U.S. Military Involvement in Mexican Science and Technology

By Prof. Guillermo Foladori
Global Research, November 05, 2011
5 November 2011

Region: Latin America & Caribbean, USA
Theme: Science and Medicine

U.S. Military Involvement in Mexican Science and Technology[1]

Guillermo Foladori

Doctoral Program on Development Studies. Autonomous University of Zacatecas, México

gfoladori@gmail.com

Abstract

International R&D collaborations have increased over the last decade in Mexico. In this article I analyze the case of an agreement between the main S&T public policy institution in Mexico (Conacyt) and a well-known military research center in the USA (Sandia National Laboratories). The case is based on the development of a BiNational laboratory and on a double use technology, the MEMs (micro-electrical Mechanical Systems). I raise the question of whether it is ethical, for Mexican scientists, to embark in research science collaboration with a foreign military science research center.

Is it ethical for scientists to work under bilateral agreements between countries where the foreign partner is a military institution? To participate in military projects of one's own country has drawn criticism in some countries; in particular within the United States of America (USA) where a significant part of public funds spent on Research & Development (R&D) since the Second World War was and continues to be used by military institutions. Is it not even more controversial for the scientists involved in research where the military institutional counterpart is from a foreign country?

This concern was of secondary importance in Latin America. The wars that were waged in Latin America were internal, and the subordination of science to military interests has not been so pronounced as in the USA. The exception were several projects to develop nuclear ammunition, guns and submarines by the Argentinean and Brazilian dictatorships between the end of the seventieth and the middle of the eightieths (Waisman, 2010; de Oliveira, 1998); or the important aeronautic industry developed by the Brazilian military dictatorship. But, in 1991, both countries signed and agreement of exclusive pacific use of nuclear energy (ABAAC, 1991).

However, since the 1990s in the majority of Latin American countries, science and technology (S&T) has undergone a significant change. Under international pressure (World

Bank, OECD, etc.) they began to modify the frameworks, incorporating private firms in publicly-funded scientific research. This change, in academic terms described as the "triple helix" (Academia + State + Business), entails an additional characteristic: that of applied science; because no business is willing to participate in research if it is not known whether results are guaranteed or are perhaps far-off. It also meant the increasing control by the private enterprises over the orientation of scientific research, and the marginalization of the State participation. This new approach is quite different from the S&T policy of the "Sabato triangle", a model based on the integration of the scientific and technological structure with the productive sector and the State, and widely accepted in Latin America from the middle of the sixties and until the ninetieths, but where the State played a central role as planner, controller of fiscal incentives, producer of S&T but also of final products in their several State enterprises (Vaccarezza, 1998).

The idea behind this new integration of business with R&D is that the application of S&T leads to the "knowledge economy," an improvement in competitiveness, the development of the country and the improvement in living conditions. This step is, at first glance, logical: Why would a society want to pursue science that could never be applied in the real world? But scientists were trained not to take things at face value. A second look changes things, because one then sees that the R&D decisions leave all social sectors outside of the process; which for not contributing with capital can not participate; and obtaining financial backing is another criteria in the competition for research projects.

These changes in the S&T framework in Latin America led to researchers lagging behind businesses that could co-fund research initiatives, adapting the projects to a language and orientation that is "marketable." The evaluation of scientists accompanied the evaluative criteria of the projects, meaning the researcher who is able to obtain external resources becomes highly valued. Chasing the money became an end unto itself, the source of those funds being unimportant. It is easy to transition from receiving financing from business or funding agencies to receiving financing from military institutions / industries.

In this paper I wish to call attention to this concern: Should the establishment of collaborative research projects with military institutions of other countries be the topic for an ethical debate? To analyze this question in the context of Latin America, there is no better example than that of Mexico.

This is, first, because in Mexico the process of reorientation of S&T to incorporate the business sector and to "follow the money" has been so explicit, resulting in part from an OECD recommendation to pursue this path once Mexico was incorporated as a member in 1994.

Second, because of the neighborhood and of the fact that USA has a high S&T development, there are several collaboration agreements between the countries; and in the USA it is a challenge to find any publicly-funded R&D institution that does not receive military funding; in the USA that is "easy money."

Third, because one cannot put aside the military history in the relationship between Mexico and the USA, it is sufficient to remember that during the 19th century Mexico lost half of its territory to that country.

Fourth, because more than twelve million Mexicans live in the USA: many of those persecuted and assaulted by American migration authorities. Furthermore, some research centers in the USA are the designers of the highly-sophisticated retention wall along the Mexican border (e.g., Sandia Military Laboratories in New Mexico) and, at the same time, are partners in S&T collaboration agreements with Mexican institutions. Also, because many Mexicans have lost their lives fighting in distant wars under the United States flag, far removed from Mexican national interests.

Fifth, because the USA's "easy-guns culture" protect the identity of the clients, and allows supplying the narcotrafficking cartels that operate in Mexico who buy their munitions in Texas, Arizona or California, while simultaneously supplying the Mexican army: having clients on both sides of the conflict.

Sixth, because the concept of "preventive actions" employed by the USA since the end of the 1990s to attack countries (e.g., Iraq, Afghanistan), places at risk the internal security of its neighbor; take as an example the speeches of the Undersecretary of the U.S. Army in early February 2011, warning that the war against the narcos in Mexico could require U.S. military action on Mexican territory.

In this article we intend to call attention to an area which has been little examined. It lies in the collaboration agreements between countries, where one of the partners is a military institution. We make use of the example of the creation of a Mexico-USA binational commercialization of technology bureau and a rapidly-growing research area: the MEMS. We must begin by explicitly noting the orientation that S&T has had in the USA in recent decades.

The Military Orientation of American S&T

The title of this section is strongly-worded, and incorrect as a general description, since there exists in the USA a great deal of research across diverse scientific sectors that are independent and have nothing to do with the military sector insofar as financing or final output. However, there is a clear tendency of interconnection among military and civilian research and also of technological and industrial unification among both sectors that crystallized following the Second World War.

Until the First World War, public financing for military research in the USA was practically non-existent. Unlike England and Germany, in the USA military laboratories were not seen as important. It is with the Second World War that the historical turning point arrived, and public funds for military research were first allocated. Under the coordination of the National Defense Research Committee (NDRC), created for this purpose, dozens of military laboratories were established to investigate the possible creation of an atomic bomb and other kinds of weaponry. Project Manhattan, which developed the atomic bomb, was one of the successes of this civilian-military association. With it, "(t)he NDRC organized a massive migration of personnel to the war laboratories it set up, funding these operations through government contracts" (Broome, 2010: 3). In the USA, a strong relationship was institutionalized between scientific capability and military interests, where private businesses and public / private universities were integrated via subsidies and public funding contracts to develop military technology.

