TECHNOLOGY INNOVATION PROGRAM
WHITE PAPER
PRODUCT-USE PREREQUISITES, ADVANCED PRODUCT FINISHING

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It took one generation, 1932 to 1952, for our nation to go from its worst economic disaster to economic and political leadership of the world. However, prosperity was followed by an ever-accelerating build-up of greed and arrogance. Thus, it has taken only a half generation, 2001 to 2011, for policies and practices to catapult the nation into its current perilous position. Putting aside off-the-books wars, nothing has had a greater impact on American society and the global economy than the practices of American manufacturing, yet today manufacturing is treated as nothing more than political football.

The first of the negative practices was 'built-in obsolesence'. Volkswagen mocked it in 1959 with an ad that said, "We do not believe in planned obsolescence. We don't change a car for the sake of change." In the '60's and '70's, Japan initiated the downfall of U.S. automotive supremacy simply by producing durable vehicles. The second practice was 'global out-sourcing' with the concomitant transformation of the U.S. economy into a 'service economy'. Such short-sited approaches ignore the impact of manufacturing within the U.S. on its own economy and therefore its society as a whole. In 2008, goods-producing industry groups accounted for 18.9% of the nation's GDP. That number clearly shows that its importance has remained pervasive and consistent, but its role in preserving the general welfare has diminished far below its potential:

> The importance of manufacturing
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> by Robert E. Scott with research assistance from Lauren Marra
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> While U.S. manufacturing has been hit hard by a decade of rapid import growth and job loss, the manufacturing sector remains a vital part of the U.S. economy. The manufacturing sector supported 14 million jobs in 2007, or about 10.1% of total employment.
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> Manufacturing industries are also responsible for a significant share of U.S. economic production, generating $1.6 trillion in GDP in 2006 (12.2% of total U.S. GDP). Because manufacturing firms also use trillions of dollars worth of commodities and services as inputs, the sector is responsible for an even bigger share of total output. U.S. manufacturing had gross output1 of $4.5 trillion in 2005, and it is by far the most important sector of the U.S. economy in terms of total output (Bureau of Economic Analysis 2008).
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> Manufacturing plays a large part in the economy in individual states, too, generating 28% of GDP in Indiana in 2006 ($70 billion), and more than 20% in Iowa (21%, $26 billion), Louisiana (21%, $41 billion), and Wisconsin (20.8%, $47 billion). California (9.8%, $169 billion) and Texas (13.1%, $140 billion) each generated more than $100 billion in manufacturing GDP in 2006.

Today, manufacturing must broaden its viewpoint beyond the immediate bottom line if it is to fulfill its obligations to the nation and return to 'good corporate citizenship'. Since the Federal government has, over time, taken on financial and R&D roles within manufacturing, it must now

take the lead in turning those roles into meaningful contributions to the general welfare. The average citizen is well aware of the automotive industry as a prime example of the impact and intersection of government and manufacturing, but is unaware of the cross-industry financial contributions to industry the Federal government had increasingly made in the past, largely through political maneuvering. Now it has taken a direct role in manufacturing using its constitutional mandate to promote the general welfare (Interstate and international land, sea, and air transportation construction and equipment easily fall within the concept, but it has been applied broadly). Whether it is in protection of the $39.0billion investment in GM and Chrysler, the $14.065billion in loans to Ford, Nissan, and Tesla, the $multi-billion financing of unspecified infrastructure, the $multi-billions expended in nano-technology research, or NASA and Department of Defense programs, or the billions spent in NIH research and development of drugs and medical treatments, manufacturing within the U.S. is key to recovery of those investments. Research and development precedes manufacturing, acquisition of output follows it. But it is domestic manufacture of components and/or products that ultimately determines manufacturing's contribution to the general welfare. It is the means not only to a return on the investment of federal funds but to the nation's economic well-being.

Beyond those much-publicized problems in automotive manufacturing, the less recognized considerations of the environment and costs containment must be incorporated into a unified oversight and guidance program wherever government funding is involved. In the automotive industry, such things as VOC emissions, air make-up within production facilities, and costly companion equipment and processes in body finishing would all fall within the parameters of the oversight program. Where best practices should be implemented, the status quo, stifled innovation, and reduced manufacturing advancement has been assured politically.

While $billions have been committed to electric cars, practicality demands the ability to recharge the battery within five-to-fifteen minute pit stops all across the nation. A Japanese retailer is building one-hour battery chargers in some of their malls as a test. It is a good marketing ploy, creating captive shoppers for at least one hour. Home recharging takes from 7-14 hours. Neither is a viable solution for mass usage of electric cars and a meaningful reduction in oil consumption and therefore begs the questions: Should government funds be expended on products that lack the pre-requisites for practical usage, and what entity should determine those prerequisites?

In addition, a basic tenant for the use of federal funds should be: Do the expenditures support the most advanced developments known to mankind anywhere? Consider the highways across America. In the winter of 1979, thirty-two years ago, I was amazed to discover that the streets and sidewalks of Oslo, Norway, were free of snow due to the implementation of a comprehensive geo-thermal system. Even the walkways in Weigland Park were free of snow. Not only is this a practical and comprehensive approach to infrastructure, it has a positive impact on the environment and on vehicle-longevity due to the elimination of chemical de-icers. Such advances in infrastructure should not be rejected as *not invented here*. They must be improved upon whenever possible and implemented anywhere applicable, most certainly in the assumed world's most advanced nation, The United States. We could one-up Norway through the inclusion of fiber optics in interstate infrastructure construction in order to make that and other technological advances available throughout the nation as a return on taxpayer investment.

