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Keynote Summaries

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Introduction to
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Water and Environment Management using Advanced Information Technology: An Opportunity for Sri Lanka to Focus Research Towards Economic Development and Export

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With the projected population growth estimate to peak around 22 million in 2031 (Silva, 2007), it is urgent that Sri Lanka develops well thought out strategies to manage its limited natural resources. One of the most critical natural resources is water. Sustainable economic growth and the quality of life of all Sri Lankans will heavily depend on long-term sustainability of both the quantity and quality of water as a resource. Urbanization and industrialization tied to rapid economic growth will contribute to water pollution and environmental degradation. Growth also contributes to water demands in the agriculture sector for irrigation and increased use of agrochemicals threatening water quality. Non-point chemical sources such as nitrates, pesticides and herbicides have the potential to pollute the nation's streams, rivers, lakes and groundwater. Climate change due to global warming contributing to rising sea-levels will have catastrophic consequences in densely populated coastal regions and their water resources. Sri Lankan scientists, engineers and entrepreneurs have the opportunity to contribute to the task of management of water as a resource through the development of technologies to address nation's problems but also for export market. The primary thesis of this presentation is that our nation with a rich heritage of innovation as engineers who developed one of the

most advanced irrigation civilization thousand of years ago, we should have the self confidence and the creativity to meet these challenges successfully.

We explore the use of resource management schemes based on information technologies (IT). IT involves "acquisition, processing, storage and dissemination of vocal, pictorial, textual and numerical information by a microelectronics-based combination of computing and telecommunications". The potential application of this technology is explored through two water related examples relevant to Sri Lanka: (1) dam safety and (2) coastal aquifer management. It is estimated that there are approximately 320 medium and large dams in Sri Lanka and around 10,000 small dams, most of which are more than 1000 years old (Samarajeeva et al. , al, 2006). In addition, as a part of development schemes such as Mahavali, a number of large concrete dams have been built. In the case of earth fill dams, catastrophic failure can occur as a result of breaching of the earthen structure through leakage, piping, slope sliding and overtopping. In the case of concrete dams, the structure can fracture, topple or slide. Any type of dam failure will have major and devastating consequences to the population, property and the environment. Such a failure of an earthen dam occurred 25 years ago in Kantale in Trincomalee district in April of 1986 killing 127 people and destroying property in the region of Rs. 575 million. It has been reported that the dam was inspected six months before the failure. It is not known when the failure process initiated and how it progressed. An early detection and warning system would have helped evacuation warning and reduced the loss of life. Instruments or sensors that are automated to detect and measure seepage, soil or structural movement, pore-water pressure, moisture content and temperature, tiltometers etc. can provide real-time data for detecting potential conditions and chain of events that may lead to catastrophic dam failures. This data transmitted through the latest IT based communication tools when interfaced with computer models of dam behavior and failure will provide an efficient computer based tool for monitoring, decision making, warning and emergency evacuation action.

A second example that is related to water supply and quality that has the potential use of sensor based IT systems involves the management of groundwater. As reported by Manchanayaka and Bandara (1999), exploitation of groundwater in Sri Lanka as a source of supply commenced in the mid-1950s and the demand has been in the increase. They also state that chances of finding good quality groundwater water in considerable amounts are promising in coastal areas and alluvial valleys. This example deals with managing fresh water extraction through pumping from such coastal aquifers. Unmanaged pumping in costal aquifers induces the movement of salt water towards the fresh water (saltwater intrusion), thus contaminating the fresh water with salt making it unusable for drinking and with long-term health consequences. A

delicate balance has to be maintained to control the extraction so that the net effects of natural recharge from rain and pumping to keep the dense seawater contaminating the fresh water. Illangasekare et al, (2006 and 2009) also reported the persistence of salinity in coastal aquifers long time after a catastrophic event like a tsunami, pointing out the need for management of affected aquifers for fast recovery. A sensor system that is interfaced with a hydrologic model simulating natural recharge and the effects of pumping on salt water intrusion will be able to be used to manage the pumping from high extraction wells.

Over the last several years we have been working on wireless sensor based systems for monitoring the water and the environment (Bandara et al, 2008; Porta et al., 2009; Barnhart et. al. 2010). This application exemplifies the emerging trend merging IT with environmental sensing and management. Recent advances in sensors, microelectronics wireless communication technologies, and information technologies have made it possible the development of potentially low-cost techniques to gather and process large amounts of data at very high spatial and time resolutions. Coupling the problem of complex processes of flow and chemical transport in water and environmental system to data acquisition and processing using automated wireless sensor network (WSN) leads us to a new and exciting interdisciplinary approach to science that challenges traditional academic divisions, frameworks and paradigms. Self organizing sensor networks that respond to the changes in the spatial and temporal behavior of the system, as controlled by complex chemical, physical and biological transformation provide us with a tool to monitor and manage water and environmental systems. Such sensor networks of heterogeneous sensor nodes having different power, processing, and storage capacities, will form a key part of the emerging worldwide sensing and information infrastructure as well. The in situ real-time data collection and processing capabilities associated with this technology is a significant improvement over the traditional monitoring based on manual observations or extractive sampling. However, incorporation into the sensor network the pattern recognition of the spatial evolution of the affected zones, to allow for re-calibration of models as a self-evolving process, will be a significant enhancement, that essentially converts the sensor network from a data collection system to an intelligent monitoring system providing directly useful information for decision making and management.

