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美國創新之分析

An Analysis of U.S. Innovation

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The Innovation Transformation: An Analysis of US innovation

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Abstract

In a global market, how does policy influence innovation on a national level? Machiavelli considered this question in his deliberations on the creation of a new order:

> "There is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new order. […] Whenever the enemies have the ability to attack the innovator they do so with the passion of partisans, while the others defend him sluggishly, so that the innovator and his party alike are vulnerable." Nicolo Machiavelli, *The Prince*

As globalization continues to expand our economic borders, what role does policy legislation in a national context play in fostering innovation, and what impact does that innovation policy have on that country's economy? In an increasingly borderless world where the transfer of knowledge and information is growing rapidly, what is the logic behind government investment in knowledge appropriation if that knowledge is going to vanish into global-related processes? The United States is a prime example for studying the impact of innovation, and will serve as the focus of this study. As a country of immigrants, the United States has drawn ideas from all over the world through the diversity of its population, and those ideas have given rise to innovations that have changed the world. Innovation is the development of new ideas, products or processes. The factors that influence and promote innovation are great, but we will limit our focus to the policies related to innovation, their effects on the development of innovation, and the impact of those policies on the economy.

Key Words: US innovation, global market, economy

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1. Introduction

1.1 Definitions of Innovation

There is nothing more fundamental to the advancement of humanity than the inherent human desire to innovate. From the very first stone tools on earth and the discovery of fire, man has been developing new ways to improve his way of life. The human experience is defined by the drive to develop new ideas, explore boundaries, and test the limits of the universe. Human innovation has been a great constant throughout recorded history, visible in every society throughout time. The innovators in every civilization have all shared the same desire, the passion for discovery. And while it is this characteristic that unites our collective differences, innovation is also the driving force behind every major change in our world.

Innovation is understood primarily as the effective introduction of new techniques, methods or practices, or new products and services. Because of its dynamic nature and far-reaching application, innovation influences a broad range of fields, including technology, social systems, economic development, commerce, and policy construction. As a natural change agent, innovation is ultimately felt in every sector of society.

Joseph Schumpeter (1934) described his economic theory of creative destruction, identifying innovation as the driving force behind economic development. His observations of capitalist societies found that long-term economic growth was generated by the creation of the new, and by the displacement of the old. In similar studies, statistical comparisons of economic performance among countries have shown that the intensity of national innovative activity is correlated with higher rates of standards of living and productivity growth (Furman et al. 2002, p.34, 899-933).

Through the course of national development, change becomes a critical element in strategic progress. As nations achieve higher levels of gross domestic product (GDP)[4] per capita, the main source of this change becomes innovation (Porter et al. 2001). Change is the natural evolution of nations as they transition from agricultural economies to manufacturing and eventually to information-based economies. The continual evolution of national structures creates an environment of perpetual change, forcing nations to adapt.

The impact of innovation on society from each new development varies greatly in significance, ranging from incremental improvements in a particular field to discoveries that change the entire world. The developments that bring about these monumental shifts in thought can be referred to as disruptive technologies, a reference to the dramatic change their introduction creates. Some of these disruptive technologies include computers, the Internet, the Manhattan Project, global positioning satellites, and many others. The changes brought about by these innovations disrupt our way of life, challenging what we understand and altering the way we operate. These transitions are sudden and powerful, crashing through barriers with the tremendous fury of creative destruction, and those who are unable to adapt are left behind. When science is ready for discovery, change is inevitable, and those who prosper are the civilizations and leaders who embrace this change.

Recognizing innovation as the driving force behind this change, many countries promote the development of new ideas as a method of national competition. By remaining at the forefront of discovery, nations are securing their position of power by shaping the direction of innovative change. As technology evolves, the rate of change increases, and with the spreading adoption of the internet, new ideas can be shared globally within instants. This global exchange of information is creating a universal society of creativity where the market environment is continuously redefined and product lifecycles are increasingly shortened. The speed at which ideas are adopted and improved upon has created increased pressure for national governments to remain competitive in the field of innovation. Many governments are focusing increasingly on methods to foster innovation.

1.2 Motivation

The United States, a country which has benefited from the concentration of ideas from its many diverse people groups, is a strong example of national innovation. With a recent score of 5.74 in the Global Competitiveness Rankings, the United States has consistently ranked first among other countries (Chart 1). This strength of competition relates directly to the power of innovation, a field in which the United States has consistently ranked at the top. Leading the world in the field of innovation for over two centuries, the United States currently places second in world innovation rankings according to the International Innovation Index[6] and in first place on the Global Innovation Index[7].

Beginning in 1776, the U.S. set a precedent for innovative thinking and has been responsible over the last two centuries for many of the most significant world discoveries and inventions. Free thinkers seeking opportunity and freedom helped create the United States, laying a social foundation for independent thought. America's Founding Fathers, among them Benjamin Franklin and Thomas Jefferson, helped lay this foundation, developing innovations in technology, electricity, governance and philosophy. From those beginnings, America has given birth to a host of world-changing innovations, including the airplane, the nuclear bomb, the assembly line, the light bulb and the telephone, which have shaped and guided the development of society. As a current world leader in the field of innovation, the United States will be deeply influenced in its future direction by the shift occurring through globalization, by which national economies are rewarded through innovation. Developing policy to accommodate these changes will be essential to the continued success of this nation. In order to accomplish this, legislatures will need to understand fully the nature of the impact of policy on a nation's innovation initiatives.

By focusing heavily on entrepreneurship and innovation, the United States has developed the largest and most technologically powerful economy in the world, with a per capita GDP of $48,000 (CIA World FactBook, 2009). As a nation, the United States has adopted a predominantly market-oriented economy where private individuals and industry make most of the decisions. U.S. business firms also enjoy greater independence than their Western European and Japanese counterparts. Decisions relating to capital plant expansion, employee retention and product development lie predominantly in the hands of private industry. Despite this freedom, American firms face higher social and political barriers of entry into their rivals' home markets than foreign firms face in entering the American market. While their advantage has narrowed since the end of World War II, U.S. firms continue to remain at the forefront in technological advances, particularly in the fields of medicine, aerospace, computers, and military equipment.

This leadership, however, is not without its challenges. Rising competition from India, China, Taiwan, Korea and Japan is threatening to disrupt America's position of power. In recent years, the United States has also become involved in a series of financially-draining events. Following the September 11, 2001 attacks on the World Trade Center, the United States began a campaign to combat terrorist organizations, primarily in the Middle East. Beginning in 2003, the US-led coalition and subsequent occupation of Iraq has required major shifts in national resources to the military. Between 2005 and the first half of 2008, soaring oil prices threatened inflation and unemployment, as higher gasoline prices limited personal spending. Presently, imported oil accounts for approximately two-thirds of U.S. consumption, resulting in a dependence on foreign production.

Despite being the global leader in innovation, the United States will clearly have pressing concerns to address in the future. It is evident that innovation alone is no longer a guarantee of prosperity. U.S. policy makers have recognized many of the faults in the current economic system and have made steps to address them. In an effort to stabilize financial markets, the U.S. Congress established a $700 billion Troubled Asset Relief Program (TARP) in October of 2008. A portion of these funds were used to purchase equity in U.S. banks and other industrial corporations. In a further effort to help the economy recover, the U.S. Congress passed a bill in January of 2009, providing an additional $787 billion fiscal stimulus package to create jobs (CIA World FactBook, 2009).

National leaders anticipate a variety of pressing concerns for future generations, including the weakened stability of the U.S. economic infrastructure, rapidly rising medical and pension costs, considerable trade and budget deficits, and the stagnation of household income in lower economic groups. In 2007, the merchandise trade deficit reached a record $847 billion but declined to $810 billion in 2008, as a falling exchange rate in the dollar against most major currencies discouraged U.S. imports, making U.S. exports more competitive abroad (CIA World FactBook, 2009). By mid 2008, the global economic downturn, sub-prime mortgage crisis, investment bank failures, and tight credit had pushed the United States into a recession.

1.3 Objectives

The main source of a nation's strength in regard to shaping the direction of innovation lies primarily in its policy. Legislation forms the foundation for every national initiative. The profound impact of national policy is manifested both directly and indirectly (Marklund, Vonortas and Wessner, 2009). The strength of a nation is deeply influenced by its wealth and natural resources, but that strength lies first in the foresight of its leaders. Leadership revolves around decisions, changing the order of things. As Machiavelli[5] observed, this is a dangerous, difficult and uncertain enterprise, which requires, in the words of Carly Fiorina (former CEO of Hewlett Packard), the "energy of change warriors," who are able to overcome fear and resistance to change. At its core, leadership is about instilling hope and passion, enabling others to see and lay hold of their own possibilities, in order to bring about positive and lasting change. The policies adopted by a nation shape the course of innovative development and ultimately determine the nation's ability to adapt to the changing world.

While the virtues of government intervention can be debated, as noted by Ronald Reagan in his declaration that "Government is not a solution to our problem, government is the problem," it can nonetheless be agreed that government is responsible for leadership in providing an environment where success is possible. The policy decisions of tomorrow will reflect the wisdom and foresight of today's leaders, and the implications of these decisions will shape the course of the United States in the future. Assuming the law of creative destruction remains valid with respect to the role of innovation within an economy, today's leaders will need to examine the impact and effectiveness of innovation policy within the contexts of a new globalized environment.

Effective innovation policies have a significant impact on national work conditions and wealth generation, as innovation is essential to job creation and economic growth. Globalization is simultaneously creating new opportunities for innovation and increasing pressure for competition in developing national innovative capabilities. The rapidly-changing global environment is altering the dynamics of policy in relation to investments in innovation. Policy makers will need to adapt to the constantly-shifting environment, reshaping their understanding of traditional policy challenges. The impact of globalization on innovation requires a comprehensive renewal of policy development, and the creation of new policy measures to foster innovation is critical for wealth generation in an ever-increasing market of global competition.

This paper will explore the core nature of innovation, the role of government in forming policy, the impact of policy on innovation and the economy, the benefits from innovation, and the implications within the United States with respect to the globalized market. The main focus of this research effort is to assess and analyze the innovation policies of the United States, highlighting the specific strengths, weaknesses and effectiveness of those policies in the specific economic environment in which the United States operates. It is hoped that the observations of national trends will contribute to an understanding of national innovation policy and its relevance within the context of a globalized environment.

2 Related Literature

2.1Discussion of innovation measurements

To understand the impact of innovation policy, the true nature of innovation itself must be clearly identified. The study of innovation has been evaluated within a variety of contexts, including technology, social systems, economic development, commerce, and policy construction. This broad variety of contexts provides a wide range of approaches for defining innovation (Fagerberg et al. 2004).

Throughout these broad perspectives on innovation, a consistent theme is evident. Innovation is predominantly understood as the effective introduction of new techniques, new methods or practices, or new products and services. Examples of these innovations include new techniques in value investing, new methods of construction using interchangeable parts, new business practices such as the assembly line, new products such as the personal computer, and new services such as the internet. These innovations were novel ideas which changed the order of operation in their respective contexts.

The introduction of a new good is, by definition, the development of a good which is unfamiliar to customers. While many of these innovations are dependent on new scientific discoveries, innovation can at times be the original application of an existing entity. This is often found in the pharmaceutical world where existing drugs are found to have new uses.

The introduction of a new method of production can exist in a new commercial treatment of a commodity. The search for new supply sources of raw materials or half-manufactured goods can also be innovative, irrespective of whether this source previously existed. Innovation can also be found in the reorganization of an industry. Schumpeter's focus on innovation is evident in Neo-Schumpeterian economics, developed by such scholars as Christopher Freeman (1982) and Giovanni Dosi (1982). Innovation is also studied by economists in other contexts, including Paul Romer's New Growth Theory and the theories of entrepreneurship.

The sources of innovation or the catalysts that drive innovative thought are difficult to reproduce but they can be classified according to several categories. In the linear model of innovation, the source of innovation is often considered to be the manufacturer. Individuals or businesses develop new ideas to improve the sale of their products. More recently recognized as a valid source of innovation is end-user innovation. Individuals or businesses develop an innovation for their own personal needs to be used in-house because of a lack of existing products to meet their needs. A prime example of end-user innovation was the development of assembly line production by Henry Ford. In Sources of Innovation, Eric von Hippel (1988) identifies end-user innovation as the most significant and critical source.

Regarding user innovation, a considerable level of innovation occurs through the direct use of related technologies by individuals implementing natural process improvement methods throughout the course of their routine activities. This can be seen in the development of interchangeable parts. Eli Terry, a clock maker in the 1700s, began using standard parts that were interchangeable to facilitate his operation. User-innovators like Terry sometimes become entrepreneurs, when they recognizer the value of their innovation. A recent trend in the market has been the free exchange of innovations using methods such as open source technology. This trend is born out of networks of like-minded individuals who are able to use the free exchange of innovative developments to further develop technologies (Tuomi, 2002)

In the business environment, considerable attention is focused on formal research in the pursuit of breakthrough innovations or disruptive technologies. These innovations are by far the most publicized and recognized accomplishments, but innovations may also be developed through more indirect routes, including the exchange and integration of professional experience as well as on-the-job modifications of practice. The more radical and revolutionary innovations emerge predominantly from traditional direct research and development. Incremental innovations more often emerge from practice, but there are numerous exceptions to each of these trends.

Within an organization, innovation programs are greatly affected by organizational goals and objectives, company business plans, and corporate positioning relative to market competitiveness. Google is an excellent example of innovation through this means. The corporate environment at Google embraces innovative ideas, methods and processes. Google offers creative outlets to its employees in the form of activities and services, and through this creative process, has introduced numerous innovations in online business, including the development of a global digital compilation from satellite photos of the earth. This dedication to innovation is often capital intensive, requiring significant percentages of corporate turnover.

The pursuit of a successful innovation requires considerable dedication, consuming tremendous resources. The large cost of experimentation associated with innovative development can be financially draining, creating a barrier of entry for many cash-poor organizations. The tremendous need for funding experimentation in the pursuit of innovation is underlined in Stefan Thomke's book, Experimentation Matters. He charges that the ability to innovate is dependent on experimentation

(Thomke, 2003), creating intense funding requirements. Investment in innovative improvements to established products, processes and services will typically average four percent within a company, but may vary throughout industries and can range from as low as one half percent of turnover to well over twenty percent, depending on the rate of change within the individual corporate markets.

While many organizations endeavor to be innovative, the intangible aspect of creativity creates an imbalanced return on investment with respect to innovative efforts. Financial resources alone are no guarantor of success, and the possibility of failure is great. The wide range in percentage of corporate turnover dedicated to innovative efforts illustrates the varied level of importance placed on innovation with respect to financial resources, but fails to address the diverse cultures impacting the organization.

As a result, the success rate of innovative investment varies greatly. A great majority of innovation projects result in failure, contributing nothing to the organizational goals. Many organizations fund a great number of innovation projects while expecting only a small percentage of them to materialize into commercial assets. And there is always the possibility that none of the innovation projects will ever be successful. As a result, the ability to recognize the commercial potential in every innovation is critical to a corporation's success. A particular example of this failure is Xerox Corporation, which invented the computer mouse and the graphical user interface, but failed to recognize the commercial potential or capitalize off of their innovation.

The debate between supply and demand origins of innovation has also been explored extensively. Supply-pushed innovations are based on the development of new technological possibilities, while demand-led innovations are based on social needs and market requirements. The co-dependent nature of both supply and demand creates a difficulty in isolating the originating source of the innovation itself. Although this debate continues to remain unresolved, recent studies have focused on the underlying nature of both supply and demand in relation to innovation. Empirical research indicates that innovation occurs in a broader context than within the confines of industrial supply or user demand, but rather in a complex interrelated network of activities linking a wide range of stakeholders, including (but not limited to) users, developers, government and consultancies. Social networks such as Facebook[8], LinkedIn[9] and Twitter[10] serve as examples of the interrelated nature of innovation, suggesting that effective innovation occurs for the most part at the boundaries of industry where technological developments are linked together with the needs of users through an original method, engaging and requiring the involvement of all parties.

The impact of innovation can be felt throughout societies on a variety of levels. From an individual corporate standpoint, an innovation is passed from the innovator to other individuals within a network. This process has a significant impact on the life cycle of innovations. The life cycle can be characterized by an S-shaped diffusion curve, commonly referred to as an "s-curve." The s-curve follows the growth of productivity against time and is derived from a portion of a traditional distribution curve.

The life cycle or product life of an innovation relates to the stages of development beginning with a start-up phase to a rapid increase in revenue and eventually resulting in a decline as new innovations displace the relevancy of the product. The life cycle of computer game consoles has been consistent over the past two decades as new products in this field emerge every four years. The market success of these innovations is somewhat predictable, but in reality, a large majority of innovations never materialize into commercial products and are not represented on the curve. Innovations that are successfully introduced into the market begin with relatively slow growth. As the product develops an established foundation within the market, demand increases, driving a rapid increase in the product growth. Related incremental innovations including minor improvements drive product growth further. As the product matures, the growth rate declines and eventually begins to plateau. At this point, new innovations will typically replace the old technology, driving the now-outdated product into decline.

Many corporations develop innovation programs to take advantage of the product life-cycle curve. A key driver for these innovation programs in corporations is to achieve growth objectives. Davila et al. (2006) notes, "Companies cannot grow through cost reduction and reengineering alone . . . Innovation is the key element in providing aggressive top-line growth, and for increasing bottom-line results" (p.6). As a product matures, these innovative companies will often develop products to replace them, introducing the new technology at successive intervals with the intent that the rapid growth phase of the more recent innovation will coincide with the peak of the aging product's s-curve. By timing intervals and accurately predicting a product life cycle, individual companies are able to maintain the highest consistent growth rate. These intervals vary greatly within markets and depend on many external and internal factors.

2.2Innovation Indices

2.2.1 Requirements for Measurement Tools

Wise leadership is a critical aspect of effective governance. Plato expressed the importance of character-driven leadership in his writings on “philosopher-kings” (Plato, 380 BC). Later writers including Aristotle expanded this concept by examining the designs of government from a legal and policy-driven standpoint. The progressive evolution of government systems have increasingly focused on policy as the foundation for national leadership, and it is the lasting legacy of inspired policy that secures the success of nations throughout the difficult struggles experienced in each passing generation. The effective development of policy tools that target innovation require careful analysis of the innovation process from a national holistic perspective. This analysis requires methods of measurement to produce quantifiable data points on innovative progress.

Traditional measurement tools on the political level have focused on amount of national investment in R&D as a percentage of GNP. While a majority of national policy decisions concerning innovation continue to use this measurement, the Innovation Imperative and to some degree the Oselo Manual address the need to expand global innovation measurement tools to support national policy decisions. In recent years, a number of national ranking systems have been developed that assess the level to which a nation has effectively implemented innovation measures. The Global Innovation Index and the International Innovation Index both examine national factors that impact innovation, including economic stability, banking methods, national stimulation through policy and investment, infrastructure, technological development, institutional knowledge and capital wealth. These assessment tools are shaping the parameters by which innovation is perceived, and forward-thinking countries will increasingly refer to these concepts in the development of future legislation and policy.

On the political level, policy results in regulations, legislation and codes of justice, national concepts that have been evolving for thousands of years. The earliest known written codes of government can be found in ancient Babylon where excavations have unearthed a set of laws known as the Ur-Nammu of Ur, dating to 2050 BC. Many other examples exist of early government policy, including Lipit-Ishtar of Isin, the Hittite code, the Assyrian code, the code of Hammurabi of Babylonia and the Mosaic Law. Other early forms of government policy are also thought to exist in present-day Iraq where evidence of Sumerian policy possibly dates as far back as 2300 BC. Early policy concerns included citizen rights, humanitarian protections and tax relief efforts for the poor.