Once the Second World War came to an end, the physical and human infrastructure that made up these research teams had obtained inertia difficult to rein in. Nonetheless, on the face of it, things changed. The NDRC was disbanded and many of the laboratories and personnel became administered by the Office of Naval Research (ONR), part of the Department of Defense (DoD). In 1950, the National Science Foundation was formed, another institution with public funds intended for civilian research and to some degree created under pressure by scientists to counteract the weight of public funds granted to the DoD. But while the NSF received some 5% of public funds for R&D, the DoD receive 70%, not including another 10% or so allocated to the Department of Energy (DoE) for nuclear and military research, and also to a lesser degree funding granted to the National Aeronautics and Space Administration (NASA). In total, the military R&D budget was around 80% of the total since the Second World War if one adds together the various departments / military agencies / internal security / intelligence services. Taken together, this indicates that in the post-war years the public share of military R&D shot up 30 times from what had existed prior to the war of all federal R&D funds; a survey undertaken in 1951 across some 750 universities and colleges showed that on average, some 70% of research activity in physics had military research aims (Forman, 1985: 152 & 193). The military's presence in scientific research coincided, between the 1950s and 1980s, with various wars launched by the USA against the "communist threat" in different parts of the world.

As a result of the collapse of the Soviet Bloc in 1989 and the end of the Cold War, many voices were raised against the application by the USA of exorbitant public funding toward military research, saying it no longer made sense; the same occurred in Europe. The public budget of the USA for defense R&D dropped some 57% between 1985 and 1996; however, after 2001 military R&D expenditures experienced resurgence, reclaiming the peak of the 1980s. The temporary drop in the 1990s was a global tendency, that saw an approximate 29% drop in world military expenditures from the final years of the Cold War. But this budgetary fallback put at risk a complex web of commitments, research networks, value chains and sources of employment. An important share of many university budgets came from military funds. A great many industries were directly subordinated to military contracts, with millions of workers dependent upon military industries protected by strong unions. Dozens of research laboratories were dependent upon funding from the DoD or DoE. The inertia of these linkages and political pressure from affected sectors resulted in the incorporation of research and civil production into laboratories and military industries, and the production of military goods in civilian industries as a way of reducing military costs.

The conversion programs rested upon the concept of *dual-use technology* (technology with civilian applications as well as military). This alliance among R&D institutions and military and civilian industries enabled a side-stepping of bureaucratic red tape and cultural barriers. Some military equipment is of limited production quantities, and does not scale well to mass production within civilian industries; the quality requirements are similarly different, being of a higher standard in the military sector; production for military use has a cost / benefit equation less stringent than in the civilian sphere; while civilian industry can create its own demand through publicity and other market mechanisms, munitions and other military-industrial products are consumed only when there is a war; while the R&D / market cycles are typically shorter in the civil sector. These and other accounting and administrative differences had to slowly dissolve to facilitate the integration of both sectors.

But this integration required the real-world testing and application of advances in military technology and production, and the convincing of the public that this is the correct path for S&T development in the USA. This presented a considerable challenge in the decade of the 1990s, when the USA had no apparent enemy to replace the Soviet Union after a 50-year conflict. Thus the spectrum of communism was replaced by the threat of terrorism; this implied a new concept of war, from defensive warfare to preventive warfare. The latter consisted of launching military attacks even when there had been no direct third-party aggression, but a potential threat may exist.

Between 1991 and 1993 a neoconservative faction of the Republican Party in the USA created a post-Cold War military strategy. The first, confidential, document crafted by Libby, Wolfowitz and Khalizad (*see* Tyler, 1992) contained the concept of preventive war as a way to guarantee USA world hegemony and prevent the proliferation of nuclear weapons (Kristol & Kagan, 1996). The document was reworked by the then-Secretary of Defense Dick Cheney in 1993, to soften the language (Cheney, 1993) and is considered to be the precursor to the document *Rebuilding America's Defenses*... in which the neoconservatives made public the principle of preventive war, which is the policy that led to the war in Afghanistan and Iraq (PNAC, 2000). This new military policy, although somewhat limited, was supported by the Democratic Party (Vayrynen, 2006), as shown in the *Iraq Liberation Act of 1998*, signed by Democratic President Clinton and which formed the basis for the first attack against Iraq at the end of that year (*Operation Desert Fox*). The policy of preventive military attacks was coordinated at the international level in particular with support from Great Britain. With the principle of preventive war, and the existence of terrorism as a threat that could manifest in any country or territory, wars were launched against Iraq and Afghanistan, consuming and testing the products of military-oriented industry, thus completing the research-production-consumption circle that the civilian-military alliance had consolidated administratively and financially.

The war against terrorism has various interpretations. Since 2002, US government spokespersons began making it known that Al Qaeda cells could have a presence in Mexico; in 2009, the US Secretary of Defense suggested that the American army might be applied to helping Mexico in the fight against narcotrafficking; and in early 2001, Department of State spokespeople floated the allegation that Mexican drug cartels had been infiltrated by Al Qaeda cells (Hernández, 2011), and also the possibility that US military troops could be sent into Mexican territory in the anti-narco fight (Broome, 2010: 3). The idea of invading Mexican territory to fight narcotrafficking first arose in the mid-1990s (*see* Turbiville, 2010).

1. The context of Mexican-US Scientific Collaboration

There exists a long history of scientific collaboration between Mexico and the USA. In the last decade, there has been an increase in the participation of Mexican and Latin American scientists in research projects shared with U.S. military laboratories and / or enterprises.

In April 2004, the US Marines and Air Force held a forum in Washington, D.C., entitled the *Latin America Science & Technology Forum*, with the stated aim "to increase the U.S. leadership's awareness of the progress of S&T in Latin America" (ONRG, 2004). Top representatives of civilian S&T institutions from Argentina, Chile and Mexico (including the Director of Scientific Research of CONACYT) presented the "state of the art" of S&T in their respective countries. These collaborative contacts were reinforced with official visits to Latin American countries. The US Armed Forces interests were explicit: to draw into its sphere of influence researchers, institutions and businesses from Latin America and the rest of the world.

The US Armed Forces have at least three branches which finance scientific research in public and private universities and research centers of various countries; the Army, the

Navy and the Air Force. These three arms work together through International Technology Centers, organized as the ITC-Atlantic, ITC-Pacific, and in 2004, the newly-formed ITC-Americas in Santiago de Chile, which covers all of the Americas and the Caribbean, including Canada (U.S. Army ITC-Atlantic, n/d). The goal of the ITC-Americas is:

to foster cooperative relationships between the U.S. Army and private sector, university, and civilian government research and development (R&D) entities that result in leading-edge scientific and technological cooperation that benefit the civilian institutions and support the U.S. Army's current programs and future goals (ID U.S. ARD&EC, 2004).

