of global finance, entertainment, fashion, and culture. With over 170 languages spoken in the schools and neighborhoods of the New York boroughs, we teach, learn, research, invent, and live in one of the most complex, dynamic cities in the world. We are the urban laboratory of the world itself!

In 2007, for the first time in human history, one-half of the world’s people will live in large urban centers. This creates exhilarating opportunities for Polytechnic. We are in New York City, viewed by many as the most exciting city in the world. We have a faculty with a strong track record in urban issues. The 9 billion citizens who are predicted to inhabit the world in 2030 will be primarily citizens of cities. Our success in improving security, transportation, infrastructure, communications, economic natural, artificial, and social systems. This unique scientific enterprise attempts to uncover the mechanisms that underlie the deep simplicity present in our complex world.

\(^8\) For an excellent survey of how science and technology have extended the scale of the observed universe -- from \(10^{-16}\) to \(10^{26}\) -- in the past century, see Gerard Piel, *The Age of Science: What Scientists Learned in the Twentieth Century*, 2001.
development, environment, healthcare, and quality of life in an urban environment will have a profound impact on their lives.

• **Global**
Global growth is defining the 21st century and education and research are at the heart of the change. If global education market was once a one-way street with most students coming to the United States, now, the flow almost everywhere is two-way: The Middle East has lured major American universities to its shores with promises of significant funds to create modern campuses. China and India are actively signing joint ventures with American universities. The Eastern European and Baltic members of the EU, and even countries like France and Spain, are offering alliances and partnerships with Polytechnic. For students throughout the world, getting a global education is not only exciting, but fundamental to the success of their careers.

At the same time, as United States corporations send major segments of their R&D, manufacturing, and the production and delivery of services offshore, these companies are eager to train indigenous managers and leaders who understand the American business model, but who are willing to work at substantially lower pay. Around the world, the emphasis is on innovation and invention to produce new products and services that serve the global marketplace. A Polytechnic education offered “there” – not in Brooklyn or Manhattan – that includes technical knowledge, managerial insights, and the insights that spawn invention – will be highly valued by these globally dispersed corporations and their employees.

Here in NYC, our students have unique global opportunities. Through assignments as interns, work in coop programs, and insights gained in classes taught by adjunct faculty, our students have access to the global savvy of the corporate managers and leading experts who populate the corporate headquarters and business centers that abound in New York City.

• **PC and Internet Services**
The increased capacity to deliver internet services is changing the economic landscape, not only in the programming, computing, information systems and telecommunications industries, but in all aspects of life from shopping to healthcare to government. The phenomenal rise of Google and Yahoo are harbingers of this new world. My friend, Alph Bingham, Vice President, e-Research and Development at e.Lilly was named one of the top innovators of 2005 for his marvelously innovative system of seeking scientific solutions using a web-based auction system like e-Bay.

Because our students, faculty, and administration will see the value of these services in their daily lives, they expect to see similar functionality in the world of education and research, even though we are highly invested in traditional classrooms and laboratories. We must learn to recruit, admit, enroll, counsel, mentor, teach, and test using 3-G phones, the web, plus our traditional brick and mortar classrooms. We must create learning modules and star-faculty lectures that can be watched on a 3-G phone or an iPod, complemented by new formats where personal attention and interaction between our faculty and students is increased. Our researchers need to create virtual teams around the world,
providing global insights and breakthroughs without the overhead of air-travel, lodging and time lost to travel.

- **Continuous and Seamless**
  The modern standard for high-quality service is one where the best service relationship – and the service itself – is continuous and seamless. No simpler system comes to mind than the iPod with its seamless integration of delivery and playing of music and video.

The same cannot be said for much that happens at Poly. We need a seamless experience for all our education and research. Yet, few would claim that the transition from NYC’s science and engineering high schools to Poly is seamless. Within Poly, one cannot move easily from engineering into the B&TM program and vice-versa. Our athlete scholars are not well-integrated into our academic programs. Many of our women students feel they are held to a higher standard and too many of our minority students cluster in ethnic posses. Our undergraduates do not always move seamlessly to the doorsteps of their first employers. Our research objectives are not always aligned with the priorities of the major research funding agencies. Our relationships with angel funds and venture capitalists are too sporadic. And, our technology transfer process lacks sufficient linkage to the demands and needs of the marketplace.