The significant cost of innovation underscores the importance of measuring tools to evaluate its impact. The organizational level and the political level represent the two areas of measurement in innovation. On the organizational level, measurements relate to individuals, group-level assessments and private industry. Information is gathered through surveys, workshops and benchmarking. Lacking a true industry standard, the majority of corporate measurements evaluate a combination of both qualitative and quantitative dimensions. Organizations often use internally-developed scorecards, ranking innovation process efficiency, business measures related to finance, employee performance and end user or customer benefit. Varying between industries, measured values may include research and development (R&D) costs, revenues from new products, revenues from older products, time-to-market, and number of patents. On the political level, measurements relate to the global competitive advantage gained through innovation.

While both the organizational and political levels are interrelated in the way they are measured, the impact of innovation in a national context is measured primarily on the political level. The Frascati Manual was one of the first recognized measurement guidelines focused on innovation. Many nations have developed measurement tools based on these guidelines but to date, these measures have been largely insular, addressing policy concerns with respect to innovation from within the confines of national borders. For the most part, national governments develop frameworks to evaluate organizational capabilities within their respective nations, resulting in a wide variety of evaluation methods that fail to account for international influences. With the increase in globalization, some governments are beginning to address these concerns from a more global perspective. European nations are addressing these global concerns through the European Foundation for Quality Management. Another organization that has begun to address innovation measurements from an international perspective is the Organization for Economic Co-operation and Development (OECD). The OECD, an international organization of 30 countries originally created after WWII, is dedicated to the principles of democracy and free-market economy (OECD, 2009). In 1995, the OECD published the Oselo Manual, suggesting standard guidelines for evaluating technological product and process innovation. The current edition of the Oselo Manual (2005) considers a broader range of indicators including marketing and organizational innovation. These methods are largely focused on Europe and North America, but some suggest that globalization has drastically changed the dynamics of innovation requiring a truly global perspective of the policy impact on innovation, using measuring tools that have yet to be developed. The Innovation Imperative (Marklund, Vonortas and Wessner, 2009) discusses the need for globalized measurement of innovation focusing on national innovation strategies in the global economy.

Policy as a national tool is particularly important in shaping the direction of a country. In general terms, policy is the course of action taken by a government with respect to a specific issue (Blakemore, 1998). The Australian Policy Handbook defines policy as a system of courses of action, regulatory measures, laws, and funding priorities concerning a given topic promulgated by a governmental entity or its representatives (Althaus et al. 2007). The concept of policy is in essence the agreement to abide by a set of rules, a concept found throughout every society, but the manifestation of this concept in practice is different throughout the world. However, the application of this concept has taken many different forms, including communism, democracy, dictatorship, fascism, monarchy, and socialism, and many others. The differing political systems impact their citizens in a variety of ways and to varying degrees.

As a democratic nation, the United States espouses governance by the people. As a result, all citizens are potential stakeholders in the shaping of policy. The concept of policy in the U.S. includes the study and the execution of political theories and practices. In application, policy refers to the political field of creating and discussing legislative decisions. In one study, policy refers to the academic field represented in schools of public policy (Blakemore, 1998).

In modern government, national policies are often formed within the purview of a constitution. The Constitution of the United States encompasses the guiding principles by which the United States conducts its affairs. All policies are examined against the Constitution to ensure new regulations follow the accepted principles of the nation. It is an accepted principle in the United States that the government is responsible for creating the conditions for its people to prosper. In order for a nation to uphold this responsibility effectively, however, a solid structure of governance must be in place. The social, economic and political variables in modern societies are increasingly great, and nations are in need of effective governance to achieve success in global competition. The foundations of the United States were shaped through the wisdom and insight of inspired policy shapers. The foresight of great men from centuries ago is still evident in the lasting relevance of their writings. As each generation passes, new struggles emerge, from civil rights to economic security and environmental protection. Each successive shift in societal evolution challenges the accepted principles of national governance, but it falls upon the nation's leaders to adapt to these changes by developing lasting policy directives to guide their nation through each difficult struggle.

A significant shift in political importance can be seen in the area of national competition on the international stage. Globalization has increased the competitive capabilities of all nations, particularly among developing powers. As a result, the international pressure to remain competitive has increased. This competition spans industrial development as well as technological progress. Boundaries to policy measures are always changing, and this change is accelerated through globalization, leading to increased challenges in addressing competition in the context of international agreements. These growing challenges underscore the importance of establishing standardized comprehensive innovation measurement tools.

2.2.2 Methods of Measurement

From a policy perspective, the establishment of internationally standardized measurement tools for innovation is particularly difficult as national dynamics with regard to policy impact varies greatly from nation to nation. Political logics are, by definition, geographically constrained by national borders and bound by the responsibility of establishing and protecting the conditions for wealth generation and security among its citizens. It is the national administrative borders that serve as the basis for policy power. Political geography has traditionally been confined to national borders due to the nature of sovereign governance. The nature of policy is symbiotic in relation to a nations population. The impact of a policy on a nation will vary from nation to nation as the makeup of populations vary between nations. As a result of this variance between nations, policies within a nation must be crafted to complement the populations they are designed for. As such, the measurements of innovation with respect to policy formation must accommodate these variances.

To truly understand the underlying rational in measurement structures with respect to policy formation, it is important to understand the dynamics of interaction of innovation within populations. A considerable body of literature on systems of innovation focuses on theoretical and empirical studies on the complexity and institutionally-embedded processes of interaction and learning at the regional, sectoral and national level (Asheim and Gertler, 2005; Edquist, 1997, 2005; Loasby, 2001; Lundvall, 1992, 2005; Malerba, 2004; Nooteboom, 200). There is, however, a noticeable absence of comprehensive studies addressing the nature and types of strategic choices that public actors in systems of innovation are facing in the ever-changing social, economic and technological contexts (Lundvall and Borras, 1998; Borras, Chaminade and Edquist, 2009). The rationales for public intervention in fostering innovation from the policy level have been predominantly abstract and theoretical, based on the properties of old knowledge and the nature of knowledge production systems, and not embedded in specific social, economic and institutional contexts (Metcalfe, 1995).

A foundation for the neoclassical approach to technology and innovation policy concerns the public rights to information, viewing knowledge as a public commodity that cannot be appropriated by the innovator due to its indivisibility and quasi-public good nature (Nelson, 1959). This approach to innovative development is considerably lacking in public incentives, and it fails to address the market drivers for innovative investment. This concern is addressed in the national contexts by means of patent generation, providing limited rights for knowledge appropriation by innovators as a financial incentive through private monetary returns on the innovators' investment. From another, broader point of view of government responsibility in innovation policy, national obligations relate more to the market conditions in general, providing the economic and political environment most conducive to private investment in innovation. This approach encompasses the concerns regarding knowledge appropriation as well as market dynamics for competition with regard to technological freedoms in diverse options (Borras, Chaminade and Edquist, 2009). By creating Pareto-optimal market conditions, national governments are providing the environment most likely to achieve the greatest public economic returns from private investment in innovation.

This has long been the primary approach to policy generation. Globalization and increasing digital information dissemination, however, are creating a unique challenge for knowledge appropriation. The advancement of communication systems has facilitated the copy and transfer of proprietary information across the globe on a tremendous scale. A familiar case involving peer-to-peer file transfer of national copyrighted material is exemplified in the A&M Records v. Napster[2] legal dispute regarding music sharing. The shared country of origin for these two companies effectively enabled national policies to intervene to preserve the financial incentive for innovative development, but the cross-border, global nature of economic activity creates barriers of jurisdiction with regard to national policies. The international trends in innovative development indicate a dramatic increase in knowledge transfer across national borders. The increasingly borderless nature of knowledge –and particularly information– is impeding the ability of national jurisdictions to protect intellectual property rights, ultimately reducing the incentives for innovation investment. Knowledge appropriation is no longer defined in national contexts but rather in global contexts, where national policy solutions in the form of patent protection hold no authority. National governments have begun to address the global aspect of innovation incentives by signing international agreements such as the TRIPS[3] (Trade-Related aspects of Intellectual Property Rights) agreement, and these initial steps towards developing effective policy in a globalized environment are a positive indication that national leaders are acknowledging the need for a better understanding of the policy dynamics of globalization. These first steps, however, are still in need of stronger legislative support, as enforcement and compliance with many of these agreements are proving to be challenging and geographically limited. The neoclassical assumptions of perfect competition with regard to innovation policies focus primarily on national solutions to problems. Traditional theoretical positions on when and how nations can effectively intervene must be revisited in the new global context.

The concerns brought about by globalization focus primarily on the nature of national borders. It is often argued that the importance of national borders is decreasing as global economies are converging. This line of thinking, however, is flawed as it fails to consider the underlying logic of global economic development. Although globalization has considerably altered the structure of value systems, business models and technological development, the importance of national borders is not decreasing but rather shifting away from corporate industry and towards national policy. Businesses are increasingly operating on an international level, spanning the national and political borders of multiple nations in the pursuit of capitalism. Business operations continue to expand past the jurisdictional limits of national borders, spreading technology and acquired knowledge internationally. As such, national borders are no longer a limiting factor in operational activities for business and knowledge development. The importance of national borders, however, is increasingly focused on national policy.

National methods of government intervention through innovation policy extend further than theoretical concepts of knowledge appropriation, and active examples of national intervention should similarly be revisited in a global context. These policy instruments include a wide variety of approaches, exemplifying how current government actions impact innovative development within national boundaries. A prime example of active government intervention with regard to innovation is the public financing of research, allocating resources across various fields of study in support of research and development. The critical decisions in complex national economies center on determining which specific fields of study should receive public funding. These decisions attempt to weigh the potential returns in particular R&D fields from additional national resources by developing complex stakeholder measurements, with the understanding that national investment should serve to foster innovative development in the economy in areas where private investment is insufficient. A similar active governmental intervention method within the confines of national borders has traditionally been tax incentives for R&D expenditures. The complex variables involved in targeting specific government intervention are dramatically affected as globalization introduces additional dimensions. With increasing globalization, the choices of public actors are strongly limited by processes they do not fully control (Archibugi and Iammarino 1999, p.326). The added complexities in these decisions stem from ambiguities regarding national benefactors in cross-national innovational investment. Industry is increasingly global, and national decisions regarding allocation of resources must now consider options of investing in foreign firms, with the intent of encouraging foreign firms to establish domestic operations within that nation.

The impact of globalization on the rationales for government intervention creates growing complexities in policy options for national leaders. Globalization is challenging the underlying assumptions of traditional approaches to innovation policy based on national conditions. The changing industry conditions at the global level are severely affected by operations in international markets with under-developed institutional frameworks. This uncertainty in the changing landscape of the innovation process could possibly deter private investment in unproven innovative fields, and this volatile environment is leading to a significant rise in the need for innovation policy across the globe. Public action needs to focus on adaptability in the innovation process, exploring the means for generating national frameworks that are open to adaptability and creating national environments for firms to take advantage of the opportunities from globalization. The challenges for national policy vary greatly throughout the world, and public action should focus on specific weaknesses to identify the aspects of various national structures that are deficient in addressing the capabilities of private industry to operate in a global environment.

The current shifts in the international environment are creating new struggles for policy shapers in adapting to a globalized world. The limited national scope of traditional policy tools is proving itself to be increasingly insufficient, and the relevance of current national policies with regard to wealth creation is becoming more and more ineffective. In an increasingly borderless world where the exchange of knowledge and information is growing rapidly, traditional national investment strategies in knowledge appropriation and innovation are resulting in the swift dilution of knowledge assets through globally-related processes. In a knowledge-based economy, the gains of competitive advantage through national investment are decreasing as globalization progressively disseminates the new ideas of innovators, almost from the moment these ideas takes shape.

In a national context, the primary challenge for policy shapers is to increase the standards of living in a progressively competitive world. In nations where economic development and structural adaptation are slow, economic competitiveness will gradually decline. For policy shapers to be effective, national structures must be flexible to accommodate the changing dynamics of international competition. A key aspect in adapting to this new environment is shaping national policy that attracts business innovation regardless of geographical boundaries. Competitive nations are recognizing the new dynamics of industry borders and crafting national policy that attracts both domestic and international business development. International organizations like the European Union, OECD and the United Nations are placing a major focus on national policy formation with respect to improving innovation competitiveness. This increased focus on policy competition among nations and regions has resulted in the development of a wide variety of political strategies for attracting innovation investments and innovation-based businesses. Yet, despite the recognized critical importance of innovation in wealth generation, most national governments do not consider "innovation policy" as a unique and specific policy field. The focus placed on innovation in the policy field is primarily applied through various established fields, including defense and economic policy. Public policy is predominantly embedded in economic and social activities, and the resulting incentive structures and opportunities for innovation developed through policy are often conditioned by obsolete perceptions of national governance. Policies affecting innovation conditions and business competitiveness within national development are found throughout public policy and in all policy fields, without being explicitly addressed in overall policy development or relevant policy fields. This unfocused approach to innovation in policy, along with unstructured discussions on national competitiveness, results in an unguided and inefficient process within the policy arena. Consequently, challenges and opportunities related to innovation competitiveness, and the options and alternatives for policy development, are often ambiguous in most policy debates.

In recent decades, technology development, research and innovation activities have increasingly developed in a global context. The economic miracles produced by nations like Taiwan have prompted studies of these national development and innovation examples (Lin, 2008). While new powers have emerged in global innovative competition, notably Asian countries, the underlying nature of globalization is shifting away from international exploitation of nationally-produced goods to the global generation of innovation (Archibugi and Michie, 1995).

Ultimately, the geographical dynamics of innovation activity are distorting the boundaries between local, national and global innovation systems. The new global environment is introducing distinctive complexities in the national realms of policy development. When and how to intervene from a national context in the system of global innovation is becoming increasingly important, presenting the need for a comprehensive understanding of rationales for public intervention through policy (Borras, Chaminade and Edquist, 2009). This global imperative for innovation presents an absolute obligation for the national policy shapers across the globe to develop their understanding of the complex and changing variables related to innovation policy. As global environments and systems of government grow and evolve, so too must leaders grow, adapting to changes to remain effective in their public service.

The strategic choices for national policy shapers must examine specific areas of policy reform within their respective nations. Policy researchers need to examine the allocation of R&D resources, policies on intellectual property rights relating to the balance of individual and social returns, regional development policies relating to institutional frameworks for facilitating local interactions, and policies focused on transforming low-technology industries into higher added-value sectors of the economy. The revelations obtained by examining these rationales for innovation policy will begin to address weak areas in traditional theoretical policy guidelines, providing a clear direction for policy makers to identify specific policy solutions with far-reaching oversight of the causal mechanisms of industry failures, possible responses to them and the ultimate innovative output. These clear guidelines will enable policy shapers to determine when, why and how governments should intervene in innovative development. These rationales need to be embedded in specific social, economic and institutional contexts for each country, bridging the gap between political practice and theoretical discussions of governmental intervention in the innovative system. To achieve this detailed country-specific analysis for policy guidelines, further empirical research is needed to develop national directives for policy shapers, identifying clear, country-specific objectives and tools for strategic decisions in innovation policy.

The opportunities in policy development brought about by globalization are great as well. The prospects of wealth generation through globalization are steadily increasing. As global competition increases, the need for continuous business renewal similarly accelerates. Innovation serves as the main determinant in economic productivity, business renewal and wealth creation, and for this reason it is becoming an increasingly critical aspect of national public policy.

New policy statutes require a new understanding of the international dynamics between legislation and innovation. Innovation continues to be the driving force in wealth creation. In the United States, innovative efforts by once-small companies have contributed greatly to the economic success of the nation. Microsoft, a once-small company begun by Bill Gates and Paul Allen, now has an annual revenue of over $60 billion US, and provides jobs to almost 90 thousand people (MSFT, 2009). Innovative developments such as the mobile phone, invented by Martin Cooper at Bell Labs, have created new markets that once never existed. There are now over four million mobile phone subscriptions in the world (ITU, 2009). Despite great historical success in the field of science and technology, growing international competition will require that national investment in innovation must adapt to changing trends in order to remain effective. As a nation, the need to influence innovation as a wealth-building process remains constant. The objectives of innovation-related policy are politically determined and can be economic, military, environmental or social in nature (Borras, Chaminade and Edquist, 2009). In practice, innovation policy initiatives are attempts to solve or mitigate “problems” in the innovation system. Such problems exist when actions of private industry do not automatically lead to the fulfillment of their objectives. This implies that public action should not replace or duplicate private action, but should supplement it and address specific problems associated with the incentives for innovation. But to design effective innovation policy initiatives, the policy shaper must first understand the source behind the problems affecting economic growth and the innovation process.

The challenges and opportunities presented in developing effective innovation policy for the future require extensive analysis to develop a clear understanding of the options and implications for government action. Most economic research on innovation policy rationale focuses on two distinct deductive approaches to the methods and manners for government action regarding when and how to intervene in innovative development. Based on traditional economic posturing, influential works by economists such as Arrow (1962), Nelson (1959) and Machlup (1980) address the economic virtues of achieving optimal Pareto equilibrium with respect to the allocation of resources to innovation (Metcalfe, 1995). This philosophy considers the level at which a change in resource allocation can improve one individual without harming other individuals. This rationale considers the primary objective of public intervention to be the national recognition of market failures which prevent Pareto optimality.

Economists are currently developing tools to harness the opportunities these changes have brought about, and while revolutionary solutions have been unprecedented, the underlying source of change is grounded in fundamental economic theory. This global change in the technological environment for innovation is not the result of economic growth but rather an integral component in the process. For nations to progress, technological change is inevitable (Nelson and Winter, 1982; Dosi and Orsenigo, 1988). But although this global dynamic is understandable in economic theory, the developing solutions differ dramatically. Increasingly, economic theory regarding innovation policy is diverging into two schools of thought. Equilibrium economists focus on Pareto optimization, considering the role of policy in limited contexts, with the primary responsibility of addressing market failure by securing sufficient investment for technology investment in private industry. For evolutionary economists, technological development and the innovative process is a natural result of a progressive societal structure as a whole. The innovative process is the fruit of corporate behavior in an ever-changing context characterized by a high level of complexity and institutionally-embedded processes of interaction and learning (Metcalfe, 1995). The evolutionary policy-maker is not concerned with achieving Pareto-equilibria of societal investment in technology, but rather with the innovation system's ability to adapt to changing conditions in order to maintain and enhance the knowledge and technological capabilities accumulated by firms and industries through time (Borras, Chaminade and Edquist, 2009). Therefore, rather than focusing on market failure, the evolutionary policy-maker focuses on a series of systemic failures or problems such as infrastructure provision, technological lock-ins, network problems and transformational problems (Smith, 200; Woolthius and Lankhuizen, 2005). This all-encompassing theory addresses all aspects of national development focusing on the adaptability of the actual innovation system. Realizing the opportunities from globalization will require a comprehensive analysis of national systems, developing new resources for private industry where competitive advantages are being redefined. Realizing these opportunities depends on industry's ability to adapt to changing circumstances, and innovation policy must address the institutional roadblocks that restrain adaptability. Unfortunately, the gap between economic theory and policy action is great. Setting priorities, designing instruments, developing new institutional arrangements, and monitoring and evaluating current policies are connected only in a general way to the literature on policy rationales (Metcalfe, 1995, p. 410). Current policy makers are grappling with the challenges presented in adapting to new economic and political environments.

The tools policy makers are using rely greatly on developing measurement tools that are currently being formulated. In recent years, a number of indices have emerged that are geared towards measuring national innovation levels. The Global Innovation Index and the International Innovation Index are two primary indices that measure national innovation levels. While both rankings differ, the measurement variables are similar, addressing issues from infrastructure, banking stability, financial commitment to R&D, education and innovative developments and outputs.

The International Innovation Index, produced jointly by The Boston Consulting Group and the National Association of Manufacturers, pertains to be the largest and most comprehensive global index of its kind. The variables that the International Innovation Index considers focus primarily on the business outcomes of innovation as well as a government's ability to encourage and support innovation through public policy. The index also includes new policy indicators for innovation, including tax incentives and policies for immigration, education and intellectual property. To rank nations, the index measures both inputs and outputs. Inputs include: government and fiscal policy, education policy and the general innovation environment. Outputs include: patents, technology transfer as well as other R&D

results including business performance, labor productivity, total shareholder returns as well as the impact of innovation on business migration and economic growth. These variables can be broken down into four primary categories including: the economy, technology, education, government tax & finance. These four categories are also prominent in the Global Innovation Index.