The incorporation of Mexican researchers into U.S. military projects was facilitated through various means:

· The North American Free Trade Agreement (NAFTA) facilitated the migration of Mexican scientists to the USA with the creation of special temporary visas (TN1).

· The existence of specific projects of the U.S. army to acquire talent in high-technology areas. The Navy, in cooperation with the Air Force, held three Latin American workshops in different countries on one of the principal topics of interest of the U.S. Department of Defense: multifunctional materials (NMAB, Chapter 3, 2003). The second of these workshops was held in Huatulco, Oaxaca, Mexico, in 2004 (Foladori, 2008).

· SPPNA (*Security and Prosperity Partnership of North America)*: an agreement signed between the three governments partners in NAFTA to foster economic development within the framework of security and military necessities. This agreement provided the cover, within the Merida Initiative, under which the FBI, CIA, DEA and other U.S. intelligence agencies operate freely within Mexican territory under the guise of fighting narcotrafficking.[2] Also, under the SPPNA agreements, bilateral scientific research projects were established, such as the Bi-National Sustainability Laboratory (BNSL) under the auspices of the Sandia National Laboratories (SNL), a military research facility located in New Mexico, whose Mexican counterpart is CONACYT, the official S&T policy institution in México (SER, 2003: 13).

· Mexican S&T policy has undergone a substantial shift over the past decade, reorienting its philosophy and financing toward the incorporation of private business in practically all investigative financing. The need for business partners to launch projects and the value placed on obtaining research projects linked to networks with international agreements has resulted in a desperate race by researchers to obtain external support of any kind.

These factors favored the incorporation of CONACYT and some Mexican scientists and institutions into U.S. military projects where there were neither precedents nor debate in Mexico.

There is no database listing the various research projects in which Mexicans are working alongside American military institutions, although many of these can be found on the pages of the CONACYT website; but neither would it be appropriate here to highlight individual examples. Rather, it serves our purpose to consider institutional cases and themes, such as the most ambitious project connected to the top Mexican S&T institution, CONACYT (equivalent of USA National Science Foundation), and an American military institution – the Sandia National Laboratories via the Bi-National Sustainability Laboratory (BNSL); and a theme of great importance: MEMS/NEMS technology, a high-technology field and a paradigmatic example of dual-use technology; and, also, for the rapid development that it has had in Mexico during the first decade of the 21st Century.

2. The Interests of the Sandia Laboratories in the Bi-National Economic Development of the Mexico-USA Border and in the Development of MEMS/NEMS

The American military's Sandia National Laboratories (SNL) operate under the GOCO (government-owned / contractor-operated) framework, based on state property with private administration. The first GOCO was the Alamos National Laboratory, operated by the University of California and a part of the Manhattan Project, which created the atomic bomb during the Second World War. The SNL has passed from various administrations to its current operator, Lockheed-Martin. Lockheed-Martin is the world's largest arms producer, with more than 70% of its earnings coming from arms sales. The SNL has an annual budget of around $2.5-billion, of which some 60% is supplied by the DoE (Department of Energy) (SNL, n/d).

Beginning the nineties, the SNL began to intensively research MEMS / NEMS (micro / nano electromechanical systems). They also initiated research lines related to national security, such as mechanisms to counteract chemical agents, systems for the detection of epidemics, high-temperature ceramics for space vehicles, Kevlar gloves made of carbon used in the wars in Iraq and Afghanistan, and flash-bang grenade technology. The SNL have been the focus of intense criticism by social organizations on the issue of nuclear testing in the state of New Mexico.[3]

In 1998, a high-ranking Reagan administration officer created and directed the Advanced Concept Group (ACG) inside the SNL, with the goal of confronting problems of terrorism and internal security through the socio-economic development of the Mexico-USA border through high-technology parks. This was far from a new idea. From the signing of the NAFTA accords, various bi-national political agreements were signed with the border states of the U.S. and Mexico to foster economic development in a coordinated manner. The installation of the *maquiladoras* on the Mexican side of the border is part of these agreements. The specificity of the SNL's proposal was to support the creation and research in high technology, something the *maquiladoras* do not provide. In order to achieve this purpose a Mexican counterpart was needed. FUMEC (Mexico-United States Science Foundation), a bi-national non-profit institution oriented to the development of S&T, served making the connections with the Mexican government and supported the initiative to create the Bi-National Sustainability Laboratory (BNSL).

The BNSL began operations in 2003, although it was officially launched in 2005. It is "a bi-national non-profit organization that creates and promotes technology-based businesses along the Mexico-United States border, whether these are recently created, medium- or small-scale, or even large, well-established companies" (BNSL, n/d). At its inauguration, the SNL Vice-President said: "This will be a wonderful opportunity for collaborative technical efforts to enhance border security … This is a perfect opportunity to follow up on work with Canada and Mexico to foster a continental approach in dealing with terrorism" (Eurekalert, 2005). Although named "Laboratory", the BNSL is a commercialization of technology bureau, linked with many S&T research centers in USA and México.

The agreement for the implementation of the BNSL was driven on the American side by the Department of Commerce and the Agency of Economic Development, the Department of Economic Development of the state of New Mexico, and by the SNL, which came up with the plan. The Mexican counterpart is CONACYT, under the direction of then-President of Mexico, Vicente Fox. The negotiations were managed by FUMEC (Eurekalert, 2005). Presently, the BNSL works in the area of MEMS / NEMS; clean fuels and nanomaterials, and environmental technologies (BNSL, n/d).

One of the key themes of the BNSL is the development of MEMS / NEMS. This theme is a significant part of the work done at the SNL and of great military interest to the U.S. government. MEMS / NEMS are miniscule electronic machines built into semi conductive materials with multiple uses. The automobile industry is one of the top clients, employing MEMS in everything from air bag sensors to tire pressure sensors. They are also used in printers, computers and wireless networking systems, aero-navigation, video games, health, energy and many other industries. In 2009 the world market in MEMS was estimated at $7.6-billion.

The first commercial MEMS appeared in computers and ink-jet printers in the 1980s. From the beginning of the 1990s, the U.S. government invested significant funds for MEMS research for military application. The AFOSR (Air Force Office of Scientific Research) and DARPA (*Defense Advanced Research Projects Agency*) financed projects in military laboratories in this field. The SNL are one of the first to receive considerable funding for MEMS research, and by the end of the decade of the 1990s they had developed technical processes to produce MEMS layers ("SUMMIT" technology). A DoD report estimated that in 1995, the government invested 35 millions of dollars for MEMS R&D, with 30 of those directed to military institutions (ODDRE, 1995).

