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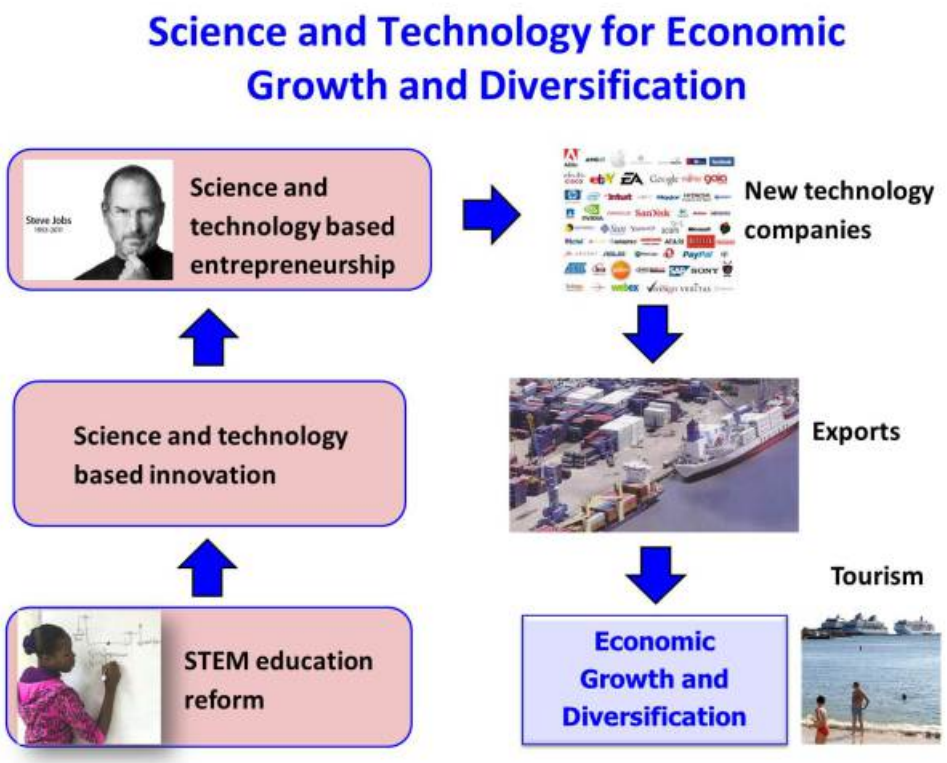
STEM Education Reform Considerations for the Caribbean

By Professor Cardinal Warde and Dr. Dinah Sah

Today, most Caribbean countries find themselves mired in debt with significant poverty levels. According to Nemat (Minouche) Shafik, Deputy Managing Director, IMF in a Sept. 20, 2013 report, "Protracted weak rates of growth and high borrowing levels over many years have left the Caribbean the most heavily indebted region of the world ... This limits fiscal flexibility, discourages private investment, and pushes up borrowing costs, creating a vicious circle."

To break this circle, and pave the way for sustainable economic development, Caribbean countries must diversify their economies by strengthening or developing a new economic pillar based on services and products derived by harnessing Science, Technology, Engineering and Mathematics (STEM). Caribbean people must become not just users of technology but originators of technology, and must convince the rest of the world that the Caribbean is not just a destination for fun and sun, but also is a place where creative and innovative concepts emerge and are put into practice. To be successful in this paradigm shift, the Region must place the highest priority on education reform in the STEM disciplines, including the integration of entrepreneurship into curricula from an early age (e.g. age 8). The figure below illustrates the path to the development of a science and engineering-based economic pillar to complement the tourism pillar, or the oil and natural gas pillar in the case of Trinidad and Tobago.



STEM Education Reform at all Levels

STEM education reform must be multi-faceted and encompass learning both inside and outside the classroom. Syllabus updates and STEM teacher training are essential for incorporating and reinforcing basic STEM and entrepreneurial concepts and skills. Resources for STEM education reform need not be expensive as the educational system can draw upon indigenous and everyday materials, and use examples from the home, workplace, school, farm and the community in its inquiry and project-based initiatives. A balance needs to be struck between mind-on and hands-on learning, as both are important. Clever use should also be made of the World-Wide Web and on-line

information and teaching modules, many of which are freely available. Using these electronic media, students can learn and review material at their own pace, with the teacher and/or parent clarifying concepts and answering specific questions.