- **Cost Escalation**
  One of the unsolved problems of the 21st century is how to obtain efficiency and effectiveness in the service industry that equals the gains of the manufacturing sector in the last century. Polytechnic needs to give birth to a savant of quality and efficiency in the services industry who matches what Deming did for manufacturing. This “science of services” is on the drawing board in the Management Department; we should all join in making it a dominant discipline at Polytechnic.

The dot-com boom reached its astounding heights based on a chimera that the web alone would revolutionize human commerce. It is not that simple. But the real price of services, such as education and research, cannot continue to escalate at 5% a year without soaring out of reach of the pocketbooks of parents and students.

Polytechnic, which prides itself in its legacy of educating “first to college” students, is under special pressure to invent a new business model which tames the escalation of tuition prices. In the next three years, the best solution for Polytechnic is to increase enrollments and revenues to broaden the base of tuition and overhead payers while moderating increases in major operating costs. But in the long-run, Polytechnic needs a new paradigm. We are about to be hammered by the same forces that transformed the telecommunications, music, retail investment banking, and real estate sales sectors. We must adjust to and use new technology and economies of scale to deliver high quality education and research at lower costs. Other industries have made the change and I am confident we will also.
• **New Delivery, Competitors, and Brand**

Today, we are already feeling the competitive power of the state-subsidized colleges and universities in New York. The CUNY and SUNY institutions are now market savvy, well-branded, filled with bright faculty, and offer degrees for one-third the price at Poly.

Next door in Jersey City, New Jersey, the University of Phoenix has a license to practice education both in the classroom and on the web. Their mode of operation, which has garnered them more than 160,000 students nationwide, is a competitive threat to our current programs and our expansion. Unless we develop new methods of delivering education, we are at risk of offering the equivalent of high-quality CD players, when the world wants 3-G phones and iPods.

Yet, no matter how exciting our education and novel our research, we will not succeed at our goals unless Polytechnic and *The Power of PolyThinking* is “first to mind” among all of our customers and supporters. Our successes, our innovation, our commitment to opportunity and diversity must be so well known that parents, students, corporations, foundations, political leaders, government bureaucrats, donors, and alumni have a vivid and positive image of Polytechnic.

• **Innovation / Invention / Systems / Technology Management**

The blueprint is already drawn for the engineer of 2020. She is smart in many technical subjects; goes deep in at least one subject; has a strong knowledge of innovation, entrepreneurship, systems and management; can communicate clearly and with passion; and knows her way around the world. For her, the traditional definition of an engineer is obsolete. She is not a mono-thinker, rather she is a PolyThinker.

Innovation, especially, is deemed by many as the most important attribute of this new breed of engineer. The National Academy of Engineers and Council on Competitiveness have spelled out what it will take to meet this challenge. Without an innovative capacity, our young graduates will be destined to compete with inexpensive computers and off-shore technicians working for appreciably lower wages. Innovation requires collaboration between disciplines and a willingness to trade past certainties for new insights. The attitudes and skills of our faculty, staff, and students must be infused with a willingness to take risks, to appreciate the ideas of others, to work around the globe, and to communicate effectively.

At the same time, similar emphasis will need to be placed on teaching our students systems design, architecture, and complex project management, all within a global framework. In-the-box engineering, science, math, and management will be insufficient to make our graduates competitive with the masses of new technically-proficient entrants entering the workforces of India and China.

**Key Tenets**

As we consider the current landscape and the major disturbances, there are a few key principles that we must keep in mind.

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9 See [www.nae.edu](http://www.nae.edu) and [www.compete.org](http://www.compete.org) for the full reports
• **Education, research, and invention are integrated into the global and urban economy**

Our global and urban economies cannot exist without major infusions of education, research, and invention. Of course, in many ways, this has been true for centuries. What is new is how many of the breakthrough inventions and wealth generating activities of the modern world depend entirely on understanding highly sophisticated scientific, technological, and organizational principles. As recently as the time of Edison and Ford, the great inventors and entrepreneurs could accomplish magnificent results by using simple, often self-discovered mechanical and physical principles. Now for example, pharmaceutical development, computer chip manufacturing, and large-scale financial transactions all require extremely well-educated, savvy people who have access to highly-sophisticated equipment, who can communicate and create teams around the globe, and who employ complex and nuanced principles to create and deliver new products and services. The machine-shop inventor, unless he or she is a well-financed entrepreneur in a high-tech lab, is unlikely to make a major breakthrough in the 21st century.

This puts a premium on many of our faculty having technical expertise, high-tech equipment, and real-world understanding of innovation and the marketplace. It also opens to Polytechnic a great opportunity to educate the managers, technicians and scientists of the current workforce about the latest technical, managerial, and entrepreneurial principles.