Their reduced size makes MEMS of strategic importance in military industries; especially for the production of smart / precision weapons. In 2001, the Forbes website noted that the U.S. government had invested some $200-million in MEMS annually, through two agencies: DARPA and SNL. The SNL Director said: "anything that's good for MEMS is good for national defense," showing the strategic military importance of MEMS (Forbes, 2001).

The boost that military industry gave to MEMS has been an important accelerant in diversifying the technology for civilian use. One director linked to DARPA noted:

In 1992, there was little industry involvement and virtually no MEMS fabrication infrastructure anywhere in the world. DARPA's MEMS investments have generated that infrastructure (cited by Rhea, 2000).

MEMS are a dual-use technology, and although military purchases of the technology are less than civilian, there are two factors of military industry that have a civil sector impact.

The first is in efficiency, since military industry is not guided by rate of profit but rather high performance. The second is maturity, which in the civil sector implies stagnation or fall in profits, but in the military sphere has no equivalent effect on research.

At the time, civilian industry was important for the military sector in relation to three factors. One is extended testing across diverse sectors. The Director of the Microsystems Science, Technology, and Components Center at the SNL said:

Before we can use MEMS and microsystems in critical weapons systems, it must be shown they are manufacturable and reliable. The best way to demonstrate this is to commercialize them and use them in everyday products (SNL, 2001).

Another factor is the elaboration of large-scale production infrastructure, although the ultimate objective remained in the production of weaponry. This was highlighted by the administrator of the SNL's MEMS project:

Ultimately, Sandia wants to use MEMS in weapons systems. But Sandia can't manufacture all the necessary parts itself, so the lab is offering its own MEMS technology and fabrication services to the industry, hoping to seed the MEMS market …. (Matsumoto, 1999).

In 1998, the *Sandia Science & Technology Park* was created, a facility associated with businesses involved in the transference of technology. In 2001, an agreement was made with *Arresta* for the production and sale of MEMS – with the SUMMiT technology developed at SNL (SNL, 2001). A permanent program of courses and training in SUMMiT technology for commercial use was established, known as SAMPLES (McBrayer, 2000); and the dialogue began with FUMEC to initiate the MEMS project in Mexico.

The third factor is the reduction of costs. In an article from a 2003 edition of the magazine *Military & Aerospace Electronics* we note:

Military developers and contractors also are looking to reduce costs by offering some of the evolving MEMS technology to commercial users, such as the automobile industry, essentially completing the development circle, as some MEMS technology came from that sector originally. "We have make sure the military application of the technology isn't proliferated, of course, but in the auto industry the accuracy they are looking for is nowhere near what the military requires," Panhorst [manager for MEMS programs at Picatinny Army facility] says of the MEMS IMU (Wilson, 2003).

With these synergies between civil and military industries, the SNL is driving the budding MEMS field via the Bi-National Sustainability Laboratory.

3. FUMEC linkage with CONACYT

The Mexico-U.S. Science Foundation (FUMEC) was created in 1993 to promote and support S&T collaboration between Mexico and the United States. It was designed by the congressional team of American George E. Brown Jr., who headed the Science, Technology and Space Committee of the U.S. House of Representatives.

Brown's team understood that the end of the Cold War required a new relationship between the United States and the developing world. A relationship built upon S&T collaboration, where developing countries could set their own agendas; altering the history of technical support from the U.S. since the Second World War that, they said, was not helping them to promote independent capacity-building in those countries (Brown & Sarewitz, 1991: 70). Brown Jr., a pacifist, saw the end of the Cold War as an opportunity to push scientific research beyond military interests (Brown, 1993: 8).

This proposal came into being in a context where the world recognized that those countries that

pursued sustainable investments in R&D could achieve significant gains, as was the case with Taiwan, South Korea and Thailand; but one had to ensure, according to Brown and Sarewitz (1991), the independence of the scientific research agenda of each country.

Applied to Latin America, which had just emerged from the "lost decade" of the 1980s, this idea would require some creativity to attract financial support. The proposal suggested copying that which had been applied in environmental campaigns. There already existed programs that changed Latin American foreign debt at market prices and with the currency of the own countries for protection to the environment. The idea was to apply the same policy of exchanging foreign debt, but in this case, for S&T instead of environment. Mexico was the test case, and the U.S. National Science Foundation should support it with a special fund. Although the funding source did not come out to be the exchange of debt for science, but rather a collaboration agreement, FUMEC was created in 1992 as a non-governmental body with a governing board made up of 10 members, 5 from each country.

Mexico chose representatives from the Academy of Sciences; Medicine; Engineering; CONACYT; and the coordinator of the Sciences Consultation Board of the Presidency. The U.S. sent representatives from the House of Representatives' Committee on Space, Science and Technology; the Smithsonian Institute; the National Academy of Sciences; the Institute of Medicine; and the National Engineering Academy. Mexico and the United States shared equally the startup funding costs (FUMEC, 1997).[4]

Between 1993 and 2001, projects focusing on sustainability, public health and socioeconomic problems were given priority. Investments were concurrently made in the training of policy specialists and S&T strategies (FUMEC, 1999). The U.S. counterparts to these projects were for the most part universities. In the *2001-2002 FUMEC Activity Report* the various projects were grouped according to programmatic areas: Health and Environment, Sustainable Industrial Development, and Development and Human Resources in Science and Technology (FUMEC, 2002).

Since 2001, two years after the death of Brown, an important policy change occurred within FUMEC. Technological innovation came to be a key phrase, and the industrial cluster with its geographic center at the border area near the Paso del Norte Industry Cluster, where the SNL were headquartered, was a strategic place. The role of U.S. partner in these projects fell to the SNL. Initially, its purpose was the launching of the Bi-National Laboratory that the military laboratories had been developing. Later, it began to integrate industries, academia and government across various themes, with MEMS / NEMS being one of the principle areas. FUMEC's Bi-annual Report 2002-2003 identified as its overall strategy the following:

The Foundation focused its efforts during 2002 and 2003 in facilitating awareness and collaboration in order to develop key actions that can facilitate the development of bi-national technology based clusters, specifically in the Paso del Norte region (Advanced Manufacturing, MEMS – Micro Electromechanical Systems). FUMEC has supported the efforts of Sandia National Laboratories, CONACYT and Border States, especially in the Paso del Norte region, to create the Bi-National Sustainability Laboratory (FUMEC, 2003a: 40).

The integration of the U.S. military laboratories in the action plans of FUMEC, and the drive toward activities tied ever more closely to business-

oriented research and commercialization of products owed a great deal to the political context guided by Mexican President V. Fox (2000-2006) and the World Trade Center attacks in New York in September, 2001, with the resulting consequences in security matters.