The Global Innovation Index is produced by the University INSEAD, as a means for identifying the degree to which nations are responding to the challenge of innovation. Similar to the International Innovation Index, the Global Innovation Index examines a nations capacity to benefit from leading technologies, increased human capacities, organizational and operational developments, and enhanced institutional performance. The index compiles a number of related measurements and concepts in a holistic comparison of indicators, highlighting a nations strengths and weaknesses with respect to innovation related policies and practices. The index uses a method of five inputs and three outputs that relate directly to a nations innovative capacity. Sources for this data include the World Bank, International Telecommunications Union and other similar institutions. The variables include information such as university enrollment rates, GDP growth rates and penetration levels for new technologies. Other more subjective data is drawn from the World Economic Forum's annual Executive Opinion Survey and helps capture concepts which are unavailable in hard data. These essential concepts include perceptions on the quality of corporate governance, the quality of scientific institutions, and the quality of intellectual property rights protections.

The five input variables include: Institutions and Policies, Human Capacity, Infrastructure, Technological Sophistication and Business Markets & Capital. These variables are critical aspects that strengthen the ability for a nation to develop knowledge and ideas as well as leverage them for innovative products and services. The three output variables include: Knowledge, Competitiveness and Wealth. These are ultimately the tangible benefits to a nation from innovation. The eight variables measured in this index are comprised of quantitative and qualitative indicators. These variable indicators are as follows:

INPUTS

INSTITUTIONS AND POLICIES
Independence of judiciary
Demanding regulatory standards
Prevalence of laws relating to ICT
Quality of IPR
Soundness of banks
Quality of scientific research institutions
Quality of management/business schools
Legal obstacles to foreign labor
Time required to start a business
Time required to obtain licenses
Rigidity of employment index
Investor protection index
ICT priority for government

HUMAN CAPACITY
Brain drain
Quality of human resource approach
Quality of math and science education
Graduates in engineering
Graduates in science
Population 15-64
Urban population
Schools connected to the internet

INFRASTRUCTURE
Quality of general infrastructure
Quality of national transport network
Quality of air transport
Fixed line penetration
Mobile penetration
Internet penetration
International bandwidth
ICT expenditure
Personal computer penetration
Mobile price basket

BUSINESS, MARKETS AND CAPITAL FLOWS

Access to loans
Sophistication of financial markets
Issuing shares in local share market
Corporate governance
Buyer sophistication
Customer orientation of firms
Domestic credit to private sector
FDI net inflows
Gross private capital flows
Gross capital formation
Extent of clusters
Commercial services imports
Manufactured Imports
Private investment in ICT
Informal economy estimate

TECHNOLOGY AND PROCESS SOPHISTICATION
Country's level of technology
E-Participation index
E-Government index
Government procurement of advanced technology
Internet use by businesses
Competition among ISP providers
Company technology absorption
Telecom revenue
Secure internet servers per 1,000 people
Spending on R&D
Royalty and license fee payments
Business/university R&D collaboration

OUTPUTS

KNOWLEDGE
Local specialized research and training
Nature of competitive advantage
Quality of production process technology
High-tech exports
Manufactured exports
ICT exports
Insurance and financial services
Patents registered (domestic and non-domestic)
Royalty and license fee receipts

COMPETITIVENESS
Growth of exports to neighboring countries
Intensity of local competition
Reach of exporting in international markets
Commercial services export
Merchandise exports
Goods exported

Service exports
Listed domestic companies

WEALTH
Final consumption expenditure
GDP per capita, PPP
GDP growth rate
Industry, value added
Manufacturer, value added
Services, value added
International migration stock
Value of stocks traded
FDI net outflows

Other index measures such as that of the Human Development Index, measures variables including: Life Expectancy At Birth, Adult Literacy Rate, Combined Gross Enrollment ratio for Primary, Secondary and Tertiary, GDP per capita, Life expectancy index, Education index and GDP index.

The variables measured in these indices, all relate to the general health of a nation. Questions regarding the individual capacity of populations across different nations aside, the general health of a nation ultimately has a substantial impact on the capacity of a nation to innovate. The methods of measurement for this capacity in the various indices differ as the weight attributed to different variables differ between the indices. However, the underlying measurements all revert to basic concepts from the economy, technology, education and policy, particularly relating to tax and finance.

It is incumbent upon American policy leaders to sufficiently understand the variables of measurement in these particular fields of economy, technology, education, tax & finance, to adequately shape future policies that address the rising competition from other nations, exemplified in the Global Innovation and International Innovation indices.

Charts

Rank	Country	Rate
1	United States	5.74
2	Switzerland	5.61
3	Denmark	5.58
4	Sweden	5.53
5	Singapore	5.53
6	Finland	5.50
7	Germany	5.46
8	Netherlands	5.41
9	Japan	5.38
10	Canada	5.37

Chart 1 08-09 Global Competativeness Index

	Country	Rate
1	United States	5.80
2	Germany	4.89
3	United Kingdom	4.81
4	Japan	4.48
5	France	4.32
6	Switzerland	4.10
7	Singapore	4.10
8	Canada	4.06
9	Netherlands	3.99
10	Kong Kong	3.97
11	Denmark	3.95
12	Sweden	3.90
13	Finland	3.85
14	United Arab Emerates	3.81
15	Belgium	3.77
16	Luxembourg	3.72
17	Australia	3.71
18	Israel	3.68
19	South Korea	3.67
20	Iceland	3.66
21	Ireland	3.66
22	Austria	3.64
23	India	3.57
24	Italy	3.48
25	Norway	3.48
26	Malaysia	3.47
27	Spain	3.38
28	New Zealand	3.35
29	China	3.21
30	Kuwait	3.14

Chart 3 09 Global Innovation Index

Rank	Country	Literacy rate
1	Cuba	99.8
1	Estonia	99.8
1	Poland	99.8
4	Barbados	99.7
4	Latvia	99.7
4	Slovenia	99.7
7	Belarus	99.6
7	Lithuania	99.6
9	Kazakhstan	99.5
9	Tajikistan	99.5
11	Armenia	99.4
11	Hungary	99.4
11	Russia	99.4
11	Ukraine	99.4
11	Uzbekistan	99.4
16	Moldova	99.1
17	Australia	99.0
17	Austria	99.0
17	Belgium	99.0
17	Canada	99.0
17	Czech Republic	99.0
17	Denmark	99.0
17	Finland	99.0
17	France	99.0
17	Germany	99.0
17	Guyana	99.0
17	Iceland	99.0
17	Ireland	99.0
17	Japan	99.0
17	Republic of Korea	99.0
17	Luxembourg	99.0
17	Netherlands	99.0
17	New Zealand	99.0
17	Norway	99.0
17	Slovakia	99.0
17	Spain	99.0
17	Sweden	99.0
17	Switzerland	99.0
17	United Kingdom	99.0
17	United States	99.0
41	Tonga	98.9
42	Azerbaijan	98.8
42	Turkmenistan	98.8
44	Albania	98.7
44	Kyrgyzstan	98.7
46	Samoa	98.6
47	Italy	98.4
47	Trinidad and Tobago	98.4
49	Bulgaria	98.2
50	Croatia	98.1

Chart 2 2008 Adult Literacy Rate

3 Innovation measurements in the US

In order to develop clear national guidelines for American innovation policy, a thorough understanding of fundamental American social, economic and political structures must be established, to effectively develop compatible policies that target the key variables outlined throughout innovation indices. Measurement tools from a policy standpoint must work in conjunction with the unique dynamics of American society. From a social perspective, Americans are particularly innovative by nature, and American innovation has exemplified the entrepreneurial spirit of Americans. This spirit is also embodied in the notion of the "American Dream," an idea describing the opportunity for personal, social and economic advancement offered in the nation. This opportunity is, to a great extent, presented through the freedoms afforded to American citizens. Innovation, in essence, is the freedom to think new ideas. For over two hundred years, America has developed through the efforts of immigrants seeking freedom and the American Dream, who have traveled from across the world to the shores of the United States with the hope of creating a better life for themselves. This adventurous spirit has consolidated independent thinkers from every nation, creating in the United States a population of innovative explorers.

The diverse strengths of the many American people groups have produced many of the world's most revolutionary ideas and discoveries, pushing the United States to the forefront of world innovation. The personal freedoms and opportunities offered through the American political system continue to attract brilliant minds from across the world, with the result that many American innovations are created by individuals who were not born in the United States. Currently, foreign-born Americans account for ten percent of the national working population, and yet, they represent twenty-five percent of the U.S. science and engineering workforce.

Transportation

Steam locomotive[11] : John Fitch, 1794
Airplane[12] : Wright Brothers, 1903
Automatic Transmission[13] : Sturtevant Brothers, 1904
Electric traffic light[14] : Lester Wire, 1912
Air traffic control[15] : Archie League, 1929
Flight simulator[16] : Edwin Link, 1929
Three Point Seat Belt[17] : Roger W. Griswold & Hugh De Haven, 1951
Catalytic converter[18] : John J. Mooney and Carl D. Keith, 1973

Military Defense

Machine gun[19] : Hiram Maxim, 1881
Radar principles[20] : Nikola Tesla, 1917
Nuclear Bomb[21] : Albert Einstein and the Manhattan Project, 1945

Manufacturing and Business process improvement

Cotton gin[22] : Eli Whitney, 1794
Interchangeable parts[23] : Eli Terry, 1814
Assembly line production[24] : Henry Ford, 1901
Mutual Funds[25] : Massachusetts Investors Trust, 1924
Value Investing[26] : Ben Graham & David Dodd, 1928
Mechanical Cash Dispenser precursor to the ATM[27] : Luther George Simjian, 1939
Credit card[28] : Ralph Schneider & Frank McNamara, 1950
Barcode and Universal Product Code (UPC)[29]: George Laurer at IBM, 1952
Electronic Spreadsheet[30] : Richard Mattessich, 1964
Point of Sales Data[31] : IBM, 1973
Index fund[32] : John Bogle, 1975
Cash Management Account[33] : Merrill Lynch, 1977

Science, Engineering and Medicine

Refrigeration[34] : Oliver Evans and Jacob Perkins, 1805
Light bulb[35] : Thomas Edison, 1880
Flashlight[36] : Joshua Lionel Cowen, 1898
Blood Bank[37] : Oswald Hope Robertson, 1917
Particle accelerator[38] : Ernest Lawrence, 1929
Microwave oven[39] : Percy Spencer, 1945
Transistor[40] : John Bardeen & Walter Brattain, 1947
Magnetic Core Memory[41] : An Wang & Way-Dong Woo, 1949
Artificial heart[42] : Forest Dewey Dodrill, 1952
Discovery of DNA structure[43] : James D. Watson & Francis Crick, 1953
Fortran[44] : John W. Backus & IBM, 1953
Disk Drive[45] : Rey Johnson & IBM, 1956
Integrated circuit[46] : Jack Kilby, 1958
Laser[47] : Theodore Harold Maiman, 1960
Mouse[48] : Douglas Engelbart, 1968
Human exploration of the moon[49] : Neil Armstrong with NASA, 1969
Personal computer[50] : John Blankenbaker, 1970
Microprocessor[51] : Ted Hoff, 1971

Liquid Crystal Display[52] : T. Peter Brody, 1972
Recombinant DNA[53] : Stanley Norman Cohen & Herbert Boyer, 1973
Digital camera[54] : Steven Sasson, 1975

Communication

Rotary printing press[55] : Richard Hoe, 1843
Telephone[56] : Alexander Graham Bell, 1876
Radio[57] : Nikola Tesla, 1891
Television[58] : Philo T. Farnsworth, 1935
Frequency Modulation[59] : Edwin Howard Armstrong, 1933
Xerography[60] : Chester Carlson, 1938
Mobile phone[61] : Martin Cooper at Bell Labs, 1947
Communications satellite[62] : John Robinson Pierce, AT&T, Bell Labs, NASA, 1962
Modem[63] : AT&T, Bell Labs, 1962
E-mail[64] : Ray Tomlinson, 1971
Ethernet[65] : Robert Metcalfe & Xerox, 1975
Internet[66] : Bob Kahn & Vinton Cerf, 1983

These accomplishments in: transportation; military defense; manufacturing & business process improvement; science, engineering & medicine and communication must all be analyzed under the parameters of: the economy, technology, education and Tax & finance. To effectively assess these measurements, it is important to consider the relative measurements of these variables against other nations.

3.1 US economy vs. other countries

Currently, the United States has the world's largest economy, with a purchasing power of $14.29 trillion (CIA Factbook, 2009). Goldman Sachs observes that if current trends continue, China will have the world's largest economy by 2041. This trend was underscored in 2006 when China raised $53.5 billion through 155 Initial Public Offerings (IPOs), making China the world's leading IPO market. With growing global competition, particularly in the rising competitive power of countries in Asia, the pressure for U.S. policy makers to develop effective innovation policy for the future is increasingly critical.

This growing perception that greater opportunities abound outside the United States is largely due to an increased global focus on competition in the field of innovation. While the United States invests $300 billion annually in R&D through public and private means, our commitment as evidenced by the percentage of GDP places the U.S. in a second tier ranking.

The gross domestic product (GDP) or gross domestic income (GDI) is one of the measures of national income and output for a given country's economy. It is the total value of all final goods and services produced in a particular economy; the dollar value of all goods and services produced within a country's borders in a given year.

To date, the strength of the U.S. economy has served to offset the lower commitment to innovative advancement. Goldman Sachs, however, predicts that the United States may not be able to retain that position.

U.S. is recognizing the need to approach innovation policy in a comprehensive manner, integrating the efforts of state governments, venture capitalists, universities, industry, angel investors, the general public and the Federal Government. Early-stage technology development is a significant part of this comprehensive approach to innovation policy. Research by Branscomb and Auerswald (2002) indicates that the Federal Government provides between 20 and 25 percent of all funds for early-stage technology development. By integrating the efforts of all stakeholders in the innovative process, federal contributions through competitive government awards are able to meet a need that is not fulfilled by industry or by other stakeholders. These national interventions often address segments of the innovative process that private industry investors find too risky. And while not all national investments produce viable economic returns, the broad application of these investments significantly strengthens the innovative process.

In 1977, Merrill Lynch launched the first CMA (Cash Management Account). The revolutionary new product combined an investment account, a transaction account (that pays interest on balances through automatic sweep), a debit card, and a credit line secured by the securities in the investment account. It was a major success, and was soon copied by almost every securities firm. The CMA promise was one-stop shopping convenience for clients, enhanced broker productivity, enhanced broker and client loyalty to the firm, and enhanced cross-selling and share-of-wallet.

One of the roles of public policy in fostering innovation is national financial investment in good ideas, ideas that often come from small firms. In the United States, small firms are responsible for the creation of between 60 and 80 percent of new jobs in the U.S. workforce, and these small firms with big ideas are a critical aspect of market-driven growth in the economy[67]. The United States recognizes the importance of equity-financed small firms, particularly as a means of capitalizing on new ideas and bringing them to market. In an effort to reduce the structural and financial hurdles faced by small firms in bringing ideas to fruition, U.S. policy makers have developed a variety of tools to aid small firms in their development. Some of these programs include innovation awards such as the Advanced Technology Program (ATP)[68] and the Small Business Innovation (SBIR)[69] Program. These and other programs have been highly successful in helping small innovative firms overcome initial hurdles. They have also improved the network of American innovators by connecting these small innovative companies with U.S. universities and with larger, more established firms.

While the United States boasts the world's largest economy, the rate of economic growth in other competing nations threatens to overtake the US, should current trends persist, particularly nations in Asia. And despite a tremendous economy, the US is sinking deeper into debt along with its European counterparts. France currently has an external debt of $5 trillion which is rapidly rising. The United Kingdom has an external debt of $10.45 trillion and Germany currently has an external debt of $4.4 trillion.

Along with the United States, Europe is similarly feeling the pressure of increasing competition. In an effort to build solidarity and economic power, many European nations converted to an international currency, the Euro. Policy struggles in Europe also center on challenges in the banking industry as well as others. The conversion to an international currency has facilitated trade between European nations but it has also limited the growth of economically stronger nations which are now impacted by foreign struggling economies. For this reason some nations in Europe such as the United Kingdom decided against adopting the Euro. Despite these efforts, European nations are currently experiencing the same economic fate that the United States is troubled by.

Asian countries by contrast are experiencing unprecedented growth. Much of the external debt mounting in European nations and the United States has been financed by countries like China which currently holds $1 trillion is US treasury debt. The increased global pressure from competition is largely driven by Asian nations where a majority of the world population is located. With nearly 7 billion people in the world, over half or 4 billion live in Asia. The growing economic strength of these nations are empowering a great many people with the tools to compete internationally.

3.2 US technology vs. other countries

The United States is particularly advanced in the fields of technology, in large parts from the extensive government agencies committed to scientific and technological pursuits. NASA, the National Aeronautics and Space Administration is an agency of the United States government, responsible for the nation's public space program. NASA was established on July 29, 1958, by the National Aeronautics and Space Act. In addition to the space program, it is also responsible for long-term civilian and military aerospace research. Since February 2006 NASA's self-described mission statement is to "pioneer the future in space exploration, scientific discovery, and aeronautics research." It has an annual budget of $17.6 billion

DARPA, the Defense Advanced Research Projects Agency (DARPA) is an agency of the United States Department of Defense responsible for the development of new technology for use by the military. DARPA has been responsible for funding the development of many technologies which have had a major impact on the world, including computer networking, as well as NLS, which was both the first hypertext system, and an important precursor to the contemporary ubiquitous graphical user interface.

DARPA was established in 1958 (as ARPA) in response to the Soviet launching of Sputnik in 1957, with the mission of keeping U.S. military technology ahead of the nation's enemies. DARPA's original mission, established in 1958, was to prevent technological surprise like the launch of Sputnik, which signaled that the Soviets had beaten the U.S. into space. The mission statement has evolved over time. Today, DARPA's mission is still to prevent technological surprise to the U.S., but also to create technological surprise for our enemies. DARPA is independent from other more conventional military R&D and reports directly to senior Department of

Defense management. DARPA has around 240 personnel (about 140 technical) directly managing a $3.2 billion budget. These figures are “on average” since DARPA focuses on short-term (two to four-year) projects run by small, purpose-built teams.

Along with the SBIR program, the Advanced Technology Program (ATP) serves as a key resource for the federal government to assist in cases where the potential for successful innovative civilian technology development is great but private procurement of funding is lacking (Stanley and Currens, 2009). Founded in 1989, the ATP provides funds to develop innovative technologies with a focus on small business.

To ensure that private funds are used effectively, ATP funding requires matching resources from the firms themselves. This policy equips the innovator with the opportunity to develop a new technology while instilling a vested personal interest in the responsible use of the federal funds (Wessner, 2009). This integration of public and private capital extends further than individual small companies.

Many emerging technologies rely on the integration of numerous innovative components, which, in some cases, may be in development through numerous firms. The ATP accounts for this collective pursuit of innovative development by supporting joint ventures and encouraging cooperation among large and small companies. This facilitation of partnerships enables multiple firms to develop innovative projects that might otherwise have been beyond the resources of an individual firm.

Small firms benefit from the institutional resources of large firms, including production capabilities, management expertise and marketing capabilities. Large firms benefit from the niche expertise and unique talents often found in small firms, enabling the large firms to remain agile, adapting to rapidly changing market competition.

Specific policies targeting innovation are having a positive effect on the innovative output in the U.S., and careful and consistent examination of their implementation is helping to develop an understanding of the innovative process. These targeted innovation policies serve as the backbone for innovative development in the United States, but the complex nature of the innovative process encompasses a broader scope of initiatives than targeted by innovation policy alone. To varying degrees, all policy exercises an influence on innovation, and is successful to the degree that it complements the innovative capacities of the nation's people.