• **New methods of operating and delivering education, research and invention are highly effective**

High-speed computers and large scale networks with substantial bandwidth and massive storage capacity are transforming the way people learn and how learning organizations realize their quest for new knowledge. For nearly a decade, head-on competitors to Polytechnic like Drexel and Stevens Institute have employed on-line technology to mirror the classroom. Now we are seeing an “end-run” to education when Google and Yahoo provide massive learning engines in the guise of answering questions. Google already has its academic search site and Yahoo, Microsoft, and Google are already digitizing major collections such as the Library of Congress and the library at Oxford University.

Yet, campus hallways are filled with boasts about the quality of traditional academia. We write off the inferior services provided by “bottom feeders” at our peril. As chronicled by Clay Christenson in the *Innovators Dilemma* and the *Innovator’s Solution*, such bottom feeders often “own” their markets in less than a decade -- and the high-quality vendor is extinct. The lesson: listen to your customers and deliver to them what they need to succeed.

• **Students and faculty want education, research, and invention that are compelling, integrated experiences**

Young people are surrounded by a pervasive communication grid that dispenses up-to-date information continuously. The format is lively, the experience is satisfying, and the price is right. This “MySpace”
generation lives online, buys online, plays online – and soon they will expect to learn online. Soon, our students and young assistant and associate faculty members will expect an academic environment that rivals the one in which they live, buy, and play. If we do not provide a compelling, integrated academic experience, these young people will almost certainly seek a new education system that satisfies their aspirations.

- **Not an end-state, but continued transformation**

There is no end or conclusion to transformation. We are not seeking to become an educational cathedral that flourishes in one century and then, in the following decades, falls empty as members move or interests ebb. Rather, we will build a responsive organization that adjusts and redefines itself, perhaps as often as every five years, to changes in science and technology, student and employer preferences, the educational and research marketplace, and global opportunities and competitors.

This is especially important because of its impact on the traditional definitions of academic excellence implicit in tenure, grand buildings, libraries filled with books, and university brands built on legacy. If we are to be a university that changes every five years, then our faculty, buildings, facilities, IT systems, administration, and brand must be resilient enough to withstand the shock of rapid change and independent enough to lead such change. We must exude stability, credibility, and quality at the same time that more than 30% of our offerings are less than five years old.

**Imperatives**

To this point, most of the factors discussed apply to universities throughout the world. My goal here is to name a set of imperatives that arise from unique qualities and conditions of Polytechnic. They are more tactical than strategic in nature, yet they are equally essential to our success because they will give a richer meaning to our brand, “The Power of PolyThinking.”

- **Broaden the revenue base**

Polytechnic must grow its gross revenues from all sources by at least $35 million in the next five years. This increase in revenues will be used to amortize the costs of generating such revenues while also allowing for future growth, working capital, new programs, a contingency fund, and an increased investment portfolio.

The principal sources of revenue growth will be from the following:

- **Undergraduate**: A substantial increase in undergraduate enrollments while reducing the relative amount of financial aid from an average of 46% to 40%.

- **Part-time graduate**: A substantial increase in part-time graduate enrollments through a major increase in technology management / business programs for career enhancement.

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10 See cover article in Business Week, December 12, 2005

11 A growth plan with the annual increases in revenue gains within each of the major areas has been prepared.
• **Full-time graduate:** A substantial increase in full-time graduate enrollments through a moderate increase in United States based doctoral students and major increase in overseas master degree and doctoral enrollments.

• **Research:** A doubling or more of our research grants and contracts by focusing on our research priorities and increasing the annual research expenditures of all faculty members. This will result in a marked increase in indirect cost recovery (overhead) payments to the university, plus direct funding for doctoral and post-doctoral appointments, and summer and other compensation for regular and research faculty members.

• **Annual giving:** A significant increase in unrestricted annual giving through alumni contributions, major gifts and bequests.

• **Major philanthropic support:** A significant increase in major grants, gifts and bequests from foundations, corporations, and most notably in today’s economy, high wealth individuals.

• **Real estate development:** Develop air rights related to the MetroTech campus to obtain a one-time cash infusion which can be used for faculty recruitment and retention, program expansion, and investment portfolio growth, while also providing for a more dramatic campus.

• **Capital Campaign.** With the support of the Board of Trustees, implement and successfully complete a four-year capital campaign that raises $75 million.