The technology development and implementation strategy we propose recognizes that it is necessary to address the technological issue as well as societal specific cultural issues associated with creating the environments for innovation and entrepreneurship. The hardware for this IT based technology is continually advancing in the electronic industry and all components could be obtained off the shelf. **The opportunity we propose to explore in the context**

of water and environmental management in Sri Lanka is an integrated monitoring system developed with the local software, IT and science talent, using local resources and investment. We recognize that Sri Lanka has built much of the necessary educational and training infrastructure to develop IT human capacity base during the last decade. To our knowledge, the universities and other IT degree granting educational and training institutions have been producing trained computer scientists and engineers to adequately meet the man-power needs.

Focus of local and expatriate talent around this idea will have several important implications beyond monitoring and managing local natural resources. It will foster interdisciplinary interaction among scientists, engineers, IT managers and other personnel. Such interaction is critical for identification of novel solutions and development of marketable products. Once the proof of concept systems are developed, local entrepreneurs will have access to this technology, to develop and market to other developing and developed countries. Much of the technology will also be adaptable to other critical tasks such as monitoring wildlife, and even spread of deceases. Deployment of monitoring system over wide areas may be carried out by involving students and teachers, thus exposing them to this new emerging branch of IT for environmental monitoring and management.

The issue of how the "culture matters" in economic performance was argued by Thomas Friedman in his highly acclaimed book *The World is Flat*, first published in 2005. He refers to one of the most important books on this subject, *The Wealth and Poverty of Nations* by the economist David Landes, "....that although climate, natural resources, and geography all play roles in explaining why some countries are able to make the leap to industrialization and others are not, the key factor is actually a country's cultural endowments, particularly the degree to which it has internalized the values of hard work, thrift, honesty, patience, and tenacity, as well as the degree to which it is open to change, new technology, and equality for women"

This forum will provide an unique opportunity for the expatriate and local scientists and engineers, educators and entrepreneurs to critically look at to what extent our current educational system from primary schools to the Universities and technical training institutes contribute towards human capacity building needed to locally develop technologies for us to be globally competitive and to create export markets. This forum also should explore how this local talent be utilized to create innovation.

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Stem Cells: From Bench to Bedside

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Almost every day we hear of news reports that stem cell biology is medicine's new frontier and how it is going to change our lives by providing cures for almost every incurable disease. This hope is entangled with politics, religious and ethical concerns and has been unjustly associated with reproductive cloning. The road map towards taking stem cells to the clinic is long and involves the overcoming of many technical and safety hurdles. However, current research data shows that the journey is a positive one and stem cells have the potential to improve the quality of lives of millions of people around the world.

In the human embryo, unspecialized cells called 'embryonic stem cells' continuously go through a process called differentiation where they divide to form specialized cells that eventually form the various tissues and organs of the human adult. It has been hypothesised that some of these unspecialized stem cells that do not complete differentiation eventually end up in a dormant state in the adult organs ('adult stem cells') and are recruited for tissue repair during disease but their numbers are small to help overcome the disease on their own. Today, stem cells have been isolated in the laboratory from embryos, the fetus, fetal membranes, umbilical cord and adult organs.

They have the unique properties of self-renewal and can be converted into desirable tissues in the laboratory dish. In preparing such transplantable tissues for the repair of diseased organs, the strategies used by laboratories is to first stimulate these stem cells to multiply in large numbers in their unspecialized state by growing them in special culture environments (cell lines), and then

treating the cells with specific agents to control their fate along one lineage so that the final converted tissue can be transplanted into the diseased organ (Bongso and Lee, 2011).

Embryonic stem cells (ESCs) are pluripotent or the 'mother of all cells' as they can be converted into every tissue of the human body. Thus, theoretically, several target diseases can be treated by making the tissue of choice for transplantation from ESCs. Stem cells from the fetus, fetal membranes, umbilical cord and adult organs are mesenchymal (MSCs), multipotent and can be converted into a specific number of tissues. Hematopoietic stem cells (HSCs) found in the bone marrow usually specialize into one lineage (blood cells). ESCs, MSCs and HSCs can be further distinguished by the presence of their own specific biochemical markers (surface markers and CD antigens).