The Presidency of V. Fox in Mexico showed a clear inclination toward the development of free markets, the role of private business in development, and closer integration with the United States. In Mexican S&T matters, the *National Science and Technology Program 2001-2006* was approved, where the strategic role of innovation and S&T to improve international competitiveness was explicit. This program, with the 2002 S&T law, gave greater power to CONACYT, freeing it from oversight by the Secretary of Public Education, awarding it an independent budget and guaranteeing a series of projects across different economic sectors oriented toward improving the bond between private business and publicly-funded R&D (Lewis, 2006). Although research funding had always been scarce, the private sector managed to secure some 10% of CONACYT research funds in 2002, increasing to 21% within four years (Martínez et al., 2009).

With regard to international relations, corporations and governments from the USA, Mexico and Canada undertook an intense lobbying effort in the initial half-decade of the 21st Century toward deepening the economic integration under NAFTA (North American Free Trade Agreement) tied to the security concerns specified by the U.S. government. As a result, by the beginning of 2005 the *SPPNA* was signed by the three countries. It is within this context that FUMEC undertook agreements with the SNL.

The success in the BNSL and in other initiatives, as well as the close interaction with key government and business organizations in the United Status and Mexico, gave FUMEC the credibility to work with the U.S. Council on Competitiveness, and the Partnership for Prosperity Initiative, providing us with the opportunity to be involved in the process of establishing a new bi-national vision of the role of innovation in the work of the Mexican Institute for Competitiveness (FUMEC, 2006).

While the location of the BNSL in New Mexico a few scant kilometers from the border between El Paso and Ciudad Juárez gave significant weight to the role of the SNL for its proximity to Albuquerque, the SNL were not the only interested parties in the MEMS program being pushed by the BNSL. In Mexico, President V. Fox was explicit in his desire to link development of MEMS to the *maquiladora* industry in the area of information and communication technologies being established in Mexico; this was a productive sector that also had U.S. corporate representation on the governing board of FUMEC.

4. BNSL and the MEMS Network in Mexico

The BNSL was officially launched in 2005 with startup funding from the U.S. Economic Development Administration and from CONACYT. It had the ambitious goal of establishing public-private partnerships to drive high-technology business development along the border. The focus of BNSL's activities lies with the commercialization of technology, considered the "death valley" separating scientific development with market-real production. Research centers and universities had the physical infrastructure and human conditions to develop new products and processes, and even to create prototypes, but to go from this point to the creation of businesses that can turn prototypes into commercial products is a great leap. This is where the BNSL comes in, offering experience in technology development, production processes for end-products, business planning and financing expertise (Acosta, 2006).

Among the BNSL's various projects, the most ambitious is the MEMS / NEMS Cluster at Paso del Norte. It is composed of a number of research institutions: In the USA, the University of Texas-El Paso; New Mexico State University; New Mexico Tech; El Paso Community College and TVI Community College were involved. In Mexico, active institutions were the Autonomous University of Ciudad Juárez (UACJ); the Juárez Technology Campus of Monterrey; and the Advanced Materials Research Center (CIMAV). Participating from the institutional / business sector in the USA were the SNL, Delphi Corporation and the Technology Team (Acosta, 2006).

To push the development of MEMS in Mexico, FUMEC in collaboration with the Secretary of the Economy launched a call toward the goal of forming a national network on CD-MEMS, with the participation of more than a dozen universities and research centers (Robles-Belmont, 2010).

In 2003, FUMEC organized the first MEMS conference with the participation of the SNL and MANCEF,[5] for U.S. businesses and venture capitalists. Mexico's representation was almost completely political (with the exception of the UACJ's delegates), since up to that point there was no precedent in MEMS research / production in Mexico – the first published article came out in 2002 (Robles-Belmont, 2010; De la Peña, 2008).

The FUMEC plan was to create bases from which the MEMS complex could provide products and a qualified workforce to *maquiladoras* located in Mexico (e.g., automobile industry, electronics and communications), integrate smaller industries in the productive chain, and protect the local jobs that the *maquiladora* industry and its productive chain demand – since by nature, *maquiladoras* are highly mobile, flexible in the purchase of inputs, and vulnerable to economic cycles (OECD, 2010).

In the state of Jalisco, and also along the U.S. border in the states of Baja California and Chihuahua, various transnational electronics corporations (e.g., Intel, HP, Sony Motorola, IBM, and Freescale) that assemble products like LCD panels, computers and home appliances are settled. These companies were ideal as potential clients of MEMS produced in Mexico. In September 2003, at a New York conference, Mexican President V. Fox was explicit in highlighting information technologies as the engine of economic development. The event was organized by FUMEC, CONACYT and AMD (a California integrated circuit manufacturer that supplied the computing and communications industries, and at the time run by a Mexican national) (Business Wire, 2003). This conference was touted by FUMEC as the turning point in its institutional policy, where it evolved to dedicate its activities more directly to bi-national business, and distancing itself from the original spirit of its mandate to address environmental problems and border region health concerns.

Since 2004, FUMEC has driven the productive gears of MEMS in Mexico and to that end established a program in stages. The first would be the installation laboratories for the prototyping and design of MEMS, an initial, least-expensive and virtual stage; later, laboratories capable of prototype construction; and finally, packaging laboratories.

By the end of 2010, Mexico had come to see a number of laboratories created. The main ones are: the laboratory at the National Astrophysics, Optics and Electronics Institute, with headquarters in the State of Puebla and which contain "clean rooms" with the ability to mock-up prototypes; the laboratory of the Physics Department at the National Autonomous

University of Mexico in Mexico City, which also has clean room capacity for prototyping and which works with BIOMEMS; The Micro- and Nanotechnology Research Center at Veracruz University in Boca del Río, Veracruz, also with prototyping capability; and the MEMS Innovation Laboratory at the UACJ (Ciudad Juárez Autonomous University), specializing in MEMS packaging in association with the SNL. Apart from these laboratories, a half-dozen other universities have research centers for the design and modeling of MEMS.

Through the CD-MEMS Network the intent is to create a relative division of labor across the different laboratories and centers, moving from one stage in the productive process to another across different units. Not all of the laboratories and research centers have direct connections with the SNL in New Mexico, and neither do they all produce MEMS with military applications. There are, though, research projects that work in partnership with the SNL, and many others whose researchers take courses in the SUMMiT programs offered by the SNL (El Diario, 2008). Still, through the BNSL – which is co-funded by CONACYT and the SNL – practically all members of the CD-MEMS Network are linked with the SNL in New Mexico.

According to the BNSL's website as of February 2001, CONACYT, CIMAV and UACJ are academic partners on the Mexican side, while FUMEC operates as a bi-national organization. On the U.S. side, there have been a great number of businesses and academic institutions, such as public institutions like the U.S. Department of Commerce / Economic Development Administration and, obviously, the SNL which are the project mentors.