When it comes to bridges, the following collapses demonstrate the need for review of component specification and certification, not by lobbyist or through Congressional earmarks, but through academic and expert collaboration in the identification of worldwide 'best practices':

June 28, 1983. Mianus River Bridge (Greenwich, Connecticut, USA)
3 people dead.

Three people were killed when their vehicles fell with the bridge into the **Mianus River** 70 feet below, and three were seriously injured. Collapse due to failure of the Pin and Hanger assembly supporting the span.

The Pin and Hanger assembly failed because of the assumption that stainless steel was rust-proof under all conditions, including when imbedded in concrete. Over 250 such bridges were built across The United States. Imagine being greeted by this gap at 55 or more miles per hour.

August 1, 2007. Minneapolis I-35W bridge (Minneapolis, Minnesota USA)
13 people dead.

On August 1, 2007, during the evening rush hour, the main spans of the **bridge collapsed**, falling into the river and onto its banks. Thirteen people died and approximately one hundred more were injured. The 1,907-foot bridge fell into the **Mississippi River.**

Investigation discovered that a metal plate essential to the support system was too thin.

Oversight of the specifications, instead of probability analysis, could have eliminated these and other tragedies. The fact that only thirteen died in the collapse of this bridge that hundreds of thousands had driven across is irrelevant.

In the case of nano-technology, much is being invested in producing nano-materials. Little is being done to address the handling of nano-particles in practical applications. The problems and costly solutions that exist in the handling of sub-micron particles have yet to be resolved.

Finally, NASA and the Department of Defense share a common manufacturing-related problem – shielding of manned vehicles. No American can forget the crash of Space Shuttle Columbia on February 1, 2003. That crash was the result of a piece of foam insulation the size of a brief case breaking off the Space Shuttle external tank under the aero-dynamic forces of launch and striking the leading edge of the left wing. It damaged the Shuttle's thermal protection system (TPS), thereby exposing the Shuttle to the heat generated during re-entry. The pictures of soldiers blown-up in Iraq due to unarmored, or improperly armored, vehicles, were not as dramatic as the Columbia, but were no less devastating. Add-on protection is UNACCEPTABLE. Heat-shielding and armor must be integrated into OEM manufacturing processes.

In the above are manufacturing programs in which the FEDERAL GOVERNMENT is **THE** CRITICAL PLAYER. Each requires advanced materials and equipment, advances that reduce costs while enhancing performance and quality, and protecting the environment. These attributes are essential pre-requisites to the achievement of sustainable global leadership, are driven by 'real world' requirements, and are the key to a meaningful return on taxpayer investment. Specific abilities include, but are not limited to, the ability to handle super-fine particles, to produce thin film coatings, and to fuse coatings to substrates as opposed to layering them. The objective must be coatings that are thick enough to protect, but thin enough to fuse. (Such an achievement would have an extraordinary impact on fuel consumption within the airline industry as well as military aircraft.) In addition, it means nano-technology must be product-driven: automotive, industrial, and medical coatings, stainless steel rust inhibiters, and ceramic coatings.

Technology has been patented and tested which achieves state-of-the-art product and/or component finishing, i.e., application equipment technology capable of handling powdered coatings independent of composition, and producing thin-film and fused coatings. Practicality dictates, and this technology achieves, application efficiencies high enough to eliminate companion reclaim and recovery equipment. In short, it has the potential to transform the finishing industry while extending its use in key areas of government responsibility.

No company, large or small, could or should take on the financial responsibility for programs within the Departments of Transportation and Defense and NASA. However, funding the research necessary to adapt technological advances to extend safety and longevity of bridge and road construction, to enable production-line manufacture of armored military vehicles, and to provide fully integrated heat-shielding wherever applicable would have the same across-the-board economic impact that NASA innovations has had from the beginning of space programs.

Thus, TIP oversight and funding of advanced product finishing is essential and wholly appropriate.

Research should also be done in the development of extra-strength thin metals, perhaps advanced titanium-iron alloys. Such metals would give U.S. manufacturing an edge in multiple industries.

To achieve the goal of manufacturing pre-eminence, the greatest societal challenge will be the transformation from the arrogance of 'not-invented-here' to pride in 'the most advanced adaptation and implementation of the best scientific know-how', regardless of origin. That change will create a standard that the world will seek to emulate because it inherently combines respect for the achievements of others and ourselves, while acknowledging lessons learned. The implementation of *best practices* within the federal government are sure to be adopted by state and local jurisdictions. To paraphrase an easily recognizable admonition: The nation which ceases to analyze and overcome the mistakes of its past is doomed to failure in the future.

The need for financial restraint and the judicious use of tax revenues demands analysis and assessment of the state-of-the-art of proposed projects and the identification of their real-world prerequisites prior to the sequence and allocation of funds. These determinations should be made by a non-political entity without regard to the size of corporation(s) competing for federal funding, all of which must be headquartered in the U.S.. Corporations headquartered outside of the U.S. should be ineligible for federal funding or direct receipt of the results of such funding. In the crucial area of manufacturing, NIST TIP is uniquely qualified to become the responsible government function. It is devoid of vested interests. No other agency is better positioned to assess the potential for 'real world' advancement, to identify and interface with academia or specialized expertise, and to be the global interface in the determination of best practices. Therefore, no agency is better qualified to direct meaningful expenditure of federal manufacturing dollars, irrespective of industry. The enhancement of TIP's mission is essential to the nation's return to manufacturing preeminence and to a stable and progressive economy.