Personal discovery and entrepreneurial spirit are human qualities that must be developed through a culture of exploration fostered in the general public. The wide-reaching nature of American culture is influenced by all policy fields, and as a result, all fields of policy have an impact on innovation. The government has taken steps to address the broad perspective of innovation policy by developing a government office dedicated to Science and Technology policy. The White House Office of Science and Technology Policy (OSTP) serves as an advisory resource to the President on all matters relating to science and technology as they affect domestic and international affairs.

Officially established by Congress in 1976 (Public Law 94-282), the OSTP operates within the Executive Office of the President, and it leads interagency efforts to develop and implement sound science and technology policies and budgets. Working with the private sector, state and local governments, the science and higher education communities, and other nations, the OSTP provides leadership and advice on all matters relating to innovation (OSTP, 2009).

Originally conceived by President John F. Kennedy in 1961, the OSTP has grown to serve as a valuable resource in developing a solid understanding of the nature of science, technology and innovation policy. The Director of the OSTP serves as the Science Advisor to the President. Other policy advisory groups in which the Director of the OSTP participates include the President's Committee of Advisors on Science and Technology (PCAST) and the President's National Science and Technology Council (NSTC). The more recent formations of the NSTC and the PCAST indicate federal recognition of the growing importance of innovation policy.

Established by Executive Order in 1993, the NSTC serves as a Cabinet level council with the express purpose of coordinating science, technology and innovation policies across the many departments, agencies and entities comprising the Federal research and development enterprise. A primary objective of the NSTC is the establishment of clear national goals for Federal science and technology investments in a broad array of areas spanning virtually all the mission areas of the executive branch.

The Council prepares research and development strategies that are coordinated across Federal agencies to form investment packages aimed at accomplishing multiple national goals (NSTC, 2009). Chaired by the President, the NSTC is comprised of the Vice President, the Director of the Office of Science and Technology Policy, Cabinet Secretaries and Agency Heads. The NSTC serves as the active arm of the OSTP, implementing the recommendations developed in the OSTP.

Also falling under the OSTP is the President's Council of Advisors on Science and Technology, which serves to provide a clear understanding of the concerns relating to science, technology and innovation policy. Officially established by Executive Order in 2001, the PCAST provides advice to the office of the president from the perspective of private and academic sectors in technology, identifying scientific research priorities and objectives in math and science education. The 35 member council is comprised of distinguished individuals appointed by the President, drawn from industry, education & research institutions and other non-governmental organizations (PCAST, 2009).

Together, these advisory systems, through the Office of Science and Technology Policy, provide the informational framework for effective innovation policy formation at all levels of the government. Unique budget structuring creates an unbiased atmosphere, enabling the OSTP to exert significant influence over other agencies in the formation of public policy. This far-reaching power also conveys substantial responsibility upon committee members.

Although the United States is well situated with agencies and offices dedicated to R&D research, it still commits under 2.7 percent of its GDP in R&D investment, and it ranks in eleventh place in the field of basic research. This commitment to innovation by foreign nations has resulted in a dramatic increase in global competition as evidenced by a number of measuring points. Between 1988 and 2001, the annual production of research papers in Asia increased from 51,800 to 113,600, an astounding increase of 119 percent. In China alone, annual research paper production rose by 354 percent, from 4,600 to 21,000. Similarly in Europe over that same period, the annual number of research papers increased from 143,900 to 229,200, an increase of 59 percent. The United States, however, increased research paper production by only 13 percent, from 177,700 to 200,900.

Japan and China both rank behind the United States in overall spending, largely due to America's large economy, but national spending on R&D in Asia is on a fast rise. China recently surpassed Japan in 2006 with R&D expenditures of $136 billion. Japan, which is now in third place for overall spending, invests $130 billion annually in R&D, but they commit a significant portion of their economy to this endeavor. R&D spending in Japan, Finland, Iceland, Israel, and Sweden exceeds 3 percent of GDP for each nation, a commitment the United States has been unwilling to meet.

While it is important for all policy shapers to develop a better understanding of innovation dynamics in the globalized market, it is incumbent on these high-level advisors to take proactive steps in fully identifying the changing nature of the innovative process, to provide thorough advice for shaping innovation policy in the future.

The steps taken to develop private-sector innovation awards through the SBIR and ATP, as well as the progressive improvements to the tax code providing R&D investment incentives, are positive steps towards building an innovative future. However, the changing dynamics of globalization will require sound judgment by national leaders to develop future innovation policies designed with a globalized worldview in mind.

While European commitment to R&D in terms of total dollars does not match the United States, in GDP percentage terms, European nations are strongly committed to scientific and technological pursuits. Similar cultures and a common currency coupled with a close national proximity has facilitated strong partnerships and collaborative efforts between European nations. A good example of this is the development of the Large Hadron Collider, the worlds largest and highest energy particle accelerator, located beneath the Franco-Swiss border near Geneva Switzerland. These strategic efforts towards technological development has enabled European Nations to remain competitive in the new global environment.

Asia has a strong commitment to R&D and has historically been a leader in robotics as well as high tech manufacturing. R&D efforts in Asia largely centers around commercially applicable efforts where there is a clear economic benefit. The United States on the other hand has often failed to capitalize on innovative efforts.

3.3. US education vs. other countries

Education is a key component in the development of innovation and the United States has historically made great efforts to strengthen it’s tertiary education programs. The National Defense Education Act of 1958 (NDEA) (Public Law 85-864) is a United States Act of Congress, passed in 1958 providing $887 million ($6 billion in today’s dollars) in aid to education in the United States at all levels, both public and private. It was prodded by early Soviet success in the Space Race, notably the launch of the first-ever satellite, Sputnik, the year before.

The NDEA was instituted primarily to stimulate the advancement of and education in science, mathematics, and modern foreign languages; but it has also provided aid in other areas, including technical education, area studies, geography, English as a second language, counseling and guidance, school libraries and librarianship, and educational media centers.

In education, while the American literacy rate is at 99%, the U.S. lags behind a number of countries, ranking between 17th and 40th among world nations. By contrast, the highest literacy rates in the world belong to Cuba, Estonia and Poland with a literacy rate of 99.8% (Chart 2). While this percentage difference is minor, it indicates a growing failure in the U.S. educational system to meet the competitive efforts of other nations. This trend can be seen throughout the United States, most notably in California where 33 percent of high school students failed to graduate in 2007. The Program for International Student Assessment (PISA), measuring the performance of fifteen year olds throughout the developed world, ranked American students 24th in math literacy and 26th in problem solving. This problem continues through higher education, where the United States ranks 16th out of 17 nations in the percentage of twenty four year olds earning degrees in natural science or engineering, according to the National Math & Science Initiative.

The quality of American teachers in pre college education has dropped over the past few decades. Currently, it has a lower barrier to entry than it once had as evidenced by entrance exam scores. A recent finding noted that a majority of math and science teachers in American pre college education have had not received degrees in those fields nor do they have any formal training in the subjects they teach. A significant drop in competitive international rankings for K through 12 education arises after 4th grade when math and science curriculum begin to be focused on.

The current perception of the pre college teaching profession is relatively poor compared with that of other nations, due to the relative ease in entering into that field. Many theorists believe the standards for entering into this profession must be raised. The drop-off in foreign students has largely been self imposed in the United States. After the attacks of September 11th, The U.S. government enacted much tighter controls on foreign students and due to a lack of resources, the process has resulted in long delays. In recent years, increased focus on this subject has resulted in better funding alleviating many of the difficulties for foreign students. The U.S. foreign student population has since increased.

In 2005 and 2006, thirty thousand Indian-born technology professionals working in the United States left to pursue “career-enhancing” opportunities in India (NASSCOM, 2006). In Hsinchu, Taiwan, the Hsinchu Industrial Park, modeled after Silicon Valley, is now a considerable source of innovation for Taiwan, and yet a third of the companies in Hsinchu were founded by individuals who had worked in the United States but ultimately left to pursue greater opportunities overseas.

Many of America's brightest minds are leaving, no longer considering America as the greatest location for opportunity. Edison Liu, former head of the U.S. National Cancer Institute has left to become a division head at the biotech firm Biolis in Singapore. Ed Holmes, Dean of the University of California San Diego (USCD) School of Medicine along with his wife Judith Swain, dean of translational medicine at USCD have also left for Singapore to work for the Agency for Science, Technology and Research.

This loss of American talent is coupled with difficulties for those who still wish to enter the United States. In 2007, the supply of H-IB visas for foreign scientists and engineers allowed visas to be processed for only two days out of the year. Other methods for entrance to the United States are equally bureaucratic. Currently, the wait for "green-cards" exceeds six years.

Europe is increasingly a destination for higher education studies as recent entrants in global competition seek to expand their academic horizons. A great number of Indian and Chinese students are pursuing higher education studies in Europe and efforts by nations such as Ireland are drawing Irish foreign nationals back to their homeland.

K through 12 education in Europe is considerably more successful than their American counterpart in terms of test scores however, substantial differences in the educational structure make this comparison somewhat irrelevant. In Europe, many professions do not require educational degrees but rather professional apprenticeships. At an early age, children are guided towards particular careers where they learn the skill sets for that trade. Children who wish to pursue advanced degrees remain in the K through 12 education system while children who intend to pursue particular professions are diverted into trade schools. The children that remain in K through 12 education are predominantly more successful, academically than their trade school counterparts.

K through 12 education is highly focused on Math and Science and test scores in many Asian countries are higher than American scores. The growing economic standing of many Asian countries is fueling international academic pursuits. Many Asian students are pursuing advanced degrees in Europe and the United States and subsequently returning to their home nations with new knowledge and understandings to help them better compete in the global market

3.4 US tax & finance vs. other countries

Policies impacting tax and financial institutions have a significant impact on the national capacity to develop innovations. In this vein, U.S. policy also encourages innovation through tax relief. The United States currently has the second highest corporate tax levels in the developed world. The majority of Europe has corporate taxes under 30% with an average in the mid 20s. With the increasing mobility of global operations, multinational corporations are capable of establishing themselves in the most conducive tax environment.

By maintaining one of the highest corporate tax rates in the world, the U.S. risks losing businesses to foreign countries. By lowering corporate taxes, foreign companies may be encouraged to establish operations in the U.S., providing jobs and encouraging the development of innovation.

Policy shapers have developed tax incentives for R&D investment in the form of credits. Federal and state level R&D tax credits work to alleviate the financial strain on developing firms with cash flow difficulties.

Many technologies take years to develop, and the financial strain from government tax through the development phase can cripple an otherwise healthy business plan. Currently, 31 states have introduced R&D tax credit programs (Wilson, 2005), and the American Competitiveness Initiative has announced that the previously provisional federal R&D tax credits will be made permanent (Domestic Policy Council, 2006). These and other efforts are serving to consolidate national initiatives to stimulate the economy through innovative development.

401K plans in the U.S., allow a worker to save for retirement and have the savings invested while deferring current income taxes on the saved money and earnings until withdrawal. The employee elects to have a portion of his or her wages paid directly, or “deferred,” into his or her 401(k) account. In participant-directed plans (the most common option), the employee can select from a number of investment options, usually an assortment of mutual funds that emphasize stocks, bonds, money market investments, or some mix of the above.

Many companies’ 401(k) plans also offer the option to purchase the company’s stock. The employee can generally re-allocate money among these investment choices at any time. In the less common trustee-directed 401(k) plans, the employer appoints trustees who decide how the plan’s assets will be invested.

An Individual Retirement Arrangement (or IRA) is a retirement plan account that provides some tax advantages for retirement savings in the United States. There are a number of different types of IRAs, which may be either employer-provided or self-provided plans, including: Roth IRA - contributions are made with after-tax assets, all transactions within the IRA have no tax impact, and withdrawals are usually tax-free.

Traditional IRA - contributions are often tax-deductible (often simplified as “money is deposited before tax” or “contributions are made with pre-tax assets”), all transactions and earnings within the IRA have no tax impact, and withdrawals at retirement are taxed as income (except for those portions of the withdrawal corresponding to contributions that were not deducted).

Depending upon the nature of the contribution, a traditional IRA may be referred to as a “deductible IRA” or a “non-deductible IRA.” SEP IRA - a provision that allows an employer (typically a small business or self-employed individual) to make retirement plan contributions into a Traditional IRA established in the employee’s name, instead of to a pension fund account in the company’s name.

SIMPLE IRA - a simplified employee pension plan that allows both employer and employee contributions, similar to a 401(k) plan, but with lower contribution limits and simpler (and thus less costly) administration. Although it is termed an IRA, it is treated separately. Self-Directed IRA - a self-directed IRA that permits the account holder to make investments on behalf of the retirement plan.

Average world corporate tax Japan provides tax credits for innovation that are three times as large as those of the United States and the Organization for Economic Cooperation and Development ranks the U.S. in seventeenth place with regard to R&D tax incentives. Japan provides a tax credit for small business innovation that is four times as great as that of the United States.

While the U.S. commitment to personal freedom and to innovation through the development of small firms has always been a critical aspect of American economic strategy, the applications of innovation policy have evolved considerably over the course of American history. Recognized innovation policy has, for the large part, emerged from science and technology (S&T) policy (OECD, 2006). The first generation of innovation policy was related to the linear model of "science push," focusing on funding scientific research in government laboratories and universities (Dahlstrand, 2009). Many of these initiatives, including the lunar landing and the development of the atomic bomb, have proven highly successful. Technologies and discoveries from these government programs have helped to develop a wide variety of industries and have had a significant impact on the U.S. economy. While this policy approach has had considerable success in opening the way to tremendous scientific breakthroughs, the U.S. has not always capitalized on the innovative developments from these discoveries.

Medicare is a social insurance program administered by the United States government, providing health insurance coverage to people who are aged 65 and over, or who meet other special criteria. Medicare operates as a single-payer health care system. The Social Security Act of 1965 was passed by Congress in 1965 by President Lyndon B. Johnson as amendments to Social Security legislation.

The independent demand-driven applications of technological discoveries resulting from national science push projects (including NASA) have helped to bring about a better understanding of fundamental dynamics in the innovation process with respect to economic development, shifting innovation policy towards an innovation systems perspective, influenced by “demand pull” interaction between end users and product developers.

The “innovation system” can be understood in a narrow as well as a broad sense (Lundvall, 1992). The narrow approach focuses on the primary source of innovation, namely institutions and establishments that develop and expand knowledge acquisitions. Equilibrium economists predominantly view the market environment from this perspective, considering the role of technology and innovation policy to be one of support in the acquisition of sufficient investment levels for institutions (Borras, Chaminade and Edquist, 2009).

The evolutionary economist takes a more broad approach, considering the underlying foundation of the society in which these institutions operate, addressing the wider socio-economic system, an area that has always been addressed through policy but only recently addressed in specific innovation contexts (Marklund, Vonortas and Wessner, 2009).

These approaches to innovation from a policy standpoint, incorporate the different variables in financial measurements found in the innovation indices. The policy standpoints on finances and government taxes play a critical role in the governance of the United States. In recent years, economic troubles have plagued the finance sector, particularly with the increase in banking failures. Banking failures also pose a problem to many European nations due to lax regulation and bad practices. Recently the French bank Societe General experienced a $7 billion loss due to the corrupt actions of one futures trader.

European taxes are also quite different from America. Europe is predominantly more socialist than America in the balance of capitalism and social responsibility. Personal and private taxes in Europe are much higher for the most part than in America in some cases reaching near 50%, while, corporate taxes in Europe are lower averaging around 20%. However, there are some European countries that significantly lower taxes in both Corporate and Private taxes such as Ireland, New Zealand, Australia and Iceland.

Banking practices are still a significant problem in many Asian countries as they are in Europe and America. Policies for curbing corruption in banking are limited in Asia, particularly in China where regional banking practices largely ignore national mandates.

Corporate and Private taxes in Asia vary greatly. Korea enjoys some of the lowest taxes with personal taxes which are particularly low at 17% while Japan has some of the highest taxes including the highest corporate tax rate of 39%. These differences in the tax and finance sectors through various nations are significant and underscore the importance of careful observation of foreign practices as foreign actions are increasingly impacting domestic operations.

4 Findings on US innovation

4.1 Strengths

American policy makers are highly adept at rising to new challenges. Many of the brightest policy minds in the world are involved in this resolve, and because of the impact American economic shifts have had on the world, the U.S. enjoys international cooperation in developing effective policy.

From their earliest beginnings, free thinkers seeking opportunity have contributed to American innovation, and those inspiring leaders, among them Benjamin Franklin and Thomas Jefferson, have shaped the direction of innovative thought, creating an environment where innovative ideas can flourish. Beginning with innovations such as discoveries in the field of electricity by Benjamin Franklin, inspired American thinkers have built a long history of American innovations:

Throughout the development of these American innovations, U.S. national policy has aided the fostering of innovative thinkers through personal freedoms and civil liberties, as well as through strong governmental support through solid national infrastructure development. Many of the innovators benefitted financially, developing their ideas into large national firms. This capacity to strengthen and grow the economy by encouraging the development of large industries from humble beginnings is a staple of the American innovation system.

Many of the independent inventors throughout American history succeeded in part from the social, economic and educational environments that U.S. policy helped create. These innovators benefited from progressive civil liberties, advanced educational establishments and the freedom for individuals with radical ideas to realize their dreams. This is and has been the American Dream (Adams, 1931), where innovators are free to dream big dreams, turning small operations into major industries.

This system draws on the strength of the nation's expansive, integrated domestic capital labor market as well as on an institutional and economic infrastructure, capable of quickly reallocating national resources. A culture of innovation is bolstered by a highly-developed and competitive higher education system with significant public and private establishments.

These innovative capabilities are strengthened by highly-developed and extensive science and technology establishments, supported nationally with specific objectives ranging from space exploration to health, the environment and national security.

The United States also has a managerial structure that is open to adopting innovative management practices, as well as a political system that recognizes the importance of innovation.

Over the past two hundred years, these strengths have helped build the United States into one of the foremost leaders in the field of innovation. The ability to adapt is key among these strengths, and in the coming years, innovation policy will need to adapt considerably to the changing globalized world to ensure that future generations of Americans continue the tradition of American innovation.

The success of small business stimulation programs such as SBIR and ATP is helping to promote effective partnerships among entrepreneurs, firms and government agencies, exemplifying the "best practice" principles behind successful U.S. innovation initiatives.

Support for innovative development is rising in Congress. Former Rep. Sherwood Boehlert (R-NY), then-Chair of the House Science Committee helped to create a “National Innovation Summit” in 2006. The purpose of the summit was to bring together the nation’s best and brightest minds to help develop a blueprint for the future of American science and innovation. Efforts such as these in Congress are helping to build a strong commitment to innovation in public policy.

Tax incentives are also helping to foster innovative investment in the private sector. American policy initiatives continue to serve as models for foreign countries, and developing nations often turn to the U.S. for help in shaping their respective national policy structures.

The national policies providing personal opportunity have been the guiding light for all American innovation, and they have been a founding principle of the nation, inspiring many of the world’s great thinkers.

While the strength of American innovation lies in the creativity of its population, public policy is largely responsible for shaping the national environment which fosters creativity, as well as providing the opportunity for creative ideas to succeed. Policy makers in the United States recognize that innovation policy remains the key to global competitiveness, and they are increasingly evaluating the foundations that foster innovation in the globalized world.

This commitment to understanding the dynamics of innovation has enabled the United States to adapt to the cycles of major change in industry throughout the history of the nation. This commitment continues to extend to the current shifting market environment.

An extremely valuable formulation on which to build an understanding of these changes and their current implications remains Vernon's (1966) original product cycle model. While significant attributes of this model change over time, the fundamental foundation has remained the same, and American policy shapers have embraced this concept. Even before its formulation, American policy shapers recognized the importance of fully understanding innovative implications.

In a State of the Union Speech in 2006, then-President Bush called for a competitiveness initiative that would double the federal commitment to basic research programs in physics and engineering over ten years, improve K though12 education in math and science, and expand workforce training programs. He also proposed reforming U.S. immigration to compete for the world's best and brightest high-skilled workers. The proposed legislation, "Protecting America's Competitive Edge Act" is pending in Congress while policy makers consider all options for restoring the American economy. Policies of this order are strongly needed as more Americans look elsewhere for opportunity.