When a scientist participates in research sponsored by or in association with military institutions, it is quite probable that s/he does not question the ultimate purpose of the military institution in that research. It is also unlikely that s/he asks him/herself if the knowledge obtained could be put to different uses than those explicitly indicated. Quite possibly, neither is the relationship between the research in question and international conventions questioned. In the case of MEMS / NEMS, for example, they are vitally important in missiles and a variety of "intelligent" weapons. In the USA, the majority of these weapons are manufactured with depleted uranium, and on this matter there is a wide-ranging discussion due to the uncontrollable and massive health effects. Scientists in many cases do not know all of these interconnections and many of them could not determine the broader context even if they wanted to do so; it would be absurd to expect the researcher, occupied with the enormous bureaucratic tasks of these projects, to expect that they would also give much thought to the broader implications of the research if that had not been specifically assigned as one of their duties.

It is for this reason that here we do not offer individual examples, but rather an institutional case, where the principal Mexican S&T agency (CONACYT) entered into an partnership agreement with a recognized military laboratory in the USA (SNL). We have made use, also, of the example of one technology – MEMS / NEMS – that is of dual use (civilian and military) and which in Mexico is in wide and growing use in the great majority of the information and communications industries as well as the automobile industry and in a lesser degree many others. These are devices put to use by corporations – the great majority of them assemblers and transnational *maquiladoras* that in 20 years have not demonstrated any contribution to the improvement of the quality of life of society – despite this being one of the explicit objectives of Mexico's Science and Technology Programs.

Are we now coming to the point where these kinds of themes will begin to be discussed in S&T forums in Mexico and Latin America? Where university programs in the physical-chemical sciences, mathematics and biology start including in their courses the social and ethical implications of S&T? And, how enlightened is the general population about the importance of S&T and the need to investigate social implications?

Treading on the Tail

Scientific knowledge is controlled and regulated by the USA (Pedersen, 1989) – something that has no equal in the countries of Latin America. As a result, Latin American scientists work in partnership with American military institutions with little or no oversight by publicly-funded S&T institutions. Regardless of the civilian application of the research – and this is not in all cases – the development of military industry in the USA results in acts of war and in military products. Here we have revealed a widespread example, that of the agreements between the Sandia National Laboratories, with which CONACYT has a significant partnership, and various CONACYT research centers who have their own specific accords; but there also exist less obvious agreements between universities or research centers of CONACYT and other military centers in the USA such as the Air Force Office of Scientific Research, or the Brookhaven National Laboratories in New York; and this is only in the narrow example of MEMS / NEMS research initiatives.

According to the most recent S&T Programs issued in Mexico, the ultimate aim of these activities is to improve the quality of life of the population and increase international competitiveness. In the last few years, the latter has overshadowed the former; the assumption that the increase in competitiveness will simultaneously improve citizens' conditions of life is far from certain neither in real-world experience nor in theoretical terms.

Contradictorily, in recent years there are indicators that Mexican competitiveness is and will continue falling; this is due in part to the degree of internal violence arising from the war against narcotrafficking. Shipments of products from transnational companies such as Sony, Sharp and Samsung have been hijacked on remote highways by gangs linked to various drug cartels. In 2009 alone, according to the security agency Freightwatch Logistics México, at least 80 shipment hijackings have been reported (Millman, 2009). The Fitch Ratings agency, which evaluates national credit risks, reported in January 2011 that the drug war was hindering the economic outlook and investment in Mexico, lowering its credit rating (Brandimarte, 2011). The city of Monterrey, known as the jewel of the North in Mexican industrialization and finance, also hosts important research centers, laboratories and high technology industries – but it also has come to be seen by American businesses as risky place to do business (Casey, 2010), and a number of business owners have already moved their families to the other side of the border with Texas for their protection, leading to a bump in the price of land in the upper-class neighborhoods of San Antonio and Austin (Brezosky, 2010).

While this occurs, the U.S. arms sellers continue to benefit from the sale of its products to both sides, the Mexican army and the drug cartels (Grimaldi & Horwitz, 2010). Thus a paradox arises. All of the S&T policies in Mexico are based upon the banner of competitiveness The BNSL, in which CONACYT and the U.S. Sandia National Laboratories are partners, as well as the CD-MEMS Network, were created with the aim of increasing Mexican competitiveness. But now this is called into question, as violence and security take center stage.

Is it necessary for Mexican S&T to work in partnership with foreign military laboratories or industries in order to develop? In 2004, and according to the most conservative estimates, 56% of the public expenditure on R&D in the USA went to the military sector. In the same year, the percentages were 6% in Germany and 5% in Japan, which clearly shows that investments in military research are not necessary for development. If we take the case of public funds for the R&D of RF-MEMS (MEMS regulated by radio frequency), we find that in 2007 Europe invested 75% of its research funding toward commercial applications; Asia invested 80%; but the USA invested nothing – 0% – in commercial applications, but some 81% in military research with the remainder going to space science (Bouchaud, *et al*, 2007). It is evident that S&T development can indeed be achieved outside of the sector which serves military interests.

***Guillermo Foladori** is coordinator of the Latin American Nanotechnology & Society Network (ReLANS) and Professor in Development Studies Doctoral Program at the Autonomous University of Zacatecas, Mexico.*

References

ABACC (Acuerdo Entre la Republica Argentina y la Republica Federativa del Brasil para el Uso Exclusivamente Pacifico de la Energía Nuclear (1991). http://www.abacc.org.br/?p=4148&lang=es

Acosta, Michael (2006). Building Businesses on the Border: The Bi-National Sustainability Laboratory As an Engine of Economic Change. *Economic Development America*, spring. www.eda.gov/EDAmerica/spring2006/border.htm

BNSL (El Laboratorio Binacional Sustentable). (s/f). Inicio. BNSL. http://www.bnsl.org/PaginaPrincipal.aspx

Bouchaud, Jérémie; Knoblich, Bernardo; Tilmans, Harrie; Coccetti, Fabio & El Fatatry, Ayman (2007). RF MEMS Roadmap. *Proceedings of the 2nd European Microave Integrated Circuits Conference*. Munich.

Brandimarte, Walter (2011). Guerra por droga en México pesa en economía: Fitch. Agencia Reuters. 01/12/2011*. Yahoo Noticias.* http://espanol.news.yahoo.com/s/reuters/110112/negocios/negocios_economia_mexico_fitch&printer=1

Brezosky, Lynn (2010). Valley´s real estate soars amid violence. MySanAntonio.com. May 04, 2010. http://www.mysanantonio.com/default/article/Valley-s-real-estate-soars-amid-violence-790614.php

Broome Williams, Kathleen (2010). The Military's Role in Stimulating Science and Technology: The Turning Point. *The Newsletter of FPRI's Wachman Center,* 15, 3. May.