Since the first isolation of human ESCs (hESCs) (Bongso et al., 1994) and the subsequent establishment of the first hESC line (Thomson et al., 1998), research on hESCs has been robust leading to their conversion into a wide variety of desirable tissues for 2 transplantation therapy. Transplantation of these hESC-derived tissues into diseased animal models have resulted in successful engraftment and functional outcome for diabetes, heart, Parkinson's and several other debilitating diseases (La Flamme et al., 2007; Shim et al., 2007; Yang et al., 2008). Unfortunately however, hESC-derived tissue transplantation is fraught with the concerns of immunorejection of the transplanted tissues (since the original source of the hESCs is from donor embryos), and the possible induction of tumours. Tumorigenesis is brought about by residual rogue unconverted pluripotent hESCs residing in the converted cell population and being accidently transferred during transplantation (Bongso et al., 2010).

To overcome the problem of immunorejection, protocols were recently developed to personalize tissues to the patient. This involved reprogramming the patient's skin cells to the embryonic state by introducing pluripotent genes into the skin cells so as to generate the patient's own hESCs (Takahashi et al., 2007). This approach referred to as human induced pluripotent stem cell (hiPSC) technology bypasses ethical sensitivities in the use of human embryos and allows the conversion of the patient's own reprogrammed hiPSCs to the tissue of choice for correcting her specific disease. However, even though immunorejection is overcome, hiPSC-derived tissue transplantation also runs the risk of tumour formation from residual unconverted pluripotent hiPSCs (Gutierrez-Aranda et al., 2010). Recently, a protocol was developed to remove the left-over unconverted hESCs/hiPSCs so as to eliminate the potential problem of tumour formation but the transplantation of derived tissues after using this protocol has not as yet been tested in the human (Tang et al., 2011).

Although research on hESCs/hiPSCs at the laboratory bench is progressing at unbelievable momentum their routine clinical application has

been slow because of the stringent safety regulatory approvals that are needed for such cell based therapies. Recently, the first FDA approved clinical trial for the transplantation of hESC-derived neural cells (GRNOPC1) into spinal cord injury patients commenced. Preliminary results show that the patients have not suffered from any pathologies thus far. When the same human GRNOPC1 cells were injected into demyelinated spinal cord lesions induced in non-human primates (multiple sclerosis) the data showed that GRNOPC1 cells survived at the lesion site and progressively promoted remyelination of axons (Geron Corp, USA).

Several studies have also assessed the fate of disease progression when MSCs from the bone marrow of a patient are transplanted into her own diseased organs (autologous) such as for myocardial infarction, spinal cord injury, liver and other diseases. Despite some encouraging results, large controlled clinical trials have not as yet confirmed a genuine functional outcome to recommend this approach routinely. It was reported that the mechanisms for any improved functional outcome of autologous bone marrow MSC transfer was the initiation of tissue repair through (1) paracrine secretion factors mobilized from neighboring environments within the patient's body, (2) stimulation of already existing stem-like progenitor cells within the host diseased organ and (3) decreasing inflammation and immune reactions (Dimmeler et al., 2008). The 3 transplantation of autologous or donor (allogeneic) MSCs from healthy fetal and adult organs into diseased organs have also shown engraftment and good functional outcome but the results here again have been controversial because of the absence of large positive controlled clinical trials.

HSCs harvested from the bone marrow have been used to treat malignant blood diseases (leukemias, lymphomas) for many years. Unfortunately, the limitations in the use of bone marrow HSCs have been (1) the inadequate cell numbers for transplantation for adult patients and (2) the pain, morbidity and potential risk of infection during cell harvest from the bone marrow. There has thus been the need to repeat HSC doses by recruiting more matched donors which are usually hard to obtain.

Alternatively, the use of HSCs from umbilical cord blood (UCB) is gaining popularity as their harvest is not painful and there is no risk of infection to the patient. UCB contains HSCs that appear to have higher growth rates and immunological tolerance compared to those in bone marrow. Unfortunately in UCB as well, the HSC yields are low and adequate only for the treatment of malignant blood diseases in children. It was estimated that for successful engraftment in a leukemic patient at least 2.5 x 106 HSCs per kg of patient body weight is required but a good UCB harvest from a single umbilical cord generates only about 10 x 106 HSCs which is adequate only for a 4 kg child (Zhang et al., 2006). Notwithstanding this, cord blood HSC

transplantation has given excellent results in the treatment of leukemias and lymphomas in children and with the development of more reliable HSC expansion methods in the future it would soon be a useful protocol for treating malignant blood diseases in adults and also non-malignant blood diseases such as thalassemia. Pregnant mothers are therefore encouraged to store their cord blood in cord blood banks for such purposes.

Recently, there has been interest in the derivation and use of MSCs from the humanumbilical cord matrix (Wharton's jelly). Such Wharton's jelly stem cells (hWJSCs) have high growth rates, can be converted into many desirable tissues, are not rejected and do not produce tumours (Fong et al., 2010; Gauthaman et al., 2011). The results of recent studies demonstrated that hWJSCs harvested from the same patient's umbilical cord provided a useful source of stromal support (scaffold) for expansion of her own HSCs as the HSCs attached and multiplied very well on hWJSC monolayers grown in plastic dishes (Fong et al., 2011). hWJSCs therefore serve as useful adjuncts to concurrent cord blood HSC storage in cord blood banks to serve as scaffolds for future expansion of HSCs for the treatment of malignant and non-malignant blood diseases as well as for the treatment of other diseases after conversion into the desired tissue of choice.

