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# Intellectual Capital and Our Place in the World: The Need for Action

The technologies that have been developed here in Los Angeles have helped mankind cure disease, mitigate environmental damage, and propagate knowledge as never before through satellites and the Internet. They have helped us better understand our universe, the human genome, and the very earth we live on. These technologies have also helped our nation win wars both hot and cold and advance the cause of peace. Los Angeles, and America's other centers of technology and innovation, have made our nation the measure of global competitiveness for decades. In short, I cannot think of a more appropriate place than this city to strongly advocate on behalf of America's global technological competitiveness.

But first, I will observe a maxim of the ancient Roman orators. They believed that there comes a time to say something and a time to say nothing, but there never comes a time to say everything. The future of American technological competitiveness is such an enormous topic that time will not allow me to discuss every dimension of it. So, as the CEO of a high-technology defense company, I would like to approach the topic through the prism of national security.

Every age in man's history has had its governing commodity, and the fortunes of nations wax and wane in correlation to their mastery of it. I believe that global competitiveness today simply refers to a nation's mastery—or lack of mastery—of the governing commodity of the era. In past millennia it was the mastery of tools and weapons—first of stone, then bronze, and finally iron. Centuries ago the governing commodity became the discovery of gold and other precious metals. More recently it has been trade and finance, heavy industry and oil. But the ultimate governing commodity of our age is intellectual capital. As a nation, we are preeminent in the world today because we dominate that commodity.

Back during the Second World War, the governing commodity was industrial capacity—and we were lucky that it was. Of course our intellectual capital, and that of our British and other allies, played an important role in our victory. But the intellectual capital of our adversaries was at least as good and sometimes better. German and Japanese aircraft, certainly in the early war years, were better than ours. Their

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submarines and torpedoes were superior. Germany outclassed us in jet and rocket propulsion, cruise, and ballistic missiles, and tank design. And let's not forget that the first man-made object to enter space had a swastika painted on it—I'm talking about the V-2 rocket. But in translating intellectual capital into the industrial output needed to win, the Axis powers failed where we succeeded. I'll give an example: On December 7, 1941, the Japanese navy possessed ten aircraft carriers to our seven. Three and a half years later, on VJ day, the Japanese had four carriers still afloat. We had a hundred.

A few years later, the Cold War commenced and we found ourselves having to wage war in peacetime. The governing commodity, at least within the realm of national security, began to subtly shift from industrial capacity to intellectual capital. It had to. The Steinway Piano Company spent World War II making wooden components for the army's assault gliders. Detroit produced thousands of tanks and military jeeps instead of passenger cars. But no free market system can long survive that degree of extended mobilization during peacetime. Our intellectual capital had to be harnessed to keep us strong without derailing our economy.

And so we saw the invention of the nuclear navy, a development that revolutionized the submarine in particular. We saw the invention of reconnaissance satellites, communication satellites, intercontinental ballistic missiles, and advances in micro processing, metallurgy,

composite materials, information technology, and aircraft design. In World War II, our defense expenditures were 50 percent

that capability made it possible to rapidly destroy Afghanistan's entire air defense system with just six B-2 sorties. By the way, recent upgrades to these aircraft now enable a single B-2 to destroy 80 separate targets per mission.

naissance Europe that followed the invention of Gutenberg's printing press. The recent explosion of the Internet has done the same thing a million-fold. And in the bargain, it has democratized access to knowledge as never before. In fact, the Massachusetts Institute of Technology is sponsoring a program that seeks to design a laptop robust enough for use in primitive locations. The target cost is no more than \$100, and they intend to distribute them to children throughout the developing world. I hope they succeed.



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The B-2 program required the invention of new technologies, new materials, new design tools, and new manufacturing processes. Because all of the major systems were integrated, this aircraft had to be designed all at once which meant that it would be the first aircraft to be completely designed by computer.

But this trend also has implications that are harrowing. Combine commercially available computing power with Internet-based technical information, and with renegade nations eager to proliferate these capabilities to those seeking to do us harm. Suddenly, even nations and terrorist groups we have long dismissed as too backward to be threats are now very threatening.

of GDP. By 1952, during the Korean War, defense expenditures peaked at 14 percent, and have been shrinking ever since to less than 4 percent today. Combining intellectual capital with a free market economy was how we prevailed over our Soviet Cold War rivals without bankrupting our nation.

And, for the time, the computing power necessary to do that design job was immense.

This dawning age of technology is a double-edged sword. And it remains for the civilized world to cultivate its benefits while managing its risks. Can we do it? Only if we continue to dominate the commodity of our age—intellectual capital. And there's the rub, because for some time now America's leading indicators have not been promising.

A wonderful and more recent example of how intellectual capital changed the game is the story of Northrop's B-2 Stealth Bomber. Our Air Force's requirements for that aircraft were astonishing. They wanted a long range, high altitude, strategic bomber that would have no detectable radar or infrared signatures. Total stealth. The objective was nothing less than to revolutionize air warfare by negating anti-air defenses. The Air Force wanted to reverse the rule of thumb that it required 16 sorties by conventional aircraft to destroy one target; The Air Force now wanted each B-2 to be able to destroy 16 targets in a single sortie mission. That meant that, in addition to the aircraft itself, precision-guided munitions—that is, smart bombs—had to be refined and advanced. Fifteen years later,

Today, two and a half decades later, computing power has enabled some of our most important emerging technologies. The viability of the Human Genome Project, nanotechnology, space-based systems and many others, are governed by computing power.