Brown, George E. Jr. (1993). The mother of necessity: technology policy and social equity. Remarks of Congressman George E. Brown Jr. Chairman, Committee on Science, Space, and Technology. AAAS Science and Technology Policy Colloquium. Capital Hilton April 16.

Washington. DC.

Brown, Jr. G.E. (1991). New World Order, Old Worldview. *Los Angeles Times*, Sept. 11, 1991. B6.

Brown, Jr. G.E.; Obey, D.; Miller, G.; Skeen, J.; Roybal, E.; Lewis, J.; Torres, E.; Wolpe, H.; Berman, H.; Coleman, R.; Richardson, B.; Hunter, D. (1991). Letter to James A. Baker III. Secretary U.S. Department of State. March 12, 1991. Washington DC.: House of Representatives. Congress of the United Status.

Brown, Jr., G. E. & Sarewitz, D. R. (1991). Fiscal Alchemy: Transforming Debt into Research. *Issues in Science and technology*, Fall, 7: 70-76.

Business Wire (2003). AMD CEO Hector Ruiz and President Fox of Mexico Convene "U.S.-Mexico Collaborative" Conference to Advance Technology Development in Mexico. *High Beam Research* Nov. 2, 2010. www.highbeam.com/doc/1G1-108252982.html

Casey, Nicholas (2010). Mexico Under Siege. Business Heads Plead as Drug Gangs Terrorize Wealthy City. *The Wall Street Journal*. August 19, 2010. http://online.wsj.com/article/SB10001424052748704557704575437762646209270.html#printMode

Cheney, Dick (1993). *Defense Strategy for the 1990s: The Regional Defense Strategy.* http://www.informationclearinghouse.info/pdf/naarpr_Defense.pdf

CONACYT (2010). I Congreso de los miembros del Sistema Nacional de Investigadores. Jueves 6 Mayo. http://www.conacyt.gob.mx/indice/sni_congr/03-a.html

De la Peña, Héctor (2008). Logros de la UNAM en Mems. *Investigación y Desarrollo*. 31 de Julio de 2008. México DF: Consultoría en Prensa y Comunicación. http://www.invdes.com.mx/suplemento-noticias/793-logros-de-la-unam-en-mems

El Diario (2008). Provee Juárez microtecnología al mundo. *El Diario,* 14 de septiembre. http://www.skyscrapercity.com/showthread.php?t=495552&page=39

Eurekalert (2005). BiNational Sustainability Laboratory opens, hopes to create 'necklace of labs' along Mexican border. Dream of Sandia's Advanced Concept Group for better border security takes on flesh, though somewhat altered. Release: 13-Dec-2005 http://www.eurekalert.org/pub_releases/2005-12/dnl-bsl121205.php

Foladori, Guillermo (2008). The U.S. Military's Influence on Nanotechnology Research in Latin America. *INESAP International Bulletin (International Network of Engineers and Scientists Against Proliferation,* 28, 87-91.

Forbes (2001). The MEMS Microcosm: Military. http://www.forbes.com/asap/2001/0402/052_print.html

Forman, Paul (1985). Behind quantum electronics: National security as basis for physical research in the United States, 1940-1960. *Historical Studies in the Physical and Biological Sciences*, 18, 149-229.

FUMEC (Fundación México-Estados Unidos para la Ciencia). (1997). *Reporte de Actividades 1993-1997.* http://fumec.org.mx/v5/htdocs/informe1993_1997.pdf

FUMEC (Fundación México-Estados Unidos para la Ciencia). (1999). *Reporte de Actividades 1998-1999.* http://fumec.org.mx/v5/htdocs/informe1998_1999.pdf

FUMEC (Fundación México-Estados Unidos para la Ciencia). (2002). *Reporte de Actividades 2000-2001.* http://fumec.org.mx/v5/htdocs/informe2000_2001.pdf

FUMEC (Fundación México-Estados Unidos para la Ciencia). (2003a). *FUMEC Bi-Annual Activities Report 2002-2003. .* http://fumec.org.mx/v5/htdocs/RepEng02_03.pdf

FUMEC (Fundación México-Estados Unidos para la Ciencia). (2003b). First Mems – Mexico Meeting 2003. September 19 – 20. Fumec. http://www.uta.edu/rfmems/Conferences/2003_Mexico_MEMS/MEMS%20Final%20Agenda%20Vallarta%20-%20Eng.htm

FUMEC (Fundación México-Estados Unidos para la Ciencia). (2006). *Biennial Activities Report 2004-2005.* México D.F.: The United States-Mexico Foundation for Science. http://fumec.org.mx/v5/htdocs/RepEng04_05.pdf

Grimaldi, James V. & Horwitz, Sari (2010). As Mexico drug violence runs rampant, U.S. guns tied to crime south of border. *Washington Post*, December 15. http://google.ad.sgdoubleclick.net/pagead/nclk?sa=L&ai=1&fadurl=googleads.g.doubleclick.net&u=http%3A%2F%2Fwww.washingtonpost.com%2Fwp-dyn%2Fcontent%2Farticle%2F2010%2F12%2F12%2FAR2010121202663.html%3Fhpid%3Dtopnews&aclck=http%3A%2F%2Fifreecatalog.com%2Fsr4.php%3Fkeyword%3DAs%2BMexico%2Bdrug%2Bviolence%2Bruns%2Brampant%252C%2BU.S.%2Bguns%2Btied%2Bto%2Bcrime%2Bsouth%2Bof%2Bborder

Hernández, J. (2011). EU teme liga de Zetas y Al Qaeda. *El Universal.* http://www.eluniversal.com.mx/notas/743834.html

ID U.S. ARD&EC (International Division U.S. Army Research, Development and Engineering Command). (2004 November). U.S. Army International Technology Center of the Americas Opens in Santiago. *REDECOM, Magazine.* www.redecom.army.mil/rdmagazine200411/part_ITC.html

Kristol, William & Kagan, Robert (1996). Toward a Neo-Reaganite Foreign Policy. *Foreign Affairs*, July/August, 75-4: 18-32.

Lewis, James A. (2006). *National Policies for Innovation and Growth in Mexico*. CSIS (Center for Strategic and International Studies). Washington DC.