The preferred option for the correction of some diseases has been to take advantage of the advances of tissue engineering by transplanting tissue constructs rather than the direct injection of cells into the damaged site. For example, providing damaged cartilage or bone with a scaffold enmeshed with the appropriate stem cells would provide a three-dimensional architecture that would have many niches for optimum growth and 4 conversion of the stem cells to chondrocytes via signaling factors at the site of injury. Of the various scaffolds, biodegradable nanofibres of various topographies prepared by electrospinning nanotechnology appear to be the most efficient in helping stem cells to convert to bone and cartilage (Gauthaman et al., 2010; Fong et al., 2011).

In summary, stem cell clinical application has not reached its full potential beyond the successful treatment of malignant blood diseases. However, given the robustness of stem cell research in many laboratories worldwide, it would not be too long before evidenced-based large controlled clinical trials show its benefits for the treatment of a variety of incurable diseases. Besides their use in the treatment of disease, stem cells also have uses in toxicity testing, drug screening and discovery, as vehicles for gene therapy and in the production of useful derivatives for the cosmetic industry.

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Emerging Infectious Diseases: Prevention and Control

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Mankind's triumph over infectious disease may be short lived - the "germs" are now striking back. New or drug-resistant infections continue to emerge through microbes exploiting new niches created by the ecological and environmental impact of human activity, including the abuse of antibiotics. Many newly emerging infections are caused by RNA viruses and they have a zoonotic origin. Arboviruses (e.g. Japanese encephalitis (JE), dengue and Chikungunya), Nipahvirus, SARS, avian flu H5N1 and the pandemic "swine" influenza H1N1 are examples. SARS arose through the adaptation of a previously unrecognized bat-coronavirus to transmit efficiently in humans. Increasing economic prosperity and the demand for exotic foods in Guangdong Province, China, led to the development of large "markets" wherein a diversity of live exotic game-animals were housed and sold for human consumption. These markets provided the milieu for the adaptation and amplification of the SARS-precursor virus from bats to other small mammals such as civet-cats. This led to repeated exposure of the human population to these animal viruses allowing the virus the opportunity to adapt to efficient human transmission. Global air travel rapidly disseminated the SARS coronavirus to affect over 8000 people in 25 countries across 5 continents. The current pandemic H1N1 swine influenza virus emerged through genetic reassortment of swine influenza

viruses. It emerged in Mexico in early 2009 and spread rapidly with >40% of children in Hong Kong being infected by September 2009. Fortunately, the virus was relatively mild, especially so in young children. This experience highlights the challenge that would be posed by a more virulent pandemic virus in the future. The pandemic H1N1 (2009) virus has now become endemic in pigs worldwide and is reassorting with other swine virus to generate novel viruses of potential risk for human health. Defining the viral genetic basis for transmissibility in humans may help detect and contain animal viruses of potential threat to human health before they become pandemic. Avian influenza H5N1 remains endemic in poultry across many Asian countries. Although this virus infects humans relatively rarely at present, when it occurs, human disease is associated with high (>30%) mortality. If such a virus were to become pandemic, its impact could be catastrophic. Understanding the mechanisms underlying the severity of avian flu H5N1 disease may help to devise novel therapeutic options. Novel "universal" vaccine and therapeutic strategies that provide broad cross protection against multiple influenza virus subtypes are needed and are now an area for intense research. New approaches for the early detection and identification of novel pathogens and for rapid assessment of disease severity are needed. Confronting emerging infectious disease threats requires a broad ecological perspective and a multi-disciplinary effort involving those in the human health sector, veterinary medicine, wild-life conservation, environmental sciences, economics, sociology and social anthropology among others.

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He has an active research programme on the synthesis and electronic applications of carbon nanotubes and other nanoscale materials. His group has many 'firsts' emanating from his research in carbon, including field emission from N doped thin film amorphous carbon and diamond, laboratory synthesis of carbon nanonions, tetrahedral amorphous carbon ('amorphous diamond')-Si heterojunctions , deterministic growth of single isolated carbon nanotubes in devices, high current nanotube field emitters and the polymer-nanotube composite solar cells. He currently sits on the steering committee of the Nokia-Cambridge University Strategic Collaboration on Nanoscience and Nanotechnology and is the head of the Nokia-CU Nanotechnology for Energy Programme. His group was amongst the first to demonstrate integration of logic level electronics for signal processing and high voltage power transistors in a single IC (chip). His current research is focussed on integrated power conversion circuits. He is a co-founder of CamSemi – which is commercialising a new generation of power and mixed-signal ICs for power management with venture capital investment. He is also a founder of Enecsys, a company formed with his research students to develop and market integrated electronics (microinverters) for grid connection of solar PV systems. Nanoinstruments, a company he founded with his colleagues to commercialise CNT synthesis equipment was acquired by Aixtron AG in 2007.