• **Invention:** By FY2012, our university, faculty and students will receive the first significant annual returns ($2M or more per year) from intellectual property rights related to increased research and invention programs.

• **Feature NYC as an asset**

A unique aspect of Polytechnic is its location in New York City, recognized as one of the most exciting cities in the world for its international financial, scientific, cultural, and entertainment leadership. In addition, the ethnic variety and entrepreneurial dynamism of the boroughs of New York City, and especially the renaissance of Brooklyn, provide an opportunity to engage in service and design learning. The university needs to capture the value of these unique features.

These initiatives will take advantage of our location in the Big Apple:

• **Urban issues:** As discussed earlier, over half the world’s population will soon live in large cities. Polytechnic has long-standing, close relationships with governmental leaders and urban consulting firms. We have a number of programs focused on the urban environment with many of these programs tied to alliances of cities and non-governmental organizations (NGOs) around the world. We are poised to be a regional and global thought leader on urban issues.

To capture this role, we will continue to create alliances, both here and abroad, that amplify our urban expertise. We will create new undergraduate degrees that focus on urban issues, such as sustainable urban environments, urban systems engineering, and urban technology management. Our urban education programs will provide young people and seasoned technicians and managers with the expanded technical, managerial, and policy skills and
insights needed to design and develop new cities and to rebuild and enhance the existing cities of the world. Our collaborative research on urban issues will be expanded to include an interdisciplinary, systems approach to mega cities and the application of technology management and policy to urban government.  

- **Medical sciences and healthcare management.** The concentration of bio-medical science research and education organizations combined with the major health care and hospital systems in NYC means we are located in the largest and strongest medical science and care centers in the world. For new product and services to be developed in this field, the medical science and healthcare providers of NYC need a new partner who can design, develop, finance and market such products and services. Polytechnic – in cooperation with the venture capital and investment banking firms located in NYC – should seize the opportunity to collaborate with these research and healthcare providers. In doing so, we can help NYC become the world’s most vigorous source of new medical technology and services.

In addition, not only is healthcare a major employer in NYC eager to hire our students, but the healthcare delivery and management organizations that abound in NYC are a test bed for Polytechnic’s communications, computer science, and management students and faculty to design and develop breakthrough solutions to the daunting problems for delivering, financing, and managing healthcare services. With healthcare representing 13% of the GNP of the United States, the economic benefits of our efforts will have substantial impact.

- **Entertainment and Technology:** The increased use of digital technology in all entertainment domains (music, film, games, television, sports, theater, and museums) creates a substantial demand for young people who are not only skilled in technology but also appreciate the business and creative aspects of entertainment. Polytechnic faculty saw this opportunity and inaugurated a new digital media program that is developing briskly with both graduate and undergraduate offerings. During the next year, we should consider expanding this area to include an Entertainment and Technology degree.

- **Science, engineering, mathematics and technology management programs geared to NYC markets:** The New York City region is filled with opportunities for engineering, science, management, humanities, and social sciences programs. For instance, civil and mechanical engineering students and faculty are in growing demand to meet the needs of the aging infrastructure, transportation, communications, power, and waste management systems throughout the New York metropolitan region. Similarly, the rising importance of security, economic development, environment, and quality of life for the citizens of NYC will increase the demand for new science, management, and policy in these areas, just as the shift from manufacturing to services will increase the demand for graduates who understand both business and technology. Finally, our financial engineering program is currently sparking great interest in the financial centers of New York. As we imbed the insights from our new research in risk

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12 Magnetic levitation portends to be a major research area for the university. Bud Griffis is committed to raising the funds to begin our research in this field. If we get a solid foothold, this research will be included as part of our urbanization and power priorities.
analysis and complex decision making to the content of this program, we will extend financial engineering’s appeal to an even broader and more-sophisticated market.

- **Service learning as a major component of undergraduate education:** The boroughs of NYC are filled with community and religious organizations, public and private schools, hospitals and healthcare agencies, cultural programs, and entrepreneurial ventures committed to making life better for their constituents and customers. These organizations provide dynamic, exciting laboratories in which our students can learn, do research, and invent and innovate. Most importantly, such service learning will give our students face-to-face experience with understanding and solving tangible problems of real life. The values our students learn in these “urban classrooms” will mold the goals and ambitions that shape their lives.