Martínez, Ma. Eugenia; Campos, Guillermo; Sánchez, Germán (2009). ¿México en la economía y sociedad del conocimiento? Una revisión a las políticas públicas. En: Sánchez Daza (ed). *América Latina y el Caribe en la Economía del Conocimiento.* CLACO/Benemérita Universidad Autónoma de Puebla. http://www.scribd.com/doc/31070468/Sanchez-ed-Porras-et-al-ALyC-en-la-economia-y-sociedad-del-conociemitno

Matsumoto, Craig (1999 Sept 21). Sandia pushes for MEMS commercialization. EETimes. Com. http://www.eetimes.com/electronics-news/4168626/Sandia-pushes-for-MEMS-commercialization

McBrayer, John D. (2000). The transfer of disruptive technologies: lessons learned from Sandia National Laboratories. SNL, http://www.osti.gov/bridge/servlets/purl/756077-DAvtfF/webviewable/

Millman, Joel (2009). Las bandas de narcotraficantes asedian a los negocios de las multinacionales en México. *The Wall Street Journal*, May 27, 2009. http://online.wsj.com/article/SB124338204627456487.html

NMAB (National Materials Advisory Board). (2003). *Materials Research to Meet 21st Century Defense Needs*. Washington D.C.: The National Academies Press.

ODDRE (Office of the Director of Defense Research and Engineering). (1995). Microelectromechanical Systems; A DoD Dual Use Technology Industrial Assessment. Washington DC: ODDRDE http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA304675&Location=U2&doc=GetTRDoc.pdf

OECD (Organisation for Economic Co-Operation and Development). (2010). *The Paso del Norte Region, Mexico and the United States*. http://www.oecd.org/dataoecd/17/61/45820961.pdf

ONRG (Office of Naval Research Global). (2004). *Regional Offices. Latin America*. Forum www.onrglobal.navy.mil/scitech/regional/latin_america_forum.asp

Pedersen, Paul. (1989). The Effect of Secrecy on the International Educational Exchange of Scientific Knowledge. *Internacional Journal of Intercultural Relations*, 13, 4: 485-499.

PNAC (The Project for the New American Century). (2000). *Rebuilding America's Defenses. Strategy, Forces and Resources For a New Century*. http://www.newamericancentury.org/RebuildingAmericasDefenses.pdf

Rhea, John (2000). MEMS: following in the footsteps of the Internet? *Militar & Aerospace Electronics*, 11-9.

http://www.militaryaerospace.com/mae/en-us/index/display/generic-article-tools-template.articles.military-aerospace-electronics.volume-11.issue-9.departments.report-from-washington-and-elsewhere.mems-following-in-the-footsteps-of-the-internet.html .

Richardson, James (2008). Revolutionizing the commercial marketplace. DARPA: 50 years of bridging the gap. http://www.google.com/url?sa=t&source=web&cd=1&ved=0CBYQFjAA&url=http%3A%2F%2Fwww.darpa.mil%2FDocs%2FCommercial_Implications_200807171322093.pdf&rct=j&q=revolutionizing%20the%20commercial%20marketplace%20richardson&ei=3btATfivKYKs8AaRpY3UBA&usg=AFQjCNFgMe_pbxYXZ1Or57GDhahlhg2UkQ&cad=rja

Robles-Belmont, Eduardo (2010). Las Fundaciones en el desarrollo de tecnologías emergentes: desarrollo de los MEMS en México. VIII Jornadas Latinoamericanas de Estudios Sociales de la Ciencia y Tecnología. Buenos Aires. http://halshs.archives-ouvertes.fr/halshs-00507810/en/

Sarewitz, Daniel (2010). George E. Brown Jr.'s ideas on US-Latin America Science Collaboration Interview with Daniel Sarewitz by Guillermo Foladori. Washington DC. October, 2010.

SER (Secretaría de Relaciones Exteriores). Estados Unidos Mexicanos (2003). Informe Visita Del C. Presidente de la República, Vicente Fox Quesada a los Estados de Arizona, Nuevo México y Texas de los Estados Unidos de América. México D.F.: Secretaría de Relaciones Exteriores.

SNL (Sandia National Laboratories). (2001). Sandia, Ardesta join forces to commercialize MEMS and Microsystems. News Releases. Sandia National Laboratories. http://www.sandia.gov/media/NewsRel/NR2001/ardesta.htm

SNL (Sandia National Laboratories). (2007). Annual report. SNL. http://www.sandia.gov/news/publications/annual/2007/acg2.html

SPPNA (Security and Prosperity Partnership of North America). [ASPAN]. (2005). *Report to the Leaders. Prosperity Annex*. http://www.spp.gov/report_to_leaders/prosperity_annex.pdf?dName=report_to_leaders

Turbiville, Graham H. Jr. (2010). U.S. Military Engagement with Mexico: Uneasy Past and Challenging Future. *JSOU Report* 10-2. Florida: Joint Special Operations University.

Tyler, Patrick (1992). Pentagon Drops Goal of Blocking New Superpowers. New York Times, 23 May 1992. http://www.btinternet.com/~nlpwessex/Documents/Wolfowitz92memo.htm

U.S. Army ITC-Atlantic (International Technology Center-Atlantic). (s/f b). Worldwide USAITCs http://www.usaitca.army.mil/ww_usaitcs.html

Vaccarezza, Leonardo Silvio (1998). Ciencia, Tecnología y Sociedad: el estado de la cuestión en América Latina. *Revista Iberoamericana de Educación*, 18. http://www.rieoei.org/oeivirt/rie18a01.pdf .

Vayrynen, Raymo (2006). Preventive Action by Military Means: A contested Approach. *Global Society*, 20-1: 69-86

Wilson, J.R. (2003). Smart munitions development relies heavily on MEMS technology. *Militar & Aerospace Electronics*, 14-1. http://www.militaryaerospace.com/index/display/article-display/165768/articles/military-aerospace-electronics/volume-14/issue-1/features/special-report/smart-munitions-development-relies-heavily-on-mems-technology.html

Notes

[1] Partially funded by UCMexus Grant CN 10-420.

[2] The SPPNA was dissolved in 2009. Its formation was not authorized by the congresses of any of the three nation partners. However, the accords continue to function in practice.

[3] For more information see Citizen Action New Mexico (http://radfreenm.org/index.htm), weeklywire.com (http://weeklywire.com/ww/07-03-00/alibi_feat4.html), and the **International Depleted Uranium Study Team** (IDUST) (http://www.ratical.org/radiation/DU/IDUST.html).

[4] Some of the Board of Governors members are directly named by the President of each country, which carries with it a degree of political strategy; and some FUMEC directors and members of its Board were also directors of U.S. military corporations and members of the Board of the SNL, creating personal alliances among the two institutions.

[5] "The Micro and Nanotechnology Commercialization Education Foundation (MANCEF) is a global membership association focused on the commercialization of small technologies. As an educational non-profit, our goal is to facilitate connections and to educate those bringing emerging technologies to market". (http://www.mancef.org/). The SNL and Lockheed Martin also participate in this organization.

Articles by: **Prof. Guillermo Foladori**