He has previously held faculty positions at the Universities of Liverpool (Chair in Electrical Engineering), Cambridge, and Southampton. He has held the UK Royal Academy of Engineering Overseas Research Award at Stanford University and been a Royal Society visitor at the School of Physics, University of Sydney. He has published over 450 journal and conference papers. Professor Amaratunga was elected a Fellow of the Royal Academy of Engineering in 2004. In 2007 he was awarded the Royal Academy of Engineering Silver Medal 'for outstanding personal contributions to British engineering'

From Research to Commercial Products in Electronics

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The commercialization of new concepts in electronics through formation of start-up companies is discussed. Three companies in which the author has been associated as a founder are examined as examples. One a fabless semiconductor integrated circuit (IC) company in the area of power management, another an inverter company in which IC technology is coupled

with novel power electronics at the module level for efficient connection of solar power to the gird and one in the area of nanotechnology equipment. It is shown that there are different routes and time frames over which start-up companies can be formed and funded. Both cases, though different, show the opportunities which exist for enabling new technologies to emerge from academic research into the market through venture capital funded start-up companies.

How can dynamism and growth in research be translated to match its central role in enabling new commercial technologies? To answer this question, at least partially, it is instructive consider the trajectory of microelectronics over the past 20 years in enabling the 'revolution' in consumer electronics. A salient feature is the creation of new start-up companies to exploit a specific 'disruptive' technology advance backed by risk/venture capital. The 'disruptive' technology originates, usually, either from a university laboratory or a large multi-product company, which has no commercial incentive to develop it on its own. In terms of innovation and growth in microelectronics, the start-up company is now an established part of the 'eco system'. So much so, that many established and publicly quoted companies in microelectronics rely on innovations to be developed and demonstrated within start-up companies, which are then acquired based on competitive and commercial needs. A key enabler for start-up companies in microelectronics to release 'disruptive' integrated circuits has been the availability of state-of the art contract IC fabrication facilities in the form of Si foundries. These companies are therefore 'fabless' , but have access to the state of the art in terms of IC fabrication, without any disadvantage compared to an IC company with its own manufacturing facilities. They can therefore focus on design innovation in a very specific area, for example, say, a single chip radios for a new standard, knowing that they can be competitive in terms of manufacturing costs, including assembly, packaging and test.

In this presentation I will discuss the experience gained in setting up three start-up companies in the Semiconductor, Power Electronics and Nanotechnology areas respectively. More specifically, all three companies emanate from research which commenced in a University environment, was gestated within it and spun-out with venture capital investment.

Ravi Silva BA MA PhD FREng CEng CPhys FIEE FInstP FRSA is the Director of the Advanced Technology Institute (ATI) at the University of Surrey and heads the Nano-Electronics Centre (NEC), which is an interdisciplinary research activity. The ATI have over 160 researchers working in interdisciplinary teams to address some of the grand challenges faced by humanity. The NEC has over 50 research staff, and is one of the leading laboratories in carbon based electronics worldwide. Prof. Silva has recently concluded one of the most successful Portfolio Partnership awards for £6.68m with Engineering and Physical Sciences Research Council (EPSRC) on Integrated Electronics and at present is working closely with E.On on fourth generation hybrid solar cells for large area deployment. He is working with the Royal Academy of Engineering and colleagues in India on the large scale deployment of solar technologies in India.

Prof. Silva joined Surrey in 1995, prior to which he was at the Engineering Department at Cambridge University for his undergraduate and postgraduate work. His research has resulted in over 400 presentations at international conferences, and over 380 archival journal papers. He has published in Nature, Science, Nature Materials, Advanced Materials, NanoLetters, Physical Review Letters, Applied Physics Letters among the many journals. He is the inventor of 20 patents, including key patents on Low temperature growth of carbon nanotubes, Large area low-k material, Electron field emission back plane structures and one on the Fabrication of large area nanotube-organic solar cells and lighting. The research conducted has already resulted in two spin out companies backed by venture capital funding. One of the companies, Surrey NanoSystems Ltd., won the spin-out company of the year 2007 award from the Engineer Magazine. He is the Chief Scientific Officer (CSO) for the company.

In 2001 he was awarded the Charles Vernon Boys Medal by the Institute of Physics, and in 2003 awarded the IEE Achievement Award by the Institute of Electrical Engineers. He was awarded the Albert Einstein Silver Medal and Javed Husain Prize by UNESCO for contributions to electronic devices. In 2007, Prof. Silva was the runner-up of the "Times Higher Education Young Scientist of the Year", and "Most Entrepreneurial Scientist 2007, United Kingdom", by UKSEC and Science Alliance of the Netherlands. He was awarded the Clifford-Patterson Lecture and Award by the Royal Society for 2011.