- **Special events in entertainment and technology:** Polytechnic should convene a national competition on a new aspect of technology in the entertainment industry. For instance, we could create an alliance with the Brooklyn Academy of Music or the Tribeca Film Festival that showcases the best new technological advances in music or film. Or, we could hold a 3-G phone film festival, much like Ithaca College did in upstate New York. In addition, we could convene a summer program for gifted high school and college students that opens the doors to the rich variety of theater, filmmaking, television production, cable operation, and music video production going on in NYC.

- **Alliances and Collaboration**

  The technologies of the 21st century open the possibility of building a great global university while remaining a relatively small organization. Such a new university will not own all elements of its global educational enterprise, but rather will deploy and invest its assets in activities where it excels and will build alliances with others to accomplish the balance of its goals to extend its reach to a truly global audience. In this model, Polytechnic is the hub that joins with others – whether in our own city, the nation, or around the world – in alliances, joint ventures, and special enterprises that educate, conduct research, and invent. Here are four examples of how this will work:

  - **Global education.** As discussed earlier, the opportunity for providing education around the world is expanding rapidly. But rather than opening Polytechnic campuses in new markets such as China, India, Israel and the Middle East, Eastern Europe, and the Baltic states, we have formed InGATE and chartered it to form alliances with high-quality universities and colleges in these countries.

  - **Research.** Many of the most promising research opportunities for Polytechnic, including our top five priorities, require significant equipment, large numbers of highly qualified faculty, and working capital to support new initiatives. In most instances, the costs entailed exceed our near-term resources. However, there are significant opportunities to collaborate with others and yet accomplish our objectives. For example, our objective of dominating bio / chem / medical engineering can be greatly facilitated by teaming up with the globally-renowned scientific centers such as Memorial Sloan Kettering, Rockefeller University, NYU, and Cold Springs Harbor on the one hand and the venture capital and angel funds that specialize in funding life science opportunities. Such partnerships will lead to joint
grants with NSF and NIH, research for our undergraduate and graduate students, and market-based opportunities for developing new products and services.

- **Real estate.** Our real estate opportunities are substantial, but to optimize their value, over 800,000 square feet of high-rise construction must be financed. The skills required and the risks that must be borne are not only in excess of our current capacity, but do not represent core skills of this or any university. Yet, by teaming with a developer, we can realize major financial benefits with only a small portion of the risk. Furthermore, by collaborating with CUNY New York City College of Technology, we have the prospect of designing and building a far more consequential “educational park” than if we proceed on our own.

- **Technology transfer.** As discussed earlier, faculty research can lead to valuable opportunities to design and develop new products and services, yet this development process is expensive and challenging. By teaming with early-stage angel and venture funds we significantly improve our prospects for marketplace success while also distributing the development costs across a wider set of investors than just Polytechnic.

- **Integrated and compelling education**

  We must dramatically improve the quality of our undergraduate education. To help us succeed at this, we will bring some of the world’s best and most innovative educators and researchers to campus to share with us their insights and recommendations. Within the university, the Honors College at Polytechnic is a new model of enhanced undergraduate education designed by our own faculty that is successfully capturing the interest of young students. Using insights from our and other’s experiences, we will build a new, stronger approach to the “education of the future” that can be applied to all our undergraduate programs. Yet as we raise the quality of our undergraduate education, we must continue our commitment to providing opportunity for young people with diverse backgrounds and limited financial resources.

  Young people are entirely at ease using instant messaging, iPod downloads, cell phones, and Google searches to learn and stay in touch. As a leading scientific and technical university, Polytechnic should model the power of technology in creating, managing, and delivering information and knowledge both in its educational programs but also in its day-to-day operations. This means that Polytechnic will develop, test, and use the best technologies available for achieving its goals and, more importantly, because of the change required for Poly’s culture, we must engage our students on their terms and where they are.

  For example, recruitment and educational programs of Polytechnic should make strong and highly-integrated use of data mining, convergent telecommunications technology, music video/DVDs, and high-touch marketing and sales techniques to maximize enrollments. This connection to the student should persist throughout the four-five years of undergraduate study at Polytechnic and equally exciting relationships should be developed with our alumni.
Similarly, Polytechnic should invent the “virtual classroom of the future” making full use of convergent technology such as 3-G phones, web delivery of material, and web-meeting techniques to replace the standard four-wall classroom.

- **Earlier and life-long educational relationship**
  Higher education, especially in science, technology, engineering, and math (STEM), can no longer afford to isolate its programs to traditional college-age students but must extend its reach both earlier and later in life.