The growing concerns over American leadership in jeopardy have been developing for years as the United States attempts to address these issues, with the result that policy makers are reevaluating the effectiveness of "best practices" policy formulation. In 2005, the U.S. Congress called for a National Academies[82] assessment of the nation's competitive profile to identify concrete steps to ensure U.S. economic leadership in the future.

4.2 Weaknesses

American innovation policy measures have proven successful in the past, but the changing dynamic of a globalized economy threatens to alter the effectiveness of many of these programs.

Although many people assume that the U.S. will always be a world leader in science and technology, this may not continue to be the case, inasmuch as great minds exist throughout the world. We fear the abruptness with which a lead in science and technology can be lost –and the difficulty of recovering a lead once lost, if indeed it can be regained at all. (National Academy of Sciences, 2005, p.3)

The American Society of Civil Engineers awarded America a "D" grade for its physical infrastructure. The organization estimates that it will take more than $1.3 trillion on roads, bridges, railways, telecommunication grids, waste and water handling systems alone to achieve acceptable conditions.

Emergency spending measures to secure failing industries, including the U.S. banking system, are creating a projected annual budget of $4 trillion, increasing the annual deficit by $1.75 trillion. Despite this tremendous spending, America's infrastructure will still be lacking modernization and stability.

The current problems in the American banking system have resulted in billions of dollars of taxpayer loss, creating wide-spread fears over the security of financial investments.

Failures in the automotive industry, the housing industry and banking have left many Americans unemployed and homeless. Current unemployment rates are at 8.5% and there are currently over 123,000 homeless people in America (Swarns, 2008).

The liquidity crisis of insurance giant AIG[81] started a financial chain reaction, causing cash flow problems in almost every industry in America, and the financial recession in the United States is creating a ripple effect throughout world markets.

To support the tremendous spending initiatives in the U.S. budget, American corporate taxes are 35%, the second highest in the developed world, and current proposals are pushing for even greater corporate taxes, particularly for small business.

Despite the strengths in policy formation, the United States is currently experiencing tremendous challenges in developing a clear road to success. The economic benefits from traditional innovation policies are declining, and mounting national debt is creating instability in the capital markets. .

This unstable environment is threatening to push multinational corporations out of the United States to regions that are more business friendly. This trend is already being seen and will continue if the American business environment does not improve.

Currently, more than 40 percent of America's high tech companies invest significantly in overseas R&D. This not only reduces the number of jobs in America but it also reduces the proximity to high technology, causing Americans to miss out on the new technology opportunities that often emerge from close engagement with manufacturing and development (Kao, 2007).

End user innovation is one of the most substantial sources of innovation. By moving high technology production overseas, Americans are losing the capabilities of end user innovation through direct interaction with these technologies. The result is a reduction in America's innovation capacity. These concerns are drawing tremendous attention from many quarters and call into question the direction in which America is heading.

This instability has also diminished America's standing in global competitiveness and innovation rankings. These index calculators consider stability in the banking industry as a critical aspect in a nation's potential to innovate and compete in the global environment

Rising Above the Gathering Storm (National Academy of Sciences, 2005) notes that the weakening federal commitment to S&T places the future growth and prosperity of the U.S. in jeopardy.

5. Recommendations

It is evident through the concerns in this paper that national policies for innovation, competition and economic development need to consider the true natures of the innovation process and economic renewal. The increasing importance in true innovative capabilities within a nation will play a larger role in determining economic and social progress (OECD, 2005). The critical role of policy formation in this equation relates to addressing the national dynamics in that environment which affect innovation. This requires a multi-dimensional perspective on innovation systems in policy measures. Innovative and competitive policy measures should focus on the interrelated renewal processes in the economy, consisting of science formation, technology formation, business formation and market formation. All areas of policy influence this system, and as such, all decisions in policy formation should consider the implications to innovative competitiveness. This requires national leaders to develop a conceptual framework for the dynamics of globalization supported by empirical evidence to guide all innovation policy. The following suggestions are based on economic observations, analyzed through the contexts of economic growth through the innovative process discussed in this paper. The six suggestions below address the four areas of economic renewal[83].

1) **Policy measures should work to improve the educational level of American students**.

A critical area of concern in the National Academy's report addressed America's growing vulnerability, calling for an increase in the American talent pool through the provision of greater incentives for math and science teachers. The report also called for a ten percent increase in federal investments in long-term basic research. The study also recommends steps to improve the appeal of American higher education to foreign students, as well as strategies for retention, including the provision of an increased number of visas permitting U.S.-trained foreign students to remain and work in the U.S. after their studies have been completed (National Academy of Sciences, 2005, ES2). Improved education will help in science and technology formation by equipping the future American workforce with the academic tools to develop S&T innovations. This commitment to education must begin at the pre-college, K through 12 level. The current deficiencies in American K through 12 education stem from the increased social and economic freedoms found in other career fields. For a majority of the 19th century through the 1960s, underemployed, brilliant women subsidized K-12 education due to a lack of other viable career options. Since the 1970s, smart women have had more and better paying career choices, reducing the talent pool for K-12 teachers. Pay for this profession has remained comparatively low and intelligent, would-be teachers have sought other career alternatives84. To increase the quality and supply of K through 12 teachers, the U.S. will need to increase the pay of teachers to match other highly-skilled professions, and the general perception of K through 12 teaching must be elevated to a more prestigious position by making entrance to this field more selective.[85]

(2) Policy measures should increase incentives for radical innovation.

A critical aspect of policy development designed to enhance the impact of innovation policy should address the need for market and business formation in industrial and economic renewal. A conspicuous missing component in market and business formation involves policy incentives for radical innovation. To resolve this imbalance, policy measures should focus on demand - pull mechanisms for addressing the increased risks associated with radical innovation investment, ultimately resulting in industrial renewal. Possible tax incentives for radical innovation investment could be developed, or the government could enact programs to mitigate the risk of investing in this field. Radical innovation opens new sources of economic value by breaking out of established business models. This disruptive characteristic is capable of creating completely new businesses as well as new business models (Marklund, Vonortas and Wessner, 2009).

2) **Policy measures should encourage the entrepreneurial spirit in small business innovation**.

Small business innovation should be a primary focus of innovation policy particularly when large corporation contributions to industrial renewal are in decline. Small business growth is a key resource for job creation and overall economic growth. They also provide agility to large firms through specialized knowledge acquisition. The dynamic relationship between small and large firms is a key driver in business formation and the innovative and entrepreneurial spirit behind many small firms is a critical aspect in developing future growth of large corporations and industries. Entrepreneurship is an essential component in business formation, connecting investors with new knowledge. Innovation policy should target incentives and structures within innovation-based entrepreneurship, further extending incentives found in SBIR and ATP programs.[86] The strength of small business in the United States is the backbone of the American economy. A majority of the largest companies in America were started by individuals with innovative ideas, including Microsoft[87], Google[88] and IBM[89].

3) **Policy measures should strengthen the national environment for investment.**

The development of healthy national environments for new innovation-based industries is essential for the creation of a successful economic system with competitive strengths. The instability in the U.S. exemplified by the current recession is particularly harmful to the development of perceptions of security in American investment[90]. Innovation policy should target the systemic hemorrhaging of budget finances and work to reduce national debt while eliminating potential liabilities for the future. Developing perceptions of security is essential to market formation and the attraction of investment. The growing dependence on foreign oil is a critical liability for future energy reliance[91]. Long-term policy measures should focus on viable renewable energy sources while short-term policy measures should clear the way for offshore drilling and nuclear energy development[92]. Another critical liability in the American economic forefront is the large percentage of an aging population[93]. The future strains on Social Security[94] and Medicare[95] will require an incredible increase in taxes if changes are not made soon[96]. Ultimately, there is no viable solution that does not include private choice in retirement and health savings accounts[97]. Other irresponsible budget expenditures such as farm aid which costs the American tax payer $20 billion annually should be eliminated[98]. The parameters of innovation policy must be expanded to include fields which nurture the economic health of America, particularly concerning national debt and the budget. By reducing national debt, America's future economic environment will be significantly strengthened[99].

4) **Policy measures should address problems in the banking industry.**

A major reason for America's fall in innovation index rankings lies in the failures in the American banking industry[100]. The development of market formation depends on a solid infrastructure. Innovation policy should eliminate risky practices such as naked short-selling[101]. Innovation policy should also address the housing crisis by permitting distressed homeowners to renegotiate their loans to reasonable rates[102]. Policy developers should follow the innovative measures taken by Hong Kong to address housing volatility by adjusting the length of the loan rather than the rate[103]. Policy measures should also target the availability of loans to credit-worthy customers. The liquidity crisis experienced by AIG caused many banks to refuse loans to qualified customers, loans that could be securing the economic environment or serving as the start-up capital for developing businesses. Innovation policy should pressure banks to make loans to credit-worthy customers and enact repercussions for banks that fail to do so[104].

5) **Policy measures should improve the tax environment for American investment.**

Tax incentives for innovation investment are positive steps towards effective reform, but future innovation policies should further extend the incentives for investments. In the short term, to combat the economic recession, capital gains taxes for equities should be suspended if held for a predetermined period of time[105]. Market formation requires personal financial stability within a population. The American population has developed poor habits in saving, creating a highly-leveraged population susceptible to economic fluctuations. Innovation policy should lock in low taxes for savings and investment[106]. Cutting capital gains taxes and expanding 401K[107] and IRA[108] contribution levels will help to develop a stronger population and a solid investment environment[109]. One of the greatest possible areas in market and business formation would be the reduction of corporate taxes[110]. American industry in the United States currently pays 35 percent in corporate taxes, the second highest in the developed world. Reducing corporate taxes to 20 percent would make corporate investment in the United States significantly more attractive[111].

6. Conclusions

Presently, the United States is experiencing a wide range of challenges that will test the resolve of the American people for years to come. The scientific "brain-drain" from American scientists leaving to compete abroad, and the failures in the American educational system noted by the PISA, underscore the need for an increased focus on knowledge development. The rising competition from Asia and Europe is helping to highlight the weak points in America, where national development rates are lagging behind the rest of the world.

The late Scottish writer, Alexander Tytler, wrote in the eighteenth century that all great nations undergo an inevitable cycle that takes them from bondage through liberty to abundance, and then from complacency through dependence and back into bondage. It is certainly evident that the United States has undergone part of this transformation, escaping colonial rule to develop into a land founded on life, liberty and the pursuit of happiness[112], eventually growing into a nation with overabundance of prosperity. America has contributed greatly to the world through tremendous innovators and has developed the world's largest economy with a university system that is unmatched. The blessings America has received have been great, but some argue that America is becoming complacent. It is certainly true that the pace of global development exceeds that of the U.S., and if trends continue, America's position of power may shift. This complacency or unwillingness to adapt is understandable as positions of power create a hesitation to change. We recall Machiavelli's observation on the nature of change and innovation:

> "And let it be noted that there is no more delicate matter to take in hand, nor more dangerous to conduct, nor more doubtful in its success, than to set up as a leader in the introduction of changes. For he who

> innovates will have for his enemies all those who are well off under the existing order of things, and only the lukewarm supporters in those who might be better off under the new. This lukewarm temper arises partly from the fear of adversaries who have the laws on their side and partly from the incredulity of mankind, *who will never admit the merit of anything new*, until they have seen it proved by the event."

Addressing these problems from a policy standpoint will help to shape the future, but true national change will need to come from a deeper source. As a Federal Constitutional Republic founded in democracy, the United States involves governance by citizens, with every American playing a critical part in shaping the future of the nation. For fundamental change to take hold, it must start in the hearts of the people, because true innovative change in America will come only from the internal desire for advancement in the American people.

The steps made by the government between 1957 and 1969 were critical in providing the best possible environment for advancement, but ultimately it was the American people who took hold of those opportunities, resulting in innovations that changed the world. Further back in American history, the American people again took hold of their own destiny, striving for a greater collective purpose. In the depths of the Great Depression of the 1930s and 1940s, American resolve was again challenged but through the leadership of President Roosevelt, Americans found hope for a stronger tomorrow, and through his "fireside chats" he reinforced the American spirit to overcome obstacles.

This passionate desire for advancement is often ignited through hardship, but just as they have done before, Americans rise to those challenges, acknowledging the need to adapt to the changing world. The current recession and economic hardships are creating a vivid image of the economic instability the U.S. has allowed itself to enter into. But just as America has overcome obstacles in the past, so it will do so again. Fifty-two years ago, the United States realized its position of power was in jeopardy when the Russian satellite Sputnik was successfully launched into space, on October 4, 1957. The realization that other nations were "reaching for the stars" and had beaten America ignited an American passion for advancement and innovation. Education curricula were revised to emphasize science and math. The $900 million National Defense Education Act was passed in Congress[112], providing scholarships, student loans and scientific equipment for schools. The government established the Defense Department's Advanced Research Projects Agency (DARPA)[113] as well as the National Aeronautics and Space Administration (NASA)[114]. The steps taken by the government through innovation policy were great, but the drive of the American people was ultimately the greatest strength, resulting in a renewed sense of purpose for innovation, eventually resulting in Neil Armstrong's monumental walk on the moon on July 20, 1969.

There is substantial risk in innovation and established powers have forever been resistant to change, but it is a constant that the world around us will always change, regardless of the hurdles we lay in its path. Globalization brings about that change, forcing nations to adapt to new realities. Should the United States continue that cycle from complacency, returning to bondage? That is unclear. But what is clear, the United States is resilient. It has weathered storms before, and throughout its short history, the periods of greatest turmoil have produced the greatest advancements. The great challenges of each generation are defined by the innovators who rise to those challenges.

Today the United States faces difficult challenges, and the leadership of policy shapers will be tested in the coming years as the American people must once again develop an inner sense of purpose, one that improves the world around them. The desire for personal advancement is not sufficient; America must recognize the opportunity and responsibility it has to build a better tomorrow. As globalization brings people and ideas together, the success of America is interconnected with the collective fortunes of every nation. This is evidenced by the dramatic global repercussions in national economies stemming from the economic crisis in the U.S. Through globalization, the success of the American people is now interrelated to the success of the world. This responsibility requires that American leaders develop the innovation policies that create an environment for advancement, but possibly more importantly, American leaders must inspire the American people with a renewed sense of purpose to be world leaders. The American people must press themselves to become the first fully-realized "Innovation Nation", assuming the role no longer as a global leader but as a global enabler, a position for which the United States is uniquely suited. No other country can tap into so many different sources of expertise (Kao, 2007). No other country has the mental freedom, the financial and creative resources and the ability to organize those resources to accomplish these great deeds. American policy must adapt to the changing dynamics of globalization, but it is the American people who will ultimately shape the success of their nation.

NOTES

1. Globalization in its literal sense is the process of transformation of local or regional phenomena into global ones. It can be described as a process by which the people of the world are unified into a single society and function together. This process is a combination of economic, technological, sociocultural and political forces. (See "Globalization" Sheila L. Croucher. Globalization and Belonging: The Politics of Identity in a Changing World. Rowman & Littlefield. (2004). p.10)
2. A&M Records, Inc. v. Napster, Inc., 239 F.3d 1004 (9th Cir. 2001), is an intellectual property case in which the United States Court of Appeals for the Ninth Circuit ruled that the defendant, Napster, could be held liable for contributory infringement of the plaintiff record company's copyrights. The court also rejected the suggestion that it impose a compulsory licensing arrangement on the plaintiff record company. This was the first major case to address the application of the copyright laws to peer-to-peer file-sharing. (See "A&M Records v. Napster" Harvard.edu http://cyber.law.harvard.edu/~wseltzer /napster.html accessed on Jan 5, 2009)
3. The Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) is an international agreement administered by the World Trade Organization (WTO) that sets down minimum standards for many forms of intellectual property (IP) regulation. It was negotiated at the end of the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) in 1994. (See "TRIPS" wto.org http://www.wto.org/english/tratop_E /TRIPS_e/trips_e.htm accessed pm Jan 9,2009)
4. The gross domestic product (GDP) or gross domestic income (GDI) is one of the measures of national income and output for a given country's economy. It is the total value of all final goods and services produced in a particular economy; the dollar value of all goods and services produced within a country's borders in a given year. (See "GDP" Sullivan, arthur; Steven M. Sheffrin (2003). Economics: Principles in action. Upper Saddle River, New Jersey 07458: Pearson Prentice Hall. pp. 57, 301. ISBN 0-13-063085-3)
5. Niccolò di Bernardo dei Machiavelli (3 May 1469 – 21 June 1527) was a philosopher, writer, and Italian politician and is considered the founder of modern political science. As a Renaissance Man, he was a diplomat, political philosopher, musician, poet, and playwright, but, foremost, he was a Civil Servant of the Florentine Republic. In June of 1498, after the ouster and execution of Girolamo Savonarola, the Great Council elected Machiavelli as Secretary to the second Chancery of the Republic of Florence. (See "Machiavelli" White, Michael. Machiavelli, A Man Misunderstood. Abacus. ISBN 978-0-349-11599-3.)
6. The International Innovation Index is a global index measuring the level of innovation of a country, produced jointly by The Boston Consulting Group (BCG), the National Association of Manufacturers (NAM), and The Manufacturing Institute (MI), the NAM's nonpartisan research affiliate. It is the largest and most comprehensive global index of its kind. (See "International Innovation Index" innovation index.org http://www.innovationindex.org.uk/ accessed Jan 22, 2009)
7. The Global Innovation Index (GII) was conceived at INSEAD as a formal model to help illuminate the degree to which individual nations and regions

are currently responding to the challenge of innovation. (See "Global Innovation Index" Managementtoday.co.uk http://www.managementtoday.co.uk/news/610009/ accessed Jan 23, 2009)

8. Facebook is a free-access social networking website that is operated and privately owned by Facebook, Inc. Founded in 2004 by Mark Zuckerberg, it currently has a revenue of $300 Million USD and is the leading social networking platform in the world. (See "Facebook Statistics" Facebook.com http://www.facebook.com/press/info.php?statistics accessed Jan. 19, 2009)
9. LinkedIn is a business-oriented social networking site founded in December 2002 and launched in May 2003 mainly used for professional networking. As of February 2009, it had more than 35 million registered users spanning 170 industries. (See "Latest LinkedIn Facts". LinkedIn. http://press.linkedin.com/about. accessed Feb 4, 2009)
10. Twitter is a social networking and micro-blogging service that enables its users to send and read other users' updates known as tweets. Tweets are text-based posts of up to 140 characters in length. Updates are displayed on the user's profile page and delivered to other users who have signed up to receive them. (See "The 12-Minute Definitive Guide to Twitter". Stutzman, Fred (April 11, 2007). AOL Developer Network. http://dev.aol.com/article/2007/04/definitive-guide-to-twitter. accessed Feb 6, 2009)
11. A steam locomotive is a locomotive powered by steam. The term usually refers to its use on railways, but can also refer to a "road locomotive" such as a traction engine or steamroller. Steam locomotives dominated rail traction from the mid 19th century until the mid 20th century, after which they were superseded by diesel and electric locomotives. As the development of steam engines progressed through the 1700s, various attempts were made to apply them to road and railway use. The world's first working steam rail locomotive was designed and constructed by John Fitch in the United States in 1794. Although Fitch hoped to win backing for a full scale working locomotive by demonstrating his invention to George Washington and his cabinet, interest in it was not forthcoming, and the locomotive was soon forgotten and lost. (See "American Steam Locomotives". Steam Town. http://www.nps.gov/history/history/online_books/ steamtown/shs2.htm. accessed on Feb. 9, 2009)
12. A fixed-wing aircraft, also known as an airplane, is a heavier-than-air craft whose lift is generated not by wing motion relative to the aircraft, but by forward motion through the air. The Wright brothers are credited with building the world's first successful human flight in a powered airplane and making the first controlled, powered, and heavier-than-air human flight on December 17, 1903. In the two years afterward, they developed their flying machine into the world's first practical fixed-wing aircraft. The brothers' fundamental breakthrough was their invention of "three axis-control," which enabled the pilot to steer the aircraft effectively and to maintain its equilibrium. This required method has become standard on all fixed-wing aircraft. From the beginning of their aeronautical work, the Wright brothers focused on unlocking the secrets of control to conquer "the flying problem," rather than on developing more powerful engines as some other experimenters did. Charles Edward Taylor built the first aircraft engine and was a vital contributor of mechanical aspects in the building and maintaining of early