He was elected a Fellow of the Royal Society of Arts in 2007. In 2008 he was elected a Fellow of the Royal Academy of Engineering, UK. In 2009 he was elected a Fellow of the National Academy of Sciences Sri Lanka for contributions to science, and setting up two private-public partnerships to exploit nanotechnology as a vehicle from which to create wealth for the nation that will allow for poverty alleviation in the country. By introducing high technology in to the manufacturing base in Sri Lanka he has spearheaded a drive to introduce innovation and competitiveness in to the industrial sector within the country. He was a member of the EPSRC Nanotechnology Task Force and Technology Opportunities Panel (TOP), and a founder member of the Nanotechnology Task Force in the United Kingdom chaired by Dr Ian Gibson MP.

Wealth Creation for a Sustainable Future via Nanotechnology

***S.R.P. Silva**, Director, Advanced Technology Institute, University of Surrey, Guildford GU2 7XH, UK. Email: s.silva@surrey.ac.uk*

Developing nations such as Sri Lanka are facing an uphill battle to devote sufficient resources for research and development in the increasingly volatile economic conditions with surging oil and commodity prices. But, for the longer term prosperity of the nation significant resources must be put into technology innovation and manufacturing if we are to move from a developing nation to developed one. With the end of the internal civil conflict, which placed a heavy burden on the nation's resources, it is now time to look with optimism for the country to harness the creativity and innovation of the people to create wealth via high technology manufacture and services. But, in an increasingly competitive world there must be key differentiators identified before large scale investment in a technology sector to show suitable returns on the investment, within a defined timescale. Should this be possible, policy makers need to be suitably engaged to show the value of technology in the development of the nation's technology base and to wealth creation. So, where does the country go if it is to mobilise its huge human capital in the form of trained scientists to get itself out of the present predicament of low value export goods and low R&D investment? One solution, probably the key solution for a country such as Sri Lanka to emerge from poverty is, technology.

In this brief paper, presented at the Global Forum, I leave it to the audience to decide the potential of Nanotechnology to provide a solution for Wealth Creation to the Nation. I will use the impending energy crisis the world is likely to face in the next 20-30 years and show how novel green energy forms need to be developed to overcome some of the issues such as climate change via nanoscale design of new renewable energy sources. The design of materials in the nanoscale allows for new hybrid materials to be developed that can be utilised not only for novel energy scavenging applications but also for large area solid state lighting, energy storage and even helping to contribute to the hydrogen economy by examining routes for the electrolysis of water. Nanotechnology can not only contribute to novel energy technologies, but also within the fields of electronics, medicine, transportation, instrumentation, manufacturing etc. To maximise the benefits of technology and its contributions to the national economy, technologists must be consulted and their views taken into consideration in a fully fledged Science and Technology policy for the nation to create wealth. In order to create wealth, significant investment must be made by both the public and the private sector, and this investment must be made in the appropriate areas. For governments to encourage more private sector participation, not only has the policy and

governance to be right, but also the tax and incentives for high technology enterprise. One has only to look towards the USA to see how suitable tax incentives can not only drive the technology agenda, but also bring significant wealth to the nation.

The renewable energy sector is defined as the effective use of natural resources for the production of energy, which are naturally replenished. These primarily include solar, wind, hydro, tidal, biomass and bio fuels for transportation as the sources of energy. Sri Lanka and other developing nations have many of these natural resources, and it is important for a national policy to be established in the exploitation of these important assets. The emergence of nanotechnology is further improving the routes for exploitation of these resources, and with a suitable policy and environment it would not be long before significant returns can be obtained for policies adopted by nations in the development and exploitation of nanotechnology. At present over 80 nations have an identified nanotechnology policy, and the number is increasing very rapidly. Lux Research estimated over US$ 150 Billion worth of nano-enabled products in 2007. The figure is set to reach US$ 3 Trillion in 2015.

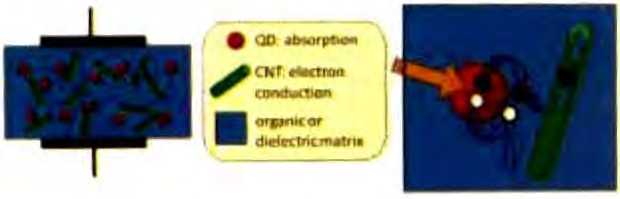
Nanotechnology fundamentally embraces the science and engineering issues encountered at the nanometre length scale. It is about the identification, manipulation, and fabrication of systems to perform useful functions in the length scale of 1-100 nm. It promises much more for less: smaller, cheaper, lighter and faster devices that have greater functionality, use less material and consume less energy. Sir John Taylor indicated that: "Any industry (or country) that fails to investigate the potential of nanotechnology, and put in place its own strategy for dealing with it, is putting its business at risk".[1] Nanotechnology promises a manufacturing revolution in nearly all sectors, that include energy (production and storage), materials (includes organic and inorganic, hybrid systems, metrology), medicine and health (including therapeutics and diagnostics), water and the environment, electronics/information technology, mechanical products, instruments. But, for such potential to be obtained a coherent strategy is essential; one with suitable safeguards in order to have robust policy that directs research & development activities down a path that is commensurate with the government strategy aimed at creating wealth for the nation. Implementation of a unified strategy using a high level team of technologists and policy makers working in tandem with government departments, industry and the academic sector, will ensure maximum benefits to the country. Without such a strategy much of the limited