In order to capture the interest and challenge the intellect of younger people, our efforts must be extended and increased in the middle schools and high schools of the New York metropolitan region. Polytechnic will help young 7th and 8th graders see the power and excitement of science, math, and engineering and then assist them as they make their commitment to rigorous learning. We will take a critical role in designing and providing STEM high school education in NYC. This will include sponsorship of a number of small high schools where the curriculum is especially attractive to young people and well-suited to succeeding at Polytechnic or other STEM universities, and a new program for educating STEM teachers for our high schools. Our goal is to nurture bright, young people from diverse cultural and economic backgrounds so that they arrive at Polytechnic technically inquisitive and proficient, ready to work hard and learn, and eager to aim high and succeed.

Similarly, Polytechnic must more effectively meet the educational needs of adults, expanding our graduate certificate and degree programs to managers, advanced scientists, and senior engineers. As our alumni seek new skills for a second or third career, we will have access to a whole new market of adult learners. Such adult education is especially well-suited to Polytechnic’s branch locations and the use of our on-line technology, but new delivery methods and innovative pricing and financing arrangements will be needed to serve this adult market place.

- **Consequential research**
  The large federal research funding agencies – NSF, NIH, NASA, DARPA, and the Department of Energy – have major programs for which Polytechnic’s goals and objectives are especially well-suited. For example, as we increase our research in bio/chem/medical engineering, we will see a substantial increase in NIH funding at Polytechnic. Similarly, with an increased emphasis on new proposals related to national defense and homeland security we will see an increase in funding to solve key problems facing the Departments of Defense and Homeland Security. Here in NYC, private sector organizations such as IBM, Siemens, Computer Associates, Northrop-Grumman, Pfizer, Merck, Citibank, and JP Morgan-Chase, have substantial needs for both basic and applied research in areas that match our priorities.

In the governmental arena, the City of New York is one of the world’s major urban laboratories and its agencies have offered to team with Polytechnic on major grant proposals. The United Nations has
major needs at the international level and Polytechnic already has key roles in supporting UN initiatives in urban infrastructure and engineering education.\(^\text{13}\)

To add even greater impact to our research, we must create an integrated, interdisciplinary, collaborative approach that joins science and engineering research with technology management and the humanities and social sciences. In doing so, we will differentiate ourselves from almost every technical university in the nation, since even the best of the technical universities have impeded the integration of management and policy with their scientific and technical research programs. Moreover, by doing so, we will be expediting our inclusion of invention as the third dimension of our academic mission.

- **Invention**

From the inception in 1876 of the American research university at Johns Hopkins, great universities have been defined by their faculties’ teaching and research and tenure is awarded to those who excel at teaching and research. Now in the 21\(^{\text{st}}\) century, universities must add a third dimension to their work: invention.\(^\text{14}\) With this third dimension, academic entrepreneurship will be a highly valued quality of the university, our undergraduate and graduate programs will integrate real world principles of industrial research and development, entrepreneurship, and innovation throughout the curriculum; and intellectual property and invention will be key factors in awarding promotion and tenure. This new element, invention, will increase the intellectual vibrancy of the campus, attract an inquisitive breed of students and faculty with entrepreneurial ambitions, and foster the creation of new products and services which will meet the challenges and opportunities of the 21\(^{\text{st}}\) century. Not only will students and faculty alike patent their inventions, but students, faculty, and the university will derive financial gain from the resulting commercialization of their inventions.

**Moving Forward to Dominance**

To meet the opportunities and challenges discussed in this paper, we need to pursue a three phase strategy. Phase One will focus on revenue growth and core leadership. Phase Two will focus on capacity building, especially expanding our faculty, testing new programs, building research expertise, and enhancing the depth of our management team. Phase Three will focus on dominance.

\(^{13}\) Urban Infrastructure Initiative promotes government, industry, university partnership for the assessment and development of innovative technology solutions and “intelligent” monitoring systems to efficiently upgrade the performance and security of critical infrastructures for sustainable urban development. The UNESCO International Centre for Engineering Education (UICEE) facilitates the transfer of information, expertise and research on engineering education and industrial training to assist developing countries and countries in economic, social and political transition worldwide.

In Phase One, we will increase our revenues and recruit the balance of our core leadership team. While we have modest discretionary capital to “jump-start” new growth\(^\text{15}\), our primary resource during this phase will be our own invention, brilliance, and execution. We are already in Phase One.

In Phase Two, we will build capacity for dominant growth. This phase will start as soon as July 2006 and will include piloting new programs to see what works best; recruiting new faculty who will enhance our education, research, and invention; bolstering our leadership team at all levels to improve our track record of success; and bettering our understanding of the innovative opportunities that will help us dominate in Phase Three.