Business and Entrepreneurial Education

The basic entrepreneurial education which must complement the STEM education, should cover basic finance, how to start a business, the various kind of capital, intellectual property concepts, how to write proposals and business plans, market place competitiveness, ethics and negotiation skills. Communication skills (listening, written and oral) development must also be part of the basic entrepreneurial curriculum. At least one foreign language is necessary for today's entrepreneurs. We recommend Mandarin. Let us not forget that we must also provide an avenue for continuing education in business and entrepreneurship principles for those who have already left the school system and need help getting their business off the ground, or in making the transition from a prototype to a globally competitive product. Well-run public incubators can play a significant role in addressing this need.

At all levels, career guidance must be provided in the STEM disciplines through the use of role models, both from the Region and the Diaspora. The breadth of technology-based career options, beyond traditional paths such as medicine, law and accounting, needs to be communicated to students from an early age, as well as to parents and teachers. Moreover, students should be encouraged at all levels to think more broadly about technology entrepreneurship careers, and to "ask not who can give me a job, but for whom can I create a job."

STEM education reform is also needed at the tertiary level where our universities must re-engineer themselves to play a more critical role in the economic development of the Region. Because the task can appear daunting, the Region's universities should put in place and leverage scientific advisory boards comprising business and scientific visionary leaders from the Diaspora and the Region to assist in strategic planning and implementation. A high priority must be placed on stimulating technology-based innovation and entrepreneurship, and more collaboration between the universities in the Region and universities and industries in the Diaspora would avoid a re-invention of the wheel and bring in much needed expertise. Key research areas based on the needs of the Region and on the identification of technologies with low financial barriers to market entry should be prioritized through careful consideration of the probability of commercialization success. These technologies, products and services should be developed within new or existing research and development (R&D) centers of excellence. Note that both the "R" and the "D" must be present.

Synergy across university campuses in the Region needs to be a key consideration for implementation of the R&D centers of excellence in order to maximize efficiency and minimize redundancy. The most competitive niche products and services emerging from these centers of excellence should be targeted for growth and development, and should be nurtured in well-run university-based incubators. Most importantly, the Region's university leaders will need to have the will and the flexibility to facilitate innovation and entrepreneurship across their campuses with a holistic approach, which may necessitate significant shifts in intercampus interactions.

Training Needed for High Technology Engineers

Further, the Region needs to place more focus on the development and training of high-technology women and men engineers to rapidly fill the void. Except for very limited activity at universities in Jamaica and in Trinidad and Tobago, high-tech engineering (the big "E") is not taught, and further is hardly practiced in the Region. Perhaps for this reason, the language in the Region is more often about "science and technology" than "science and engineering". We want to make clear that we are not speaking of technicians who are trained to repair, copy, or install products and systems that were originally designed and built by engineers. High-technology engineers are superb physicists, chemists, biologists, computer scientists and mathematicians, who often work in an R&D environment and combine these disciplines with art to design, model, simulate, develop and build innovative products and services for the betterment of mankind. They are the creators of our cell phones, pacemakers, photovoltaic solar cells, spacecraft, robots, software, microprocessors, and special-purpose materials, to mention a few. They are the group who start most of the technology-based companies in the developed world. They could do the same for the Caribbean if we would make it a priority to cultivate and highly train more of them.

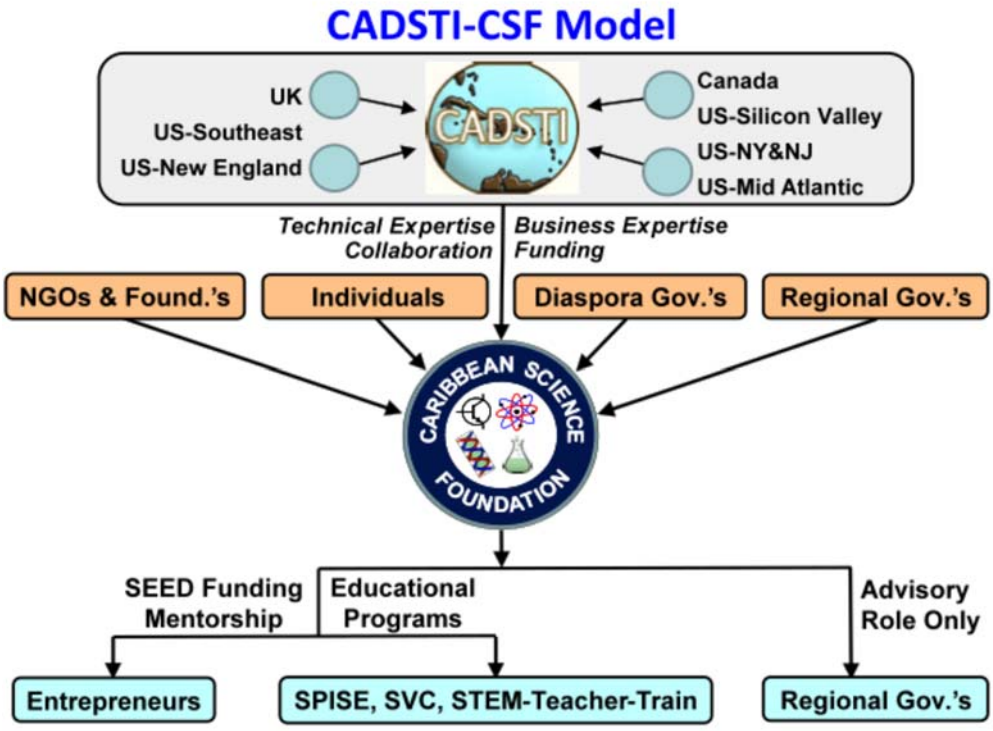
Market and foreign exchange opportunities are being ignored because we are not sufficiently exploiting the STEM talent in the Region, stimulating entrepreneurship, and grooming our students into the engineering professions. There is no good reason why the Region could not, for example, produce electrical engineers to develop and market new niche and innovative low-power circuits for cell phones and computers (extends battery life between recharges) to the big manufacturers of these products; or why our software engineers could not be