Wright engines and airplanes. The Wright brothers are officially credited worldwide through the Fédération Aéronautique Internationale, the standard setting and record-keeping body for aeronautics and astronautics, as achieving "the first sustained and controlled heavier-than-air powered flight". (See "The Wright brothers and the Invention of the Airplane". U.S. Centennial Flight Commission. http://www.centennialofflight.gov/essay/Wright_Bros/WR_OV.htm., "The World's First Airplane Mechanic". First Flight Society. http://www.firstflight.org/shrine/charlie_taylor.cfm. accessed on Jan. 19, 2009)

13. An automatic transmission is an automobile gearbox that can change gear ratios automatically as the vehicle moves, freeing the driver from having to shift gears manually. Modern automatic transmissions can trace their origins to an early "horseless carriage" gearbox that was developed in 1904 by the Sturtevant brothers of Boston, Massachusetts. This unit had two forward speeds, the ratio change being brought about by flyweights that were driven by the engine. At higher engine speeds, high gear was engaged. As the vehicle slowed down and engine RPM decreased, the gearbox would shift back to low. (See "Automatic Transmission"http://www.experiencefestival.com/automatic_transmission_-_history_and_improvements accessed on Jan. 5, 2009)
14. The traffic light, also known as traffic signal, is a signaling device positioned at a road intersection, pedestrian crossing, or other location. Its purpose is to indicate, using a series of colors, the correct moment to stop, drive, ride or walk, using a universal color code. In Salt Lake City, Utah, policeman Lester Wire invented the first red-green electric traffic lights. The color of the traffic lights representing stop and go are likely derived from those used to identify port (red) and starboard (green) in maritime rules governing right of way, where the vessel on the left must stop for the one crossing on the right. (See "Scientific American Inventions and Discoveries". John Wiley and Sons. http://books.google.com/books?id=pDbQVE3IdTcC. accessed on Jan. 19, 2009)
15. Air traffic control (ATC) is a service provided by ground-based controllers who direct aircraft on the ground and in the air. The primary purpose of ATC systems worldwide is to separate aircraft to prevent collisions, to organize and expedite the flow of traffic, and to provide information and other support for pilots when able. Archie League, who controlled aircraft using colored flags at what is today Lambert-St. Louis International Airport, is often considered the first air traffic controller. (See "Air Traffic Control". Centennial of Flight Commission. http://www.centennialofflight.gov/essay/Government_Role/Air_traffic_control/POL15.htm. accessed on Jan. 18, 2009)
16. A flight simulator is a system that tries to copy, or simulate, the experience of flying an aircraft. It is as realistic as possible. The different types of flight simulator range from video games up to full-size cockpit replicas mounted on hydraulic or electromechanical actuators, controlled by state of the art computer technology. In 1929, Edwin Link invented the flight simulator, calling it the "Blue Box" or Link Trainer, which started the now multi-billion dollar flight simulation industry. Prior to his death in 1981, he had accumulated more than 27 patents for aeronautics, navigation and oceanographic equipment. (See "Edwin A. Link". National Inventors Hall of

Fame. http://www.invent.org/hall_of_fame/192.html. accessed on Jan. 20, 2009)

17. The three point seat belt (the so-called CIR-Griswold restraint) was patented in 1951 by the Americans Roger W. Griswold and Hugh De Haven. (See "Three Point Seat Belt" Andréasson, Rune; Claes-Göran Bäckström (2000.). The Seat Belt : Swedish Research and Development for Global Automotive Safety. Stockholm: Kulturvårdskommittén Vattenfall AB. pp. 15-16. ISBN 91-630-9389-8.)
18. A catalytic converter is a device used to reduce the toxicity of emissions from an internal combustion engine. The catalytic converter was developed by John J. Mooney and Carl D. Keith at the Engelhard Corporation, creating the first production catalytic converter in 1973. (See "Carl D. Keith" http://www.referenceforbusiness.com/history/En-Ge/Engelhard-Corporation.html accessed on Jan. 24, 2009)
19. The machine gun is a fully automatic mounted or portable firearm, usually designed to fire rifle cartridges in quick succession from an ammunition belt or large-capacity magazine, typically at a rate of several hundred rounds per minute. The first true machine gun was invented in 1881 by the American inventor Hiram Maxim. The Maxim gun used the first recoil power of the previously fired bullet to reload rather than being hand powered, enabling a much higher rate of fire than was possible using earlier inferior designs by Puckling or Gatling. Maxim's other great innovation was the use of water cooling to reduce overheating. Maxim's gun was widely adopted and derivative designs were used on all sides during the First World War. The design required less crew, was lighter, and more usable than earlier Gatling guns. (See "Spartacus International- Hiram Maxim". http://inventors.about.com/gi/dynamic/offsite.htm?zi=1/XJ&sdn=inventors&cdn=money&tm=35&gps=102_1664_1436_731&f=11&tt=2&bt=1&bts=1&zu=http%3A//www.spartacus.schoolnet.co.uk/FWWmachinegun.htm. accessed on Feb. 8, 2009)
20. Nikola Tesla, in August 1917, first established principles regarding frequency and power level for the first primitive radar units. He stated, "[...] by their [standing electromagnetic waves] use we may produce at will, from a sending station, an electrical effect in any particular region of the globe; [with which] we may determine the relative position or course of a moving object, such as a vessel at sea, the distance traversed by the same, or its speed." (See Page, R.M., "*The Early History of RADAR*", Proceedings of the IRE, Volume 50, Number 5, May, 1962, (special 50th Anniversary Issue)
21. On August 2, 1939, just before the beginning of World War II, Albert Einstein wrote to then President Franklin D. Roosevelt. Einstein and several other scientists told Roosevelt of efforts in Nazi Germany to purify uranium-235, which could be used to build an atomic bomb. It was shortly thereafter that the United States Government began the serious undertaking known then only as "The Manhattan Project." Simply put, the Manhattan Project was committed to expediting research that would produce a viable atomic bomb. (See "Manhattan Project" http://www.cfo.doe.gov/me70/manhattan/ accessed on Jan. 11, 2009)
22. The cotton gin is a machine that quickly and easily separates the cotton fibers from the seedpods and the sometimes sticky seeds, a job previously done by hand. These seeds are either used again to grow more cotton or, if badly

damaged, are disposed of. It uses a combination of a wire screen and small wire hooks to pull the cotton through the screen, while brushes continuously remove the loose cotton lint to prevent jams. Eli Whitney and his invention makes possible a revolution in the cotton industry and the rise of "King Cotton" as the main cash crop in the South. However, it will never make him rich. Instead of buying his machine, farmers built inferior versions of their own which led to the increasing desire for slave labor from Africa. (See "Eli Whitney The Invention of the Cotton Gin". Julian Rubin. http://www.juliantrubin.com/bigten/whitneycottongin.html. accessed on Jan. 6, 2009)

23. Interchangeable parts are components of any device designed to specifications which ensure that they will fit within any device of the same type. This streamlines the manufacturing process, since all pieces are guaranteed to fit with all others, and it similarly creates the opportunity for replacement parts. Achieving mass production using interchangeable parts was an American. According to Diana Muir writing in Reflections in Bullough's Pond, the world's first complex machine mass-produced from interchangeable parts was a pillar-and-scroll clock invented by Eli Terry, which rolled off the production line in 1814 at Plymouth, Connecticut. (See "Eli Terry- Kosmix". Kosmix. http://business.kosmix.com/topic/Eli_Terry. accessed on Jan. 6, 2009)
24. An assembly line is a manufacturing process in which interchangeable parts are added to a product in a sequential manner using optimally planned logistics to create a finished product much faster than with handcrafting-type methods. Primitive assembly line production was first used in 1901 by Ransom Eli Olds, an early car-maker. Henry Ford used the first conveyor belt-based assembly-line in his car factory in 1913–1914 in the Highland Park, Michigan plant. This type of production greatly reduced the amount of time taken to put each car together, reducing production and labor costs. (See "Fascinating facts about the invention of the Assembly Line by Ransom E. Olds in 1901". The Great Idea Finder. http://www.ideafinder.com/history/inventions/assbline.htm. accessed on Jan. 7, 2009)
25. A mutual fund is a professionally managed type of collective investment scheme that pools money from many investors and invests it in stocks, bonds, short-term money market instruments, and/or other securities. The mutual fund will have a fund manager that trades the pooled money on a regular basis. Currently, the worldwide value of all mutual funds totals more than $26 trillion. The first mutual fund was developed by the Massachusetts Investors Trust (now MFS Investment Management) , founded 1924. Within one year, it had 200 shareholders and $392,000 in assets. The entire industry, which included a few closed-end funds represented less than $10 million in 1924. (See "Mutual Funds" ,U.S. SEC answers on Mutual Funds. U.S. Securities and Exchange Commission (SEC). http://www.sec.gov/answers/mutfund.htm. accessed on Jan. 7, 2009)
26. Value investing is an investment paradigm that derives from the ideas on investment and speculation that Ben Graham & David Dodd began teaching at Columbia Business School in 1928 and subsequently developed in their 1934 text Security Analysis. Although value investing has taken many forms since its inception, it generally involves buying securities whose shares appear underpriced by some form(s) of fundamental analysis. (See "Value Investing"

Graham, Benjamin (1934). Security Analysis New York: McGraw Hill Book Co., 4. ISBN 0-07-144820-9.)

27. The first mechanical cash dispenser was developed and built by Luther George Simjian and installed in 1939 in New York City by the City Bank of New York (See “Mechanical Cash Dispenser” Inventor of the Week: Luther George Simjian MIT http://web.mit.edu/invent/iow/simjian.html accessed Jan. 8, 2009)
28. A credit card is part of a system of payments named after the small plastic card issued to users of the system. The issuer of the card grants a line of credit to the consumer from which the user can borrow money for payment to a merchant or as a cash advance to the user. The concept of paying different merchants using the same card was invented in 1950 by Ralph Schneider and Frank X. McNamara, founders of Diners Club, to consolidate multiple cards. The Diners Club, which was created partially through a merger with Dine and Sign, produced the first “general purpose” charge card, and required the entire bill to be paid with each statement. (See “The First Credit Card”. The New York Times Company. http://history1900s.about.com/od/1950s/a/firstcreditcard. htm. accessed on Nov. 17, 2008)
29. The barcode is an optical machine-readable representation of data. Norman Joseph Woodland is best known for developing the barcode for which he received a patent in October 1952. The first Universal Product Code, invented by George Laurer at IBM, was first used on a marked item scanned at a retail checkout, Marsh’s supermarket in Troy, Ohio, at 8:01 a.m. on June 26, 1974[344D]. (See “A Short History Of Bar Code”. Adams Communications. http://www.adams1.com/history.html. accessed on Dec. 19, 2008)
30. The concept of an electronic spreadsheet was outlined in the 1961 paper “Budgeting Models and System Simulation” by Richard Mattessich while at University of California at Berkeley. The subsequent work by Mattessich (1964a, Chpt. 9, Accounting and Analytical Methods) and its companion volume, Mattessich (1964b, Simulation of the Firm through a Budget Computer Program) applied computerized spreadsheets to accounting and budgeting systems (on main-frame computers in FORTRAN IV). Batch Spreadsheets dealt primarily with the addition or subtraction of entire columns or rows - rather than individual cells. (See “Electronic Spreadsheet” Mattessich, Richard (1961). “Budgeting Models and System Simulation”. The Accounting Review 36 (3): 384–397. http://www.jstor.org/pss/242869.)
31. Point of sale data is the automatic collection of data from items as they are sold throughout a store, region or industry. Early electronic cash registers (ECR) were programmed in proprietary software and were very limited in function and communications capability. In August 1973 IBM announced the IBM 3650 and 3660 Store Systems that were, in essence, a mainframe computer packaged as a store controller that could control 128 IBM 3653/3663 Point of Sale Registers. This system was the first commercial use of client-server technology, peer to peer communications, Local Area Network (LAN) simultaneous backup, and remote initialization. By mid-1974, it was installed in Pathmark Stores in New Jersey and Dillards Department Stores.(See “IBM 3640”http://www-03.ibm.com/systems/x/hardware/rack/x3650/index.html accessed Jan. 10, 2009)
32. An index fund or index tracker is a collective investment scheme (usually a mutual fund or exchange-traded fund) that aims to replicate the movements of

an index of a specific financial market, or a set of rules of ownership that are held constant, regardless of market conditions. John Bogle started the First Index Investment Trust on December 31, 1975. At the time, it was heavily derided by competitors as being "un-American" and the fund itself was seen as "Bogle's folly"[1]. Fidelity Investments Chairman Edward Johnson was quoted as saying that he "[couldn't] believe that the great mass of investors are going to be satisfied with receiving just average returns[2]". Bogle's fund was later renamed the Vanguard 500 Index Fund, which tracks the Standard and Poor's 500 Index. John Bogle graduated from Princeton University in 1951, where his senior thesis was titled: "Mutual Funds can make no claims to superiority over the Market Averages." Bogle wrote that his inspiration for starting an index fund came from three sources, all of which confirmed his 1951 research: Paul Samuelson's 1974 paper, "Challenge to Judgment", Charles Ellis' 1975 study, "The Loser's Game," and Al Ehrbar's 1975 Fortune magazine article on indexing. Bogle founded The Vanguard Group in 1974; it is now the second-largest mutual fund company in the United States as of 2005. (See "John Bogle" Ferri, Richard (2006-12-22). "All About Index Funds". McGraw-Hill. http://books.google.com/books?id=wuTWFNXuNw8C&pg=PA38&lpg=PA38&dq=index+fund+unamerican&source=web&ots=9JuonIA0u4&sig=_ni97KfBlBoyPjhyLBiQh--9RxE#PPA37,M1)

33. In 1977, Merrill Lynch launched the first CMA (Cash Management Account). The revolutionary new product combined an investment account, a transaction account (that pays interest on balances through automatic sweep), a debit card, and a credit line secured by the securities in the investment account. It was a major success, and was soon copied by almost every securities firm. The CMA promise was one-stop shopping convenience for clients, enhanced broker productivity, enhanced broker and client loyalty to the firm, and enhanced cross-selling and share-of-wallet. (See "CMA" http://registeredrep.com/advisorland/career/cma_success/ accessed Jan. 12, 2009)
34. The American inventor Oliver Evans, who is acclaimed as the "father of refrigeration," designed the first vaporized refrigeration machine in 1805. However, Jacob Perkins modified Evans' original design, thus building the world's first refrigerator in 1834 and filing the first legal patent for refrigeration using vapor compression. In 1841, John Gorrie, an American doctor from Florida made the first mechanical device based on Evans' invention that would make ice in order to cool the air for yellow fever patients. Gorrie's mechanical refrigeration unit was issued a patent in 1855. The first electric refrigerator was invented in 1903 by Thomas Moore. The first commercial refrigerator designed to keep food cold was sold in 1911 by the General Electric Company and in 1913, invented by Fred W. Wolf of Fort Wayne, Indiana, these models consisted of a unit that was mounted on top of an ice box. A self-contained refrigerator, with a compressor on the bottom of the cabinet, was invented by Alfred Mellowes in 1916. Mellowes produced this refrigerator commercially but was bought out by W.C. Durant in 1918, who started the Frigidaire Company in order to mass-produce refrigerators. (See "The Refrigerator Revolution". Penton Media, Inc.. http://machinedesign.com/article/the-refrigerator-revolution-0405., "The History of the Refrigerator". Intown Entertainment. http://www.gizmohighway.com/history/refrigerator.htm., "What a Cool Idea,

Dr. Gorrie". CondéNet, Inc.. http://www.wired.com/science/discoveries/news/2008/07/dayintech _0714., "Barfly Fridge History". Barfly. http://www.barfly.ca/english/history.html., "Frigidaire Parts". Appliance Service. http://www.applianceservice.com/frigidaire.php. accessed on Jan. 19, 2009)

35. The incandescent light bulb, incandescent lamp or incandescent light globe is a source of electric light that works by incandescence. An electric current passes through a thin filament, heating it until it produces light. Thomas Edison is credited for the invention developing an effective incandescent material, a strong vacuum and a high resistance lamp that made power distribution from a centralized source economically viable. (See Friedel, Robert, and Paul Israel. 1987. Edison's electric light: biography of an invention. New Brunswick, New Jersey: Rutgers University Press. pages 115-117)
36. A flashlight is a portable electric spotlight which emits light from a small incandescent lightbulb, or from one or more light-emitting diodes. Invented by Joshua Lionel Cowen in New York City in 1898. (See "The invention of the flashlight". Padre Island Trading Company. http://padreislandtraders.com/flashlight.htm. accessed on Jan. 13, 2009)
37. A blood bank is a cache or bank of blood or blood components, gathered as a result of blood donation, stored and preserved for later use in blood transfusions. An early development leading to the establishment of blood banks occurred in 1915, when Richard Lewison of Mount Sinai Hospital in New York City initiated the use of sodium citrate as an anticoagulant. This discovery transformed the blood transfusion procedure from direct (vein-to-vein) to indirect. This discovery transformed the blood transfusion procedure from direct (vein-to-vein) to indirect. In the same year, Richard Weil demonstrated the feasibility of refrigerated storage of anticoagulated blood. The introduction of a citrate-glucose solution by Francis Peyton Rous and JR Turner two years later permitted storage of blood in containers for several days, thus opening the way for the first "blood depot" established in Britain during World War I. Charles R. Drew researched in the field of blood transfusions, developing improved techniques for blood storage, and applied his expert knowledge in developing large-scale blood banks early in World War II. Oswald Hope Robertson, a medical researcher and U.S. Army officer who established the depots, is now recognized as the creator of the first blood bank (See "Blood Bank" Morris Fishbein, M.D., ed (1976). "Blood Banks". The New Illustrated Medical and Health Encyclopedia. 1 (Home Library Edition ed.). New York, N.Y. 10016: H. S. Stuttman Co. pp. 220)
38. A particle accelerator is a device that uses electric fields to propel electrically-charged particles to high speeds and to contain them. The earliest particle accelerators were cyclotrons, invented in 1929 by Ernest Lawrence at the University of California, Berkeley. (See "Accelerators and Nobel Laureates". Nobel Prize. http://nobelprize. org/nobel_prizes/physics/articles/kullander/. accessed on Mar. 10, 2009)

39. A microwave oven is a kitchen appliance that cooks or heats food by dielectric heating. This is accomplished by using microwave radiation to heat water and other polarized molecules within the food. Cooking food with microwaves was discovered by Percy Spencer on October 8, 1945, while building magnetrons

for radar sets at Raytheon. He was working on an active radar set when he noticed a strange sensation, and saw that a peanut candy bar he had in his pocket started to melt. Although he was not the first to notice this phenomenon, as the holder of 120 patents, Spencer was no stranger to discovery and experiment, and realized what was happening. The radar had melted his candy bar with microwaves. The first food to be deliberately cooked with microwaves was popcorn, and the second was an egg. (See "Who Invented Microwaves?". J. Carlton Gallawa. http://www.gallawa.com/microtech/history.html. accessed on Jan. 16, 2009)

40. In electronics, a transistor is a semiconductor device commonly used to amplify or switch electronic signals. A transistor is made of a solid piece of a semiconductor material, with at least three terminals for connection to an external circuit. On 17 November 1947 John Bardeen and Walter Brattain, at AT&T Bell Labs, observed that when electrical contacts were applied to a crystal of germanium, the output power was larger than the input. William Shockley saw the potential in this and worked over the next few months greatly expanding the knowledge of semiconductors and is considered by many to be the "father" of the transistor. (See "Transistor" Dennis F. Herrick (2003). Media Management in the Age of Giants: Business Dynamics of Journalism. Blackwell Publishing. ISBN 0813816998. http://books.google.com/books?id=59rxoe1IkNEC&pg=PA383&ots=UC_NxASdwo&dq=transistor+greatest-invention&sig=Ul_DYQxG7EhLsRvhE8QM821JEQ.)