[1] New Dimensions for Manufacturing: A UK Strategy for Nanotechnology A report prepared by Dr. John M Taylor, Director-General of the UK Research Councils, chairing the Nanotechnology Advisory Group, July 2002.

resources being used to fund nanotechnology will operate in isolation and lead to no accumulated benefits.

I will introduce the key issues associated with the energy problem faced by humanity at present, and how fabrication of inexpensive photovoltaic devices could be the key to producing renewable energy sources that will allow for a sustainable solution. Within the presentation I will introduce some of the key areas being developed in the quest for solution processable solar cells, and how nanotechnology is being used to optimise the harvesting of energy from the sunlight bathing the earth. On a daily basis the sun bathes the earth with the equivalent of 165,000 TW of power. The total current usage of power by the world population is equivalent to ~10 TW today. There is a huge disparity between the energy arriving from the sun on the earth and that used to produce photo-electricity. There are many routes to produce solar cells, but these are either of limited dimension and very expensive to produce. If one can sacrifice part of the efficiency but gain on cost, there are means to make the energy production route via solar energy economically viable. One route for capturing the energy from the sun is to use polymer based solar cells in the form of thin film hetero-structures. By designing solar cells with pre-determined interpenetrating bulk heterojunctions at the nano-meter scale, where each exciton created would not need to travel more than 10nm to reach the electrodes, high efficiency cells that are inexpensive to produce could be manufactured. We at Surrey have been working on the organic-inorganic systems based on multi walled carbon nanotubes (MWCNT) as the inorganic component. These composite materials may be in the form of a solution that can easily be applied to surfaces with a method such as dip-coating. The nano-engineered materials not only help in the charge carrier separation but can also increase the absorption within the materials, and be suitable for portable and are necessary for humanity to live the lifestyle they have become accustomed to at present. flexible light-weight substrates such as plastics. But, this is but one of the facets to this multi-dimensional problem, that can have many different scenarios and potential solutions. What is absolutely certain is that new and sustainable renewable energy sources

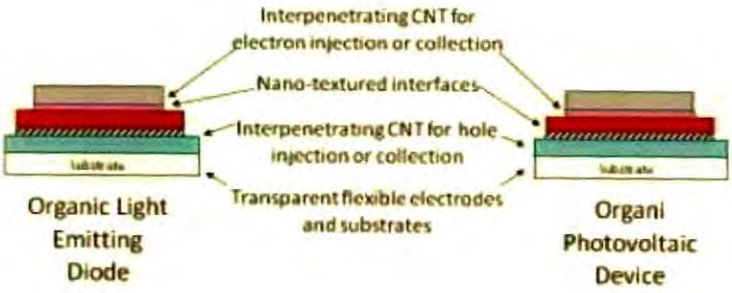
The key points in using nanostructures to capture solar energy is the ability to tailor the 'relative' bulk of the material in a nanoscopic manner such that the



capture cross-section for the excitons can be expanded and extended in range. This is illustrated, where expanded surface areas or concentrator surfaces for the excitons are created by adding nano-particles into the bulk of the organic materials, which help not only in the charge transport but also in the exciton capture and dissociation of the charge carriers. We can also extend the spectral range in which the solar harvesters operate and also extend the working temperature of the devices and thus increase the potential to further concentrate the light falling upon the cells for added efficiency. But, the key point to note is that the cost of producing such devices must be kept to a minimum in order to make the devices widely available at an affordable cost. Any potentially screen printable or solution processable process can be scaled up and sold at relatively low cost.

SOLUTION PROCESSABLE: Inorganics-in-Organics

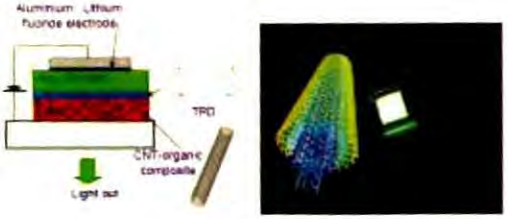
The scope in using clever materials engineering on the nanoscale to solve energy problems is unlimited, and we should all look towards nano-engineered materials for cheap large are electronics for high quality products in the future. The Advanced Technology Institute of Surrey University is leading the way in this new area of "inorganics-in-organic" composites, and the future is very bright for composite devices based on these concepts. A systematic study of using such a concept to capture solar energy and produce efficient lighting based on the model carbon nanotube-organic system is discussed below; but the lessons learnt can be applied to many other inorganics-in-organics systems throughout the material world with the potential benefits being very large.