Phase Three – dominance – will begin in about three years. The influx of discretionary capital for all sources, but especially from the Capital Campaign and our air rights will provide the financial foundation for an era of high performance in which we dominate the academic and economic landscape as the model of a new university for a new age. The heart of such dominance – the proof to the world of the power of PolyThinking – is defined by the people of Polytechnic: it resides in the brilliance and energy of our faculty, the aptitude and ambition of our students, the insight and impact of our research, the utility and value of our invention, and the capacity for growth and performance of our staff.

To bring Polytechnic to this dominance, I am counting on you for your creativity, insights, leadership, teamwork, and action. Between now and 2008, we must focus on our five priorities while using the disruptions, trends, and forces on our landscape to our advantage. We must attract and retain faculty, students, trustees, and staff that match our ambitions. We must decide how best to employ the funds we will earn from operations and our air rights and receive from donors and the capital campaign. We must engender a culture and create practices that reward charismatic teachers, brilliant researchers, breakthrough inventors, and innovative managers. We must design a new facility that enhances our workplace, accelerates our growth, and improves our image. And, most importantly, we must define the qualities that will lead to our being a dominant new university for a new age.

**Phase One: Basics**

*Phase One is starting now.*

- **Revenue Growth**
  - **Top Priority:** Starting now, at every level of the university we will make revenue growth our number one priority for the next two years. This means that all the major leadership teams – the University Cabinet, the Faculty Executive Council, the Management Network, the Enrollment Management Council, the Marketing Council, the Department Heads, and the Board of Trustees – will devote their top attention to actions that encourage and create significant revenue growth.

\(^{15}\) Polytechnic University has already consumed almost all of its discretionary resources in building its expanded campus of today and in meeting its unanticipated revenue shortfalls during the past four-five years.
• **Revenue Growth Action teams:** We will convene six special action teams to dramatically increase revenues in these key areas

  - **Undergraduate recruitment and retention success:** Such as recruit and retain more undergraduate students, introduce new minors that attract new students, and increase student role in research, projects, and competitions

  - **Part-time and full-time graduate programs:** Such as recruit and retain more part-time graduate students, especially in programs at the three satellite campuses, in management programs, and through on-line education, and recruit more full-time graduate students from strong markets such as China and India

  - **Research growth:** Such as increase the size of major grants and expand the number of faculty performing funded research, improve our funding from Congressional earmarks and New York state and city appropriations, seek additional near-term returns from our patent portfolio

  - **International alliances:** Develop the new alliances and relationships which we have negotiated into strong revenue-generating programs

  - **Branding and marketing:** Stronger, integrated branding and marketing effort that makes its top priority revenue growth in all aspects of the university

  - **Grants, contracts, and donations:** Increase the volume and size of philanthropic giving that can be used to “jump start” innovation and change; increase alumni giving; set the stage to obtain a number of significant contributions and gifts through our new capital campaign.

• **Core Leadership**

  - **Complete the team:** We will finish the build-up of the administrative and faculty leadership team and distribute leadership responsibility more broadly throughout the university, including:

    - **Administration Leadership:** Filling key positions of Provost, VP of Research, Dean of Undergraduate Enrollment, and Director of the Capital Campaign.

    - **Faculty Leadership:** Fill the open “named-chairs” with exceptionally strong candidates.

    - **Branding and Marketing Leadership:** Assign single-point responsibility for all branding and marketing programs.

    - **Management Network:** Assigning greater responsibility for regular operations to the Management Network.
• **Faculty Leadership:** Fill the open “named-chairs” with exceptionally strong candidates.

• **Department Heads:** Expand the authority and responsibilities of Department Heads / Chairs.

• **Reorganizing the Trustees:** Continue the transition of the Board of Trustees role to focus on strategic decisions and new opportunities and continue to expand the influence and global qualities of the board.

**Phase Two: Capacity**

Phase Two will start as soon as July 2006.

• **Faculty growth**
  
  - We will identify the key areas where further growth in the faculty is needed for educational, research, and invention growth.
  
  - We will seek high-qualified, innovative candidates to fill these key faculty positions.
  
  - We will develop programs that provide current faculty with opportunities for academic and technological advancement.

• **Excellence at innovation**
  
  - I will designate the new Provost as the senior leader of the university for innovation and make him or her responsible for improving the innovative culture and capacity of the university.
  