41. Magnetic core memory, or ferrite-core memory, is an early form of random access computer memory. It uses small magnetic ceramic rings, the cores, through which wires are threaded to store information via the polarity of the magnetic field they contain. Such memory is often just called core memory, or, informally, core. Developed at Harvard University's Computation Laboratory, the earliest work on core memory was carried out by American physicists, An Wang and Way-Dong Woo, who created the pulse transfer controlling device in 1949. The name referred to the way that the magnetic field of the cores could be used to control the switching of current in electro-mechanical systems. (See "Magnetic Core Memory" http://members.fortunecity.com/pcmuseum/coremem.htm accessed Apr. 5, 2009)

42. An artificial heart is a mechanical device that is implanted into the body to replace the biological heart. On July 3, 1952, 41-year-old Henry Opitek suffering from shortness of breath made medical history at Harper University Hospital at Wayne State University in Michigan. The Dodrill-GMR heart machine, considered to be the first operational mechanical heart was successfully inserted by Dr. Forest Dewey Dodrill into Henry Opitek while performing heart surgery. In 1981, Robert Jarvik implants the world's first permanent artificial heart, the Jarvik 7, into Dr. Barney Clark. The heart, powered by an external compressor, keeps Clark alive for 112 days. Contrary to popular belief and erroneous articles in several periodicals, the Jarvik heart was not banned for permanent use. Since 1982, more than 350 people have received the Jarvik heart as a bridge to transplantation. (See "1952: The First Mechanical Heart Pump". General Motors Corporation. http://wiki.gmnext.com/wiki/index.php/1952,_The_First_Mechanical

_Heart_Pump., “Artificial Heart”. Massachusetts Institute of Technology. http://web.mit.edu/invent/iow/jarvik.html. accessed on Jan. 21, 2009)

43. In 1953, based on X-ray diffraction images and the information that the bases were paired, James D. Watson along with Francis Crick discovered what is now widely accepted as the first accurate double-helix model of DNA structure in the journal called Nature. (See “The elementary DNA of Dr Watson”. Times Newspapers Ltd.. http://entertainment.timesonline.co.uk/tol/arts_and_entertainment/books/article2630748.ece. accessed on Mar. 21, 2009)
44. Fortran is a general-purpose, procedural, imperative programming language that is especially suited to numeric computation and scientific computing. In late 1953, John W. Backus submitted a proposal to his superiors at IBM to develop a more efficient alternative to assembly language for programming their IBM 704 mainframe computer. Backus’ historic FORTRAN team consisted of programmers Richard Goldberg, Sheldon F. Best, Harlan Herrick, Peter Sheridan, Roy Nutt, Robert Nelson, Irving Ziller, Lois Haibt and David Sayre. (See “Fortran” http://www.softwarepreservation.org/projects/FORTRAN/index.html#By_FORTRAN_project_members accessed Jan. 15, 2009)
45. A hard disk drive is a non-volatile storage device which stores digitally encoded data on rapidly rotating platters with magnetic surfaces. Introduced by an IMB team led by Rey Johnson in 1956, hard drives were orriginally developed as data storage for IBM accounting computers. (See “IBM 350 disk storage unit” http://www-03.ibm.com/ ibm/history/exhibits/storage/storage_350.html accessed Jan. 25, 2009)
46. An integrated circuit is a miniaturized electronic circuit that has been manufactured in the surface of a thin substrate of semiconductor material. Integrated circuits are used in almost all electronic equipment in use today and have revolutionized the world of electronics. The integration of large numbers of tiny transistors into a small chip was an enormous improvement over the manual assembly of circuits using discrete electronic components. On September 12, 1958, Jack Kilby developed a piece of germanium with an oscilloscope attached. While pressing a switch, the oscilloscope showed a continuous sine wave, proving that his integrated circuit worked. A patent for a “Solid Circuit made of Germanium”, the first integrated circuit, was filed by its inventor, Jack Kilby on February 6, 1959. (See “Jack Kilby: The Chip that Jack Built”. Texas Instruments. http://www.ti.com/corp/docs/kilbyctr/jackbuilt.shtml. accessed on Jan. 11, 2009)
47. The first working laser was demonstrated on 16 May 1960 by Theodore Maiman at Hughes Research Laboratories.In 1917 Albert Einstein, in his paper Zur Quantentheorie der Strahlung (On the Quantum Theory of Radiation), laid the foundation for the invention of the laser and its predecessor, the maser, in a ground-breaking rederivation of Max Planck’s law of radiation based on the concepts of probability coefficients (later to be termed “Einstein coefficients”) for the absorption, spontaneous emission, and stimulated emission of electromagnetic radiation. (See Townes, Charles Hard. “The first laser”. University of Chicago. http://www.press.uchicago.edu/Misc/Chicago/284158 _townes.html. accessed on Jan. 12, 2009)

48. Douglas Engelbart at the Stanford Research Institute invented the mouse in 1968 after extensive usability testing. He initially received inspiration for the design after reviewing a series of experiments conducted in the early 1960s by American geneticist Clarence Cook Little. Intrigued by Little's examination of laboratory mice at the National Cancer Institute, Engelbart endeavored to design a more efficient method for controlling computers, based on small movements of the hand corresponding to a point on a screen. The term "mouse" is a play on this connection, originally coined by Bill English, Engelbart's friend and colleague at the institute. He never received any royalties for it, as his patent ran out before it became widely used in personal computers. (See "Computer Mouse" Maggie, Shiels (2008-07-17). "Say goodbye to the computer mouse". BBC News http://news.bbc.co.uk/1/hi/technology/7508842.stm accessed on Jan. 19, 2009)
49. The Apollo 11 mission was the first manned mission to land on the Moon. It was the fifth human spaceflight of Project Apollo and the third human voyage to the Moon. It was also the second all-veteran crew in manned spaceflight history. Launched on July 16, 1969, it carried Commander Neil Alden Armstrong, Command Module Pilot Michael Collins and Lunar Module Pilot Edwin Eugene 'Buzz' Aldrin, Jr. On July 20, Armstrong and Aldrin became the first humans to land on the Moon, while Collins orbited above. At 02:56 UTC on July 21 (10:56pm EDT, July 20), 1969, Armstrong made his descent to the Moon's surface and spoke his famous line "That's one small step for man, one giant leap for mankind" exactly six and a half hours after landing. Aldrin joined him, describing the view as "Magnificent desolation." (See "Apollo 11" Richard W. Orloff. Apollo by the Numbers: A Statistical Reference (SP-4029))
50. The personal computer (PC) is any computer whose original sales price, size, and capabilities make it useful for individuals, and which is intended to be operated directly by an end user, with no intervening computer operator. Today a PC may be a desktop computer, a laptop computer or a tablet computer. While early PC owners usually had to write their own programs to do anything useful with the machines, today's users have access to a wide range of commercial and non-commercial software which is easily installed. The Kenbak-1 is considered by the Computer History Museum and the American Computer Museum to be the world's first personal computer which was invented by John Blankenbaker. (See "Kenbak Computer Company: Kenbak-1". Old Computers.com. http://www.old-computers.com/museum/computer.asp?st=1&c=1259. accessed on Feb. 7, 2009)
51. The microprocessor The microprocessor incorporates most or all of the functions of a central processing unit on a single integrated circuit. The first microprocessor was the 4004, designed in 1971 by Ted Hoff for a calculator company named Busicom, and produced by Intel. (See "Microprocessor History- Invention of the Microprocessor". The Great Idea. http://www.ideafinder.com/history/inventions/ microprocessor.htm. accessed on Jan. 20, 2009)
52. A liquid crystal display (LCD) is an electronically-modulated optical device shaped into a thin, flat panel made up of any number of color or monochrome pixels filled with liquid crystals and arrayed in front of a light source (backlight) or reflector. It is often utilized in battery-powered electronic

devices because it uses very small amounts of electric power. The first active-matrix liquid crystal display panel was produced in the United States by T. Peter Brody in 1972. (See “Active Matrix” Brody, T.P., Birth of the Active Matrix, Information Display, Vol. 13, No. 10, 1997, pp. 28-32.)

53. Recombinant DNA is a form of synthetic DNA that is engineered through the combination or insertion of one or more DNA strands, thereby combining DNA sequences that would not normally occur together. In terms of genetic modification, recombinant DNA is produced through the addition of relevant DNA into an existing organismal genome, such as the plasmid of bacteria, to code for or alter different traits for a specific purpose, such as immunity. The Recombinant DNA technique was engineered by Stanley Norman Cohen and Herbert Boyer in 1973. They published their findings in a 1974 paper entitled “Construction of Biologically Functional Bacterial Plasmids in vitro”, which described a technique to isolate and amplify genes or DNA segments and insert them into another cell with precision, creating a transgenic bacterium. (See “Recombinant DNA” DNA Learning Center. http://www.dnaftb.org/dnaftb/concept_34/con34bio.html. accessed Jan. 17, 2009)
54. The digital camera is a camera that takes video or still photographs, digitally by recording images via an electronic image sensor. Steven Sasson as an engineer at Eastman Kodak invents and builds the first digital camera using a CCD image sensor. (See “Steven Sasson named to CE Hall of Fame”. Let’s Go Digital. http://www.letsgodigital.org /en/16859/ce-hall-of-fame/. accessed on Jan. 17, 2009)
55. A rotary printing press is a printing press in which the images to be printed are curved around a cylinder. Richard Hoe creates a revolution in printing by rolling a cylinder over stationary plates of inked type and using the cylinder to make an impression on paper. This eliminated the need for making impressions directly from the type plates themselves, which were heavy and difficult to maneuver. (See “Hall of Fame: Inventor Profile of Richard Hoe”. Invent Now. http://www.invent.org/hall_of_fame/274.html. accessed on Jan. 20, 2009)
56. The telephone is a telecommunications device that is used to transmit and receive sound, usually two people conversing but occasionally three or more. The early history of the telephone is a confusing morass of claim and counterclaim, which was not clarified by the huge mass of lawsuits which hoped to resolve the patent claims of individuals such as Antonio Meucci and Elisha Gray, the inventor of water transmission. However, the patent of a Scots-American by the name of Alexander Graham Bell, who became a naturalized citizen of the United States, was forensically and commercially victorious in 1876 with the United States Patent and Trademark Office . (See “The Bell Telephone: Patent Nonsense?”. The Washington Post. http://www.washingtonpost.com/wpdyn/content/ article/2008/02/19/AR2008021902596.html. accessed on Jan. 23, 2009)
57. Radio is the transmission of signals, by modulation of electromagnetic waves with frequencies below those of visible light. Electromagnetic radiation travels by means of oscillating electromagnetic fields that pass through the air and the vacuum of space. Information is carried by systematically changing some property of the radiated waves such as amplitude, frequency, or phase. Although a contending topic, Nikola Tesla is widely regarded by most, as well

as the United States Supreme Court who in 1943 overturned Guglielmo Marconi’s patent, to be the original inventor of effective radio transmissions and many of the patents concerning radio such as reliable radio frequencies, his system of four circuits in resonance which showed the aerial connection with the ground as the essential element of wireless telegraphy, and effective transmission of long-distance signals. (See “Nikola Tesla’s Invention of Radio”. Twenty First Century Books. http://www.tfcbooks.com/teslafaq/q&a_022.htm. accessed on Jan. 23, 2009)

58. Philo T. Farnsworth worked out the principle of the image dissector television camera at age 14, and produced the first working version at age 21. A farm boy, his inspiration for the scanning lines of the cathode ray tube (CRT) came from the back-and-forth motion used to plow a field. During a patent lawsuit against RCA in 1935, his high school chemistry teacher, Justin Tolman, reproduced a drawing that Farnsworth, when he was just 14, had made on the blackboard at the school. Farnsworth won the suit and was paid royalties but never became wealthy. The video camera tube developed from a combination of the work of Farnsworth and Zworykin, was used in all television cameras until the late 20th century, when alternate technologies such as charge-coupled devices started to appear. Farnsworth developed the “image oscillite”, a cathode ray tube receiver that could display images captured by the image dissector. (See http://www.time.com /time/time100/scientist/profile/farnsworth.html accessed on Jan. 7, 2009)
59. While working in the basement laboratory of Columbia’s Philosophy Hall, Edwin Howard Armstrong, an American electrical engineer and inventor, created wide-band frequency modulation radio (FM). Rather than varying the amplitude of a radio wave to create sound, Armstrong’s method varied the frequency of the wave instead. FM radio broadcasts delivered a much clearer sound, free of static, than the AM radio dominant at the time. Armstrong received a patent on wideband FM on December 26, 1933. (See “Frequency Modulation” Armstrong, E. H. (May 1936). “A Method of Reducing Disturbances in Radio Signaling by a System of Frequency Modulation”. Proceedings of the IRE (IRE) 24 (5): 689–740. doi:10.1109/JRPROC.1936.227383)
60. Xerography or electrophotography is a dry photocopying technique invented by Chester Carlson in 1938, for which he was awarded a Patent on October 6, 1942. Carlson originally called his invention electrophotography. It was later renamed xerography—from the Greek roots xeros (dry) and graphos (writing)—to emphasize that, unlike reproduction techniques then in use such as cyanotype, this process used no liquid chemicals. (See “Xerography” Schein, L.B., Electrophotography and Development Physics, Springer Series in Electrophysics, Volume 14, (Springer-Verlag, Berlin 1988))
61. A mobile phone, also known as a cell phone, is a long-range, electronic device used for mobile voice or data communication over a network of specialized base stations known as cell sites. Early mobile FM radio telephones had been in use in since 1946, but since the number of radio frequencies is very limited in any area, the number of phone calls was also very limited. Only a dozen or two calls could be made at the same time in an area. To solve this problem, there could be many small areas called cells which share the same frequencies. But when users moved from one area to another while calling, the call would have to be switched over automatically without losing the call. In this system,

a small number of radio frequencies could accommodate a huge number of calls. This cellular phone concept was devised by a team of researchers at Bell Labs in 1947, but there were no computers available to do the switching. As small inexpensive computers were developed, cell phones could be produced. Known as the "father of the cell phone," Martin Cooper invented the first handheld cellular/mobile phone, being operational in 1973 when the first call was made to Joel S. Engel. (See "Dr. Martin Cooper Engineer, and Inventor of the Mobile Phone". Engology.com. http://www.engology.com/eng5cooper.htm. accessed on Feb. 9, 2009)

62. Telstar was the first active communications satellite, and the first satellite designed to transmit telephone and high-speed data communications. Its name is used to this day for a number of television broadcasting satellites. However, the original, experimental program included just two nearly-identical satellites: "Telstar 1", launched July 10, 1962 and operational until February 21, 1963, and "Telstar 2", launched May 7, 1963 and operational until May 16, 1965.During its time in service, Telstar 1 relayed the first television pictures, telephone calls and fax images through space and provided the first live transatlantic television feed. Belonging to AT&T, the original Telstar was part of a multi-national agreement between AT&T, Bell Telephone Laboratories, NASA, the British General Post Office, and the French National PTT (Post, Telegraph & Telecom Office) to develop experimental satellite communications over the Atlantic Ocean. The satellite was built by a team at Bell Telephone Laboratories, including John Robinson Pierce who created the project. (See "Telstar" Helen Gavaghan (1998). Something New Under the Sun: Satellites and the Beginning of the Space Age. Springer. ISBN 0387949143. http://books.google.com/books?id=z3bN76jIBjkC&pg=PA180&dq=telstar+pierce&as_brr=3&ei=6PnZRorJEpzmpwKop-GSCw&sig=l5Qi-eC5I0hPWDcH-Eq1QpwhNcA.)

63. The Bell 103 modem was the first commercial modem for computers, released by AT&T in 1962. It allowed digital data to be transmitted over regular telephone lines at a speed of 300 bits per second. Modems grew out of teletype machines, which in turn grew out of automated telegraphs. News wire services in 1920s used multiplex equipment that met the definition, but the modem function was incidental to the multiplexing function, so they are not commonly included in the history of modems. George Stibitz connected a New Hampshire teletype to a computer in New York City by phone lines in 1940. Modems in the United States were part of the SAGE air-defense system in the 1950s, connecting terminals at various airbases, radar sites, and command-and-control centers to the SAGE director centers scattered around the U.S. and Canada. SAGE ran on dedicated communications lines, but the devices at each end were otherwise similar in concept to today's modems.(See "Modem" IEEE History Center. "Gottfried Ungerboeck Oral History". http://www.ieee.org/web/aboutus/history_center/oral_history/abstracts/ungerboeckab.html. accessed on Feb. 14, 2009)

64. The interface of an e-mail client Electronic mail, often abbreviated to e-mail, is any method of creating, transmitting, or storing primarily text-based human communications with digital communications systems. Ray Tomlinson as a programmer while working on the U.S. Department of Defense's ARPANET, develops electronic mail and sends the first message on a time-sharing

computer. Tomlinson is also credited for making the “@” sign the mainstream of e-mail communications. (See “A Conversation With The Inventor Of Email”. Jupitermedia Corporation. http://itmanagement.earthweb.com /entdev/article.php/1408411. accessed on Mar. 8, 2009)

65. Ethernet was originally developed at Xerox PARC in 1973–1975. In 1975, Xerox filed a patent application listing Robert Metcalfe, David Boggs, Chuck Thacker and Butler Lampson as inventors (U.S. Patent 4,063,220 : Multipoint data communication system (with collision detection). In 1976, after the system was deployed at PARC, Metcalfe and Boggs published a seminal paper. Ethernet is a family of frame-based computer networking technologies for local area networks (LANs). The name comes from the physical concept of the ether. It defines a number of wiring and signaling standards for the Physical Layer of the OSI networking model, through means of network access at the Media Access Control (MAC) /Data Link Layer, and a common addressing format. (See “Ethernet Prototype Circuit Board”. Smithsonian National Museum of American History. http://americanhistory.si.edu/collections/object.cfm?key=35&objkey=96. accessed Dec. 7, 2008)
66. The concept of packet switching of a network was first explored by Paul Baran in the early 1960s, [510D] thus later invented by Leonard Kleinrock. [511D] On October 29, 1969, the world’s first electronic computer network, the ARPANET, was established between nodes at Leonard Kleinrock’s lab at UCLA and Douglas Engelbart’s lab at SRI. In addition, both Bob Kahn and Vinton Cerf are globally known as the “fathers of the internet” since they invented Internet Protocol and TCP in 1973 while working on ARPANET at the U.S. Department of Defense. [512D] The first TCP/IP-wide area network was operational on January 1, 1983, when the National Science Foundation (NSF) of the United States constructed a university network backbone that would later become the NSFNet. This date is held by most as the birth of the Internet. It was then followed by the opening of the network to commercial interests in 1985. As of December 31, 2008, Internet World Stats estimate that 1,574,313,184 billion people around the world use the Internet for many applications including e-mail and the World Wide Web. [513D] The entire network as we know it today, is streamlined into what is known as the Internet Protocol Suite. (See “A History of the GUI”. Condé Nast Digital, Inc. http://arstechnica.com/old/content/2005/05/gui.ars., “Paul Baran Invents Packet Switching”. Living Internet. http://www.livinginternet.com/i/ii_rand.htm., “The Birth of the Internet”. Leonard Kleinrock. http://www.cs.ucla.edu/~lk/LK/Inet/birth.html., Fascinating facts about the invention of the Internet by Vinton Cerf in 1973”. The Great Idea Finder. http://www.ideafinder.com/history/inventions/internet.htm.accessed on Jan. 5, 2009)
67. Acs and Audretsch (1990) argued in their influential study of small companies that small firms show an exceptional ability to focus and develop new innovative products and processes.
68. The ATP was considered one of the most effective U.S. public private partnerships. At this point however, it is not large and it is very objective. It also has a budget that is unsecured and funding levels are often unknown until late in the legislative process making planning by R&D managers extremely

difficult. The program was evaluated by the National Academy of Science Committee on Government-Industry Partnerships and the resulting report was highly positive, commending the concept and operation of the program. (See C. Wessner (ed.), 2001 *National Research Council, The Advanced Technology Program, Assessing Outcomes*, Washington, DC: National Academy Press.)