Because computing power is widely prevalent, advanced technology, even military technology, is now available to far more users and would-be users than ever before. Moore's Law tells us that affordable computing power will continue to double every 18 months. It is worth noting that the X-Box your children play with at home contains more computing power than the decade-old computers aboard the B-2. The implications of all this are at once inspiring and harrowing.

Nearly a year before the September 11 attacks, the U.S. Commission on National Security in the 21st Century, headed by Senators Gary Hart and Warren Rudman, concluded among other things that, "*The inadequacies of our system of research and education pose a greater threat to U.S. national security over the next quarter century than any potential conventional war that we might imagine.*"

Inspiring, because the advance of the human condition is linked to the propagation of knowledge. Think of the explosion of knowledge throughout Re-

Last year a National Academies report, commissioned by Congress, pointed out that in 2004 U.S. universities graduated only 70,000 engineers. Mean-

while, India graduated about 200,000 and China graduated over 500,000. And the quality of those engineers is becoming every bit as good as our own.

**The trend, however, is clear. We are losing our edge to the world's fastest growing economies in the areas of science, math and engineering**

The non-partisan Economic Strategy Institute notes that in 2000 the U.S. led the world in Internet broadband access. Today we are in 16th place. Study after study reveals that American students are avoiding math and science in high school and college. And those who seek out such courses often have trouble finding teachers. U.S. school districts will need to hire 240,000 middle school and high school math and science teachers by 2010 to arrest this spiral. Where will these teachers come from?

Now, I will tell you that in the contentious arena of public policy debate, the accuracy of figures such as these is often subject to criticism. The trend, however, is clear. We are losing our edge to the world's fastest growing economies in the areas of science, math and engineering. And we are doing so at a time when science and technology have never been more essential to the defense of the nation and the health of our economy.

Our competitive lead must be kept and it must be kept large. Just maintaining parity is fraught with risk. Had we managed nothing more than parity with

our nearest technological peers four decades ago, our lunar landings might today be remembered as some other nation's achievement. And the Cold War would still be with us. As stated in the National Academies study, "*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 it can be recovered at all,*" The speed of technology's progress makes just trying to maintain parity a dangerous standard. An old test pilot's saying puts it another way: You ain't been lost until you've been lost at mach three.

In his State of the Union speech earlier this year, the president called for a major national effort to increase America's competitiveness through increased research funding, tax credits for research and development, and the training of more science and math teachers. These are all important. But we must also not discount the role of inspiration. I and many other scientists and engineers of my generation were inspired to our life's work by our nation's early space program. If the renewal of manned space flight and a return to the moon does nothing more than inspire a new generation into science and math, the investment required will be well worth it. I have said it several times—inspire our youth and give them a mission and they will amaze us.

The most significant human failures are often failures of imagination. The notion of perpetual American technology dominance is so entrenched in our national psyche that we no longer perceive it for what it is—an assumption—and one, by the way, that does not survive acquaintance with the historical record.

Very few of history's great nations crash-landed suddenly from their positions of prominence. More frequently, they simply wound down. They got tired. They stopped innovating, creating, and exploring. They lost their optimism and

their confidence. They turned inward, focusing more on preserving their past than on boldly embracing the future. They abandoned the hard, risky, struggle for progress until, inch by inch, they created their own irrelevance. As the historian Arnold Toynbee asserted, the autopsy of history shows that great nations die not by murder, but rather by slow suicide.

That is a fate we can avoid if we choose. Not only must Americans invest more in applied research, but we must invest more in basic research. Our national laboratories are neglected jewels in our country's crown and they must be re-energized. Yes, we must hire more high school science and math teachers, but we must also inspire students into their classrooms. Yes, we need to generate more graduate-level engineering and science students, but we must also make it easier for talented foreign students to work in this country after they graduate, and to become Americans. Above all we must fight the lie that holds advanced technology to be the source of our problems instead of a means of deliverance.

We are not without some reasons for optimism. Even if the gap is narrowing, our technology lead is still large. And we still have the world's best nursery for innovation and creativity—a vibrant, healthy free market economy—an economic system that thrives on competition. We Americans are also blessed with a wonderful cultural trait that values the liberal arts tradition of questioning conventional wisdom, thinking outside the box, and applying artistic creativity to the problems of science and engineering.

We may think that this new high-tech age has pretty much had its run, but it has not. It is just starting. Last year the British historian Paul Johnson put the issue in perspective. He said, "*The species Homo Sapiens is less than 1 million*

*years old. Civilization has existed for only about 8,000 years. The Industrial Revolution occurred less than 250 years ago. We've harnessed electricity for only 150 years, and atomic power for half a century. The rate of advance is accelerating very fast indeed, yet the pace is going to quicken at a speed we cannot now imagine. We are only at Chapter One in the story of humanity and its glories."*

Our current technological age is not well advanced; it is, in fact, quite nascent—the runners in the race are barely off the starting blocks. If we are proac-

tive, if we choose to struggle, invest, and risk, we can improve our standard of living, our economic power, and our national security. If we choose complacency, others will exploit this new age at our expense. Spain dominated the sixteenth century but France dominated the seventeenth. Much of the eighteenth and nineteenth centuries belonged to Britain. The twentieth century truly was "the American century," but we should understand that it was not so by tenure or accident, but by effort. The twenty-first century is now very much up for grabs. With focus, conviction, and action, we can make it ours as well.

Thank you.

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