  - We will create an Innovation Leadership Team of senior and junior faculty, staff, and students to improve the innovative culture of the university.
  
  - We will organize an “Innovation Speakers Series” to bring leading innovators to campus to broaden the repertoire of innovative techniques and ideas within the university community; topics will focus on the five priorities of the university.
  
  - We will convene a series of high-return innovation exercises that engage small teams of students, faculty, administrators, alumni, and trustees.
  
  - We will experiment with at least six new pilot programs in education, research, and invention, operations, branding, and donations to expand our understanding of what works best in each area; here the focus of these pilot programs will be the five priorities of the university.
• **Leadership Depth and Community**

  - We will expand board, academic, and operational leadership through a series of key new appointments, hires and assignments so that the university is fully capable of continued growth and financial stability while also developing recruiting new faculty and developing new programs that will make Polytechnic dominant as a technical research university.

  - We will continue to develop ways of operating that increase morale, cohesion, innovation, and productivity across the whole university. We will provide encouragement and incentives to faculty and staff that pursue our goals; build collaborative, high-performance teams; get results; and positively represent the university to all of our stakeholders.

• **New facility design and development**

  - We will negotiate and close a financial transaction with a developer that optimizes the value of our air rights and also assures an architectural statement that enhances the vibrancy of the campus.  

  - We will convene a Design Team to develop the specifications for a highly-innovative and architecturally-stunning facility for the university; in coordination with the real estate development team and the Innovation Leadership Team, this team will assure that the facility can support our growth for at least the next ten years and that it will reinforce our innovative approaches to education, research, invention, and operations.

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  **Phase Three: Dominance as a Model New University**

  *Phase Three will start in about three years. The current goal is July 2009.*

  At the start of Phase Three, we will begin in earnest the deep and fundamental changes needed to fully respond to the five disruptions and the other strategic factors presented in this paper. To dominate as a new university for a new age, we will need to successfully manage our day-to-day operations while we simultaneously expand the innovation, reach and prominence of our education, research, and invention.

  Another way of framing this challenge is to say that we must have a working operational mechanism that is so good at running the basic university that we have sufficient excess capacity to dominate the academic landscape for being an innovative technical university with significant regional, national, and global impact.

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16 The ability of Polytechnic to develop these air rights is a high priority for all of us; however, there are some factors related to this development that may be beyond the control of the university. The schedule outlined in this document may be delayed as we deal with such impediments.
If the “acid test” of Phase I is the creation of surplus revenues for growth, the acid test of Phase Three is that, within five years, we are recognized in the United States and in key countries around the world as the dominant prototype of a “new university for a new age.”
## MILESTONES

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| Intellectual Property and Invention | Begin invention program | First major invention investments | Continue | Continue | $ in hand from IP / invention |
| Air rights development | Negotiate air rights package | $ in hand from air rights | | | |
| Design and construction of new building | Initial requirements and design | Final building requirements and design | Begin construction of new building | Continue | Occupy new building |
| Innovation | Innovation Pilots | Innovation Infusion | Continue Innovation | Continue Innovation | |
| Faculty Growth | Funded chairs filled | Faculty Hiring Round Two | Continue | | |
| Revenue Growth | Revenue as Top Priority | Continue | Continue | | |
| Leadership Recruitment | Leadership Round Two | Leadership Round Three | | | |
| Vision Statement and Action Plan | Final decisions | | | | |

Figure 2: Timeline of Phase One through Three
Our Future

We have what it takes to succeed and we are a prime candidate to dominate the landscape. As I said at our 150th Anniversary in September,

*A university can transform itself if it has less at stake and more to gain; if it is small enough to be agile and smart enough to think innovatively; if it has diversity within its faculty and students; and if it has friends and supporters who will provide resources.*

We have a unique opportunity. Not only is the world hungry for new solutions, but it has provided the structural systems and technological tools by which a small university can dominate the landscape.

The challenge for us is to rise to this opportunity. We must succeed at the day-to-day imperatives of revenue growth and, simultaneously, we must increase our capacity for delivering high-quality education, research, and invention. To do this, each of us needs to understand the disruptions, the landscape, and the opportunities of the new century. Each of us must be quick to get things done, open to innovation, devoted to collaboration, and committed to winning. We must be PolyThinkers! If we are, we can be confident that we will be a dominant force in providing technical education, research, and invention during the first half of the 21st century.

I am excited to be the President of Poly and I am eager to mobilize your energy and your talent to take Polytechnic to higher ground.