69. Formulation of SBIR legislation was influenced by evidence gathered by David Birch in the late 1970s. His evidence indicated that small companies were taking on an increasingly important position in the development of innovation as well as job creation. This trend was verified by empirical evidence Zoltan Acs and David Audretsch, working for the U.S. Small Business Innovation Data Base. (See Acs and Audretsch (1990)).
70. The rise in venture capital has increased the need for studies on the development of high-technology firms. (See "High-Technology Firm Evolution" Jeffrey Sohl, University of New Hampshire, Center for Venture Research www.unh.edu/cvr accessed Feb. 11, 2009).
71. These include the Department of Defense, Department of Health and Human Services, National Aeronautics and Space Administration, Department of Energy, National Science Foundation, Department of Agriculture, Department of Commerce, Department of Education, Department of Transportation, Environmental Protection Agency, and Department of Homeland Security.
72. This certification effect was first identified by Lerner (1999).
73. The Bayh-Dole Act of 1980 is designed to encourage the use of inventions developed with federal funding by allowing universities and small businesses to retain the title of inventions made in performance of federally funded programs.
74. Adobe Systems Incorporated is an American computer software company headquartered in San Jose, California, USA. The company has historically focused upon the creation of multimedia and creativity software products, with a more-recent foray towards rich Internet application software development. Adobe was founded in December 1982 by John Warnock and Charles Geschke, who established the company after leaving Xerox PARC. (See "Adobe - Company Overview" Hoover's http://www.hoovers.com/adobe/--ID__12518--/free-co-factsheet.xhtml accessed Feb. 13, 2009)
75. Advanced Micro Devices, Inc. (AMD) is an American multinational semiconductor company based in Sunnyvale, California, that develops computer processors and related technologies for commercial and consumer markets. The company was founded on May 1, 1969, by a group of former executives from Fairchild Semiconductor, including Jerry Sanders III, Ed Turney, John Carey, Sven Simonsen, Jack Gifford and three members from Gifford's team, Frank Botte, Jim Giles, and Larry Stenger. (See "About AMD" amd.com http://www.amd.com/us-en/Corporate/AboutAMD/0,,51_52_10554,00.html accessed Mar. 8, 2009)
76. FedEx Corporation (NYSE: FDX), originally Federal Express, is a logistics services company, based in the United States. The company was founded by Fred Smith in Little Rock, Arkansas in 1971. After a lack of support from the Little Rock National Airport, Smith moved the company to Memphis, Tennessee and the Memphis International Airport in 1973. Beginning as a cargo airline, the air division of FedEx Corporation is now the world's largest airline in terms of aircraft and in terms of freight tons flown. (See "FedEx

Express Facts" FedEx.com http://www.fedex.com/us/about/today/companies/express/facts.html accessed Jan. 7, 2009)

77. Intel Corporation is the world's largest semiconductor company and the inventor of the x86 series of microprocessors, the processors found in most personal computers. Intel was founded by semiconductor pioneers Robert Noyce and Gordon Moore on July 18, 1968 as Integrated Electronics Corporation and based in Santa Clara, California, USA. (See "Intel Corporation". Encyclopædia Britannica. http://www.britannica.com/EBchecked/topic/289747/Intel-Corporation. accessed Jan 6, 2009)
78. Microsoft Corporation is an American-based multinational computer technology corporation that develops, manufactures, licenses, and supports a wide range of software products for computing devices. Originally founded to develop and sell BASIC interpreters for the Altair 8800, William Henry Gates III, (known as Bill Gates) called the creators of the new microcomputer, Micro Instrumentation and Telemetry Systems (MITS), offering to demonstrate an implementation of the BASIC programming language for the system. After the demonstration, MITS agreed to distribute Altair BASIC. Gates left Harvard University, moved to Albuquerque, New Mexico where MITS was located, and founded Microsoft there. (See "Information for Students: Key Events In Microsoft History" Microsoft.com http://www.microsoft.com/about/companyinformation /visitorcenter/student.mspx accessed on Jan. 22, 2009)
79. Qualcomm is a wireless telecommunications research and development company based in San Diego, California. Orriginally founded in 1985 by UC San Diego Professor Irwin Jacobs, Andrew Viterbi, Harvey White, Adelia Coffman, Andrew Cohen, Klein Gilhousen, and Franklin Antonio, the company is the inventor of CDMA standards and its technology is found in a majority of cellular phones. (See "Qualcomm History" Qualcomm.com http://www.qualcomm.com/who_we_are/history.html accessed Jan 19, 2009)
80. The drop-off in foreign students has largely been self imposed in the United States. After the attacks of September 11th, The U.S. government enacted much tighter controls on foreign students and due to a lack of resources, the process has resulted in long delays. In recent years, increased focus on this subject has resulted in better funding alleviating many of the difficulties for foreign students. The U.S. foreign student population has since increased. (See "Sustaining the Nations Innovation Ecosystems" President's Council of Advisors on Science and Technology, ostp.gov (2004)).
81. American International Group, Inc. (AIG) is a major American insurance corporation based at the American International Building in New York City. It suffered from a liquidity crisis after its credit ratings were downgraded below "AA" levels, and the Federal Reserve Bank on September 16, 2008, created an $85 billion credit facility to enable the company to meet collateral and other cash obligations, at the cost to AIG of the issuance of a stock warrant to the Federal Reserve Bank for 79.9% of the equity of AIG. In November 2008 the U.S. government revised its loan package to the company, increasing the total amount to $152 billion. AIG is attempting to sell assets to repay the loans. So far the U.S. government has given the company over $170 billion. (See "AIG's meltdown has roots in Greenberg era" Reuters.com http://www.reuters.com/article /ousiv/idUSTRE5222EV20090303 accessed Jan 24, 2009)

82. The National Academy of Sciences (NAS) is a corporation in the United States whose members serve pro bono as advisers to the nation on science, engineering, and medicine. The Act of Incorporation, signed by President Abraham Lincoln on March 3, 1863, created the National Academy of Sciences and named 50 charter members. Many of the original NAS came from the so-called Scientific Lazzaroni, an informal network of mostly physical scientists working in the vicinity of Cambridge, Massachusetts in the 1850s. (See "Founding of the National Academy of Sciences" Nationalacademies.org http://www7.nationalacademies.org/archives/nasfounding.html accessed Jan. 12, 2009)
83. The policy recommendations expressed in this paper are not based on empirical evidence but rather the broad innovative framework through which policy decisions should be assessed. Empirical research is needed to develop sound recommendations for future policy decisions and it is hoped that this paper will assist in defining the innovative contexts in which all policy should be measured.
84. The quality of American teachers in pre college education has dropped over the past few decades. Currently, it has a lower barrier to entry than it once had as evidenced by entrance exam scores. A recent finding noted that a majority of math and science teachers in American pre college education have had not received degrees in those fields nor do they have any formal training in the subjects they teach. A significant drop in competitive international rankings for K through 12 education arises after 4th grade when math and science curriculum begin to be focused on.
85. The current perception of the pre college teaching profession is relatively poor compared with that of other nations, due to the relative ease in entering into that field. Many theorists believe the standards for entering into this profession must be raised.
86. Japan provides a tax credit for small business innovation that is four times as great as that of the United States.
87. Microsoft Corporation is an American-based multinational computer technology corporation that develops, manufactures, licenses, and supports a wide range of software products for computing devices. Headquartered in Redmond, Washington, USA, its best selling products are the Microsoft Windows operating system and the Microsoft Office suite of productivity software. Originally founded to develop and sell BASIC interpreters for the Altair 8800, Microsoft rose to dominate the home computer operating system market with MS-DOS in the mid-1980s, followed by the Windows line of operating systems. Its products have all achieved near-ubiquity in the desktop computer market. Founded in 1975 by Bill Gates and Paul Allen, Microsoft now has an annual revenue of $60.4 billion U.S.
88. Google Inc. is an American public corporation, earning revenue from advertising related to its Internet search, e-mail, online mapping, office productivity, social networking, and video sharing services as well as selling advertising-free versions of the same technologies. The Google headquarters, the Googleplex, is located in Mountain View, California. As of December 31, 2008, the company has 20,222 full-time employees. Google was co-founded by Larry Page and Sergey Brin while they were students at Stanford University and the company was first incorporated as a privately held

company on September 4, 1998. Google now has a revenue of $21.8 billion U.S.

89. International Business Machines Corporation, abbreviated IBM and nicknamed "Big Blue" (for its official corporate color), is a multinational computer technology and IT consulting corporation headquartered in Armonk, New York, United States. The company is one of the few information technology companies with a continuous history dating back to the 19th century. IBM manufactures and sells computer hardware and software, and offers infrastructure services, hosting services, and consulting services in areas ranging from mainframe computers to nanotechnology. Founded in 1896 as the Tabulating Machine Company, it now has an operating revenue of $103.6 billion U.S.
90. The recent economic crisis experienced in the U.S. has caused many world investors to question the economic stability of America. China recently proposed a move to a world currency for World Bank reserves, a move that many analysts believe would never have been proposed had there been no concern over the economic viability of the U.S. economy for the foreseeable future.
91. The United States consumes 20,680,000 barrels of oil per day. and a majority of it comes from outside the U.S. in regions of the world that are not friendly with America. Energy requirements are predicted to increase dramatically in the future and foreign dependence on oil makes the U.S. susceptible to economic manipulation by foreign oil markets. Other nations are looking for alternative sources of power to alleviate the demand for oil including France which gains 78% of their electricity from nuclear power.
92. The current requirements of foreign oil require that new sources of energy be found. Offshore drilling which is currently prohibited by the U.S. is being conducted by more environmentally conscious nations including Britain and Norway and other nations are looking for alternative sources of power to alleviate the demand for oil including France which gains 78% of their electricity from nuclear power.
93. In the coming years, the Baby Boom generation will be reaching retirement age which will require a substantial increase in government spending for Social Security and Medicare.
94. Social Security in the U.S. is the federal Old-Age, Survivors, and Disability Insurance (OASDI) program. U.S. Social Security is a social insurance program funded through dedicated payroll taxes called Federal Insurance Contributions Act (FICA). Tax deposits are formally entrusted to Federal Old-Age and Survivors Insurance Trust Fund, or Federal Disability Insurance Trust Fund, Federal Hospital Insurance Trust Fund or the Federal Supplementary Medical Insurance Trust Fund. It was begun in 1935 by President Roosevelt as part of his New Deal.
95. Medicare is a social insurance program administered by the United States government, providing health insurance coverage to people who are aged 65 and over, or who meet other special criteria. Medicare operates as a single-payer health care system. The Social Security Act of 1965 was passed by Congress in 1965 by President Lyndon B. Johnson as amendments to Social Security legislation.
96. The rising number of retirement age population will increase the financial strains on the U.S. government to a point that is unsustainable by 2030.

97. Financial experts including Steve Forbes see no viable solution paying future Social Security and Medicare costs other than a privatized system.
98. Pork barrel spending including farm aid is a substantial portion of the American budget promulgated by earmarks and other forms of spending commitments. The difficulty in eliminating this waste arises from the system of governance in America. Senators and Congressmen are elected by their constituents which often benefit from that spending at the cost to national tax payers. Many of these programs serve no purpose and create a larger deficit for the budget. Some of these programs include paying farmers not to grow crops as to evenly distribute competition. The result is that American tax payers are paying American farmers not to work. This counterintuitive model is a great burden on the U.S. budget.
99. By borrowing on national debt, the United States becomes indebted to the country that holds out debt, namely China. This action results in unequal trade agreements favoring the country holding the debt which hinders free market progress in the nation which is borrowing.
100. Innovation indexes consider banking strength a critical component in ranking calculations, due to the implications on the market environment and health as a whole.
101. Although controversial, Mark to Market rules were recently revised, a move that was applauded by much of Wall Street. Similar problems still exist in the banking industry including naked short selling, or naked shorting, a type of financial speculation. It is the practice of selling a stock short, without first borrowing the shares or ensuring that the shares can be borrowed as is done in a conventional short sale. When the seller does not obtain the shares within the required time frame, the result is known as a "fail to deliver". The transaction generally remains open until the shares are acquired by the seller or the seller's broker, allowing the trade to be settled. Naked short selling can be used to manipulate the price of securities by driving their price down, and its use in this way is illegal
102. It has been argued that the economic crisis was sparked by home ownership problems. In the early 2000s, home prices rose considerably for a period of time causing many Americans to view their home as an asset rather than a residence. Mortgage lenders facilitated lending to the massive influx of borrowers seeking to take advantage of investment opportunities as well as low interest rates. Many of these borrowers had subprime credit and could not afford the houses they were purchasing but mortgage lenders enabled them to make purchases by creating adjustable arm loans, loans which remain low for a period of time at which point the interest rates increase dramatically. The eventual cooling off of the housing market and eventual implosion of housing prices resulted in many failed investments still requiring loan payments to the banks and the subsequent expiration of low interest periods in the adjustable arm loans resulting in substantially increased bank payments, provided a scenario in which a substantial percentage of the American population could not afford to make bank payments. The resulting backlash was a wave of foreclosures and individuals cut their losses and declared bankruptcy.
103. Hong Kong experienced a similar housing crisis as many over leveraged homeowners could not keep up with rising home ownership costs. Hong Kong solved this crisis by adjusting the length of housing loans rather than the rate allowing borrowers to pay a manageable monthly payment.

104. The current liquidity crisis is resulting in a massive freeze on loans. One of the most visible victims of this crisis is businesses which operate on cash flow to pay suppliers and employees. Banks are increasingly refusing to lend to businesses despite their good standing. The result is a chain reaction of business failures as industry comes to an impasse.

105. Problem investments in the housing market were exacerbated by individuals who bought and sold properties at a rapid pace, artificially increasing the perceived value of those investments. The subsequent economic fall out has resulted in uncertainty in the markets where the stock market has fallen over 40%. This instability is a self fulfilling cycle spurred by a lack of faith in the market. By increasing investors in the market, normal equilibrium levels can be achieved. By offering a temporary tax shelter from capital gains for investments held through the end of a given time frame, the government can encourage investors to reenter the stock market, helping to shorten the recovery time for this economic crisis.

106. American do not save enough and some of the economic crisis was brought about from individuals who were over leveraged. By providing incentives for early investment by locking in low taxes, the American government can encourage the American population to be more fiscally responsible with their finances.

107. 401K plans in the U.S., allow a worker to save for retirement and have the savings invested while deferring current income taxes on the saved money and earnings until withdrawal. The employee elects to have a portion of his or her wages paid directly, or “deferred,” into his or her 401(k) account. In participant-directed plans (the most common option), the employee can select from a number of investment options, usually an assortment of mutual funds that emphasize stocks, bonds, money market investments, or some mix of the above. Many companies’ 401(k) plans also offer the option to purchase the company’s stock. The employee can generally re-allocate money among these investment choices at any time. In the less common trustee-directed 401(k) plans, the employer appoints trustees who decide how the plan’s assets will be invested.

108. IRA, An Individual Retirement Arrangement (or IRA) is a retirement plan account that provides some tax advantages for retirement savings in the United States. There are a number of different types of IRAs, which may be either employer-provided or self-provided plans, including: Roth IRA - contributions are made with after-tax assets, all transactions within the IRA have no tax impact, and withdrawals are usually tax-free. Named for Senator William Roth. Traditional IRA - contributions are often tax-deductible (often simplified as “money is deposited before tax” or “contributions are made with pre-tax assets”), all transactions and earnings within the IRA have no tax impact, and withdrawals at retirement are taxed as income (except for those portions of the withdrawal corresponding to contributions that were not deducted). Depending upon the nature of the contribution, a traditional IRA may be referred to as a “deductible IRA” or a “non-deductible IRA.” SEP IRA - a provision that allows an employer (typically a small business or self-employed individual) to make retirement plan contributions into a Traditional IRA established in the employee’s name, instead of to a pension fund account in the company’s name. SIMPLE IRA - a simplified employee pension plan that allows both employer and employee contributions, similar to a 401(k) plan, but with lower

contribution limits and simpler (and thus less costly) administration. Although it is termed an IRA, it is treated separately. Self-Directed IRA - a self-directed IRA that permits the account holder to make investments on behalf of the retirement plan.

109. The economic health of the American market is influenced by many factors. Financial instability from an over leveraged population is a prime concern, resulting in periods of economic and investment lags. By encouraging fiscal responsibility, the American population will be better equip to invest in viable solutions resulting in a healthier economic environment that is more conducive to innovative development.

110. The majority of Europe has corporate taxes under 30% with an average in the mid 20s. With the increasing mobility of global operations, multinational corporations are capable of establishing themselves in the most conducive tax environment. By maintaining one of the highest corporate tax rates in the world, the U.S. risks losing businesses to foreign countries. By lowering corporate taxes, foreign companies may be encouraged to establish operations in the U.S., providing jobs and encouraging the development of innovation.

111. Average world corporate tax Japan provides tax credits for innovation that are three times as large as those of the United States and the Organization for Economic Cooperation and Development ranks the U.S. in seventeenth place with regard to R&D tax incentives.

112. The National Defense Education Act of 1958 (NDEA) (Public Law 85-864) is a United States Act of Congress, passed in 1958 providing $887 million ($6 billion in today's dollars) in aid to education in the United States at all levels, both public and private. It was prodded by early Soviet success in the Space Race, notably the launch of the first-ever satellite, Sputnik, the year before. The NDEA was instituted primarily to stimulate the advancement of and education in science, mathematics, and modern foreign languages; but it has also provided aid in other areas, including technical education, area studies, geography, English as a second language, counseling and guidance, school libraries and librarianship, and educational media centers.

113. DARPA, the Defense Advanced Research Projects Agency (DARPA) is an agency of the United States Department of Defense responsible for the development of new technology for use by the military. DARPA has been responsible for funding the development of many technologies which have had a major impact on the world, including computer networking, as well as NLS, which was both the first hypertext system, and an important precursor to the contemporary ubiquitous graphical user interface. DARPA was established in 1958 (as ARPA) in response to the Soviet launching of Sputnik in 1957, with the mission of keeping U.S. military technology ahead of the nation's enemies. DARPA's original mission, established in 1958, was to prevent technological surprise like the launch of Sputnik, which signaled that the Soviets had beaten the U.S. into space. The mission statement has evolved over time. Today, DARPA's mission is still to prevent technological surprise to the U.S., but also to create technological surprise for our enemies. DARPA is independent from other more conventional military R&D and reports directly to senior Department of Defense management. DARPA has around 240 personnel (about 140 technical) directly managing a $3.2 billion budget. These figures are "on average" since DARPA focuses on short-term (two to four-year) projects run by small, purpose-built teams.

114. NASA, the National Aeronautics and Space Administration is an agency of the United States government, responsible for the nation's public space program. NASA was established on July 29, 1958, by the National Aeronautics and Space Act. In addition to the space program, it is also responsible for long-term civilian and military aerospace research. Since February 2006 NASA's self-described mission statement is to "pioneer the future in space exploration, scientific discovery, and aeronautics research." It has an annual budget of $17.6 billion and is directed by the NASA Administrator, the highest-ranking official in the U.S. space program who serves as the senior space science adviser to the President of the United States. The position of Administrator is currently vacant, as former NASA Administrator Michael D. Griffin, whose term started on April 14, 2005, resigned effective January 20, 2009 Associate Administrator Christopher Scolese has been named NASA's Acting Administrator pending a permanent appointment by the President of the United States and successful confirmation by the United States Senate.

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