parsing, sorting and preprocessing big-data for sale on the global markets; or why our biotechnologists could not be developing more contract laboratories to provide services for biotech companies in North America and Europe. The latter is, perhaps, the fastest way to attract new biotech industries from overseas to set up shop in the Region.

Funding of the R&D centers of excellence would need to be supported and facilitated by the private sector, the government, NGOs, the international community, and the Diaspora. Developing these relationships and facilitating and nurturing the relationships between these partners and the universities will be important to ensure the sustainability of these R&D centers of excellence. Another critical link in the process, are technology transfer experts who can provide business, intellectual property, and commercialization advice and guidance, and who know: (a) how to identify potentially interested companies and, (b) how to negotiate deals with them that will move university research into the private sector. The Diaspora can help with finding leaders with such experience, and this experience should be tapped. Seed capital funding for new ventures emerging from these R&D centers and incubators could come from the international community, including especially networks in the Diaspora.

Diaspora Engagement

The Diaspora does, indeed, want to help in both the educational reform and the innovation and entrepreneurial initiatives. In 2010, the Caribbean Diaspora for Science, Technology and Innovation (CADSTI) – see http://cadsti.org – established the Caribbean Science Foundation (CSF) – see http://caribbeanscience.org – as its implementation arm, on the ground in the Region, to assist with some of these challenges. CADSTI has active branches in the UK, New England, US Southeast and the US Mid-Atlantic States. Soon to be launched are branches in Toronto, Silicon Valley and the New-York-New Jersey area. The mission of CADSTI is to: (a) facilitate economic and social development of the Caribbean region by mining and harnessing the diverse, dispersed and largely untapped talent of the Caribbean Diaspora in the areas of science and technology, (b) connect with and catalog the key experts and resources within the Caribbean Diaspora, and (c) to mobilize the global financial and other resources in support of mission and objectives of science and technology organizations of Region, especially the CSF. The CADSTI-CSF model is shown below.



In carrying out this mandate, the CSF has initiated two educational reform initiatives: the Student Program for Innovation in Science and Engineering (SPISE), and the Sagicor Visionaries Challenge (SVC), the latter in collaboration with Sagicor Financial Corporation and the Caribbean Examinations Council (CXC). SPISE is designed to groom the most gifted high-school students in STEM to join the next generation of technology and business leaders in the Region (see details here and view video here). The SVC complements the SPISE in that

it reaches large numbers of high school students over a wide age range, with the goal of piquing their interest in STEM through project based learning experiences within teams in the schools (details here). The CSF expects to soon embark on a STEM teacher training project in collaboration with the Caribbean Academy of Sciences. Further, with the aid of the Diaspora and several NGOs, the CSF is beginning to assemble a seed-capital fund to ignite small technology-based business, on a competitive basis.

In summary, strategic development of a new economic pillar based on science and engineering must include at least six key educational elements: (a) science popularization for the masses with the "science is cool" factor for children (e.g., more science and engineering on TV, and more math Olympiads and science fairs with winners celebrated more in the media), (b) STEM education reform at all levels – primary, secondary, tertiary and continuing, (c) business and entrepreneurship education starting at about age 8, (d) the formation of more technology incubators within and outside the university, (e) the creation of R&D centers of excellence within the universities in key niche areas, and (f) the training of more high-technology engineers within our universities. Ideally, the "R", the "D" and the "E" should be strengthened in parallel. Government, private sector, the international community and the Diaspora, will be key in financing, guiding and expanding these initiatives, and ultimately transforming the economies of the Caribbean.

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