Carbon nanotubes (CNTs) have recently emerged as a unique material suitable for hybrid macro-electronic devices employing organic semiconductors, with the potential to address many of the barriers to the widespread exploitation of organic semiconductors as the basis of low cost,

large area, flexible optoelectronics. This work focuses on the applications of MWCNTs in organic light emitting diodes (OLEDs) and photovoltaics. These devices are currently being pursued with much anticipation as energy efficient solid state lighting and a scalable means of harvesting electrical energy from sunlight.

A further field in which nanotechnology clearly shows its multi-faceted nature in energy is in solid state lighting. The need for adequate lighting represents ~40% of the electricity costs for commercial businesses and ~20% for domestic and industrial users. However, a substantial proportion, if not the greater majority of existing lighting installations use inefficient lighting equipment- namely incandescent light bulbs (about 2.1% efficiency) and fluorescent lamps (about 8.2% efficiency). The heat dissipated puts an extra burden on air-conditioning and cooling systems, thereby increasing electricity consumption and its inherent effects on the environment. Solid state lighting systems based on MWCNT-organic systems can also give routes to high efficiency, low energy lighting. Some work conducted at Surrey in realising this aspect will be highlighted. Work presented will demonstrate the improved efficiency in the brightness of our devices, when inorganics-in-organics are utilised.



Conclusions

In summary, Sri Lankan technology has much to offer but to achieve a vibrant eco-system for exploitation it is essential that we have a coherent top down policy that provides a viable path for taking the process from science to technology to companies and the private sector. If the principle of the free market economy-i.e., that everything will find its own level-is extended to the new industries and technologies within it, the government must accept that the bolder and more commercially astute economies in the world will take the initiative and reap the benefits.

Nanotechnology is the future. It will underpin future developments in health, industry and the environment. Failure to invest now in nanotechnology is a failure to invest in our future.

"Nanotechnology is being heralded as a new technological revolution, one so profound that it will touch all aspects of human society."

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Hemantha Kumar Wickramasinghe, IBM Fellow (Ret), NAE, FIEEE, FInst P, FAPS, FRMS, FMRS (Hon) India is a distinguished pioneer in the invention and practical uses of nanotechnology. Dr. Hemantha Kumar Wickramasinghe now manages nanoscience and technology research at IBM's Almaden Research Center, San Jose, Calif. A native of Colombo, Sri Lanka, Wickramasinghe was educated at the University of London (B.Sc. and Ph.D. degrees in electrical engineering in 1970 and 1974, respectively). After a post-doctoral appointment in the Applied Physics Department at Stanford University, he joined the Electrical Engineering Department at University College, London, in 1978, gaining tenure in 1982. In 1984, Wickramasinghe joined IBM Research at the T. J. Watson Research Center in Yorktown Heights, N.Y. There, he led the team that developed atomic force microscopes (AFMs) into fully hardened instruments that could be used both within IBM and outside. He invented a number of novel scanning probe microscopes and near-field optical instruments and applied them to data storage and in-situ measurements that improve the yield and/or throughput of manufacturing lines. Among the microscopes he helped invent are the vibrating mode AFM, magnetic force microscope, electrostatic force microscope, kelvin probe force microscope, scanning thermal microscope and the apertureless near-field optical microscope.

In June 2001, Wickramasinghe moved to Almaden to lead the development of technology aimed at increasing the data density of magnetic hard-disk drives. He was named manager of nanoscale and quantum studies in August 2002.

Dr. Wickramasinghe is a fellow of the American Physical Society, and the United Kingdom's Institute of Physics, Institution of Electrical Engineers (IEE), the Institute of Electrical and Electronics Engineers (IEEE) and the Royal Microscopical Society. He was elected to the National Academy of Engineering in 1998. In 2000, Wickramasinghe and Calvin Quate of Stanford U. received the American Physical Soceity's Joseph F. Keithley Award for their "pioneering contributions to nanoscale measurement science through their leadership in the development of a range of nanoscale force microscopes that have had major impact in many areas of physics."

Devices for Probing the Nanoscale in Biology

***H. Kumar Wickramasinghe**, University of California, Irvine, CA 92697, USA*

The US has budgeted $3.8B for nanotechnology R & D in 2011. Europe and Japan are spending R & D dollars at a similar level. If we look at the developments in science and technology that sparked this nanotechnology revolution, we can identify one key enabler – namely the invention and development of the Scanning Tunneling Microscope (STM) and the related Scanning Probe Microscopes (SPM) ; they enabled us to visualize and control

surfaces at the atomic and molecular levels. Today, one cannot imagine any laboratory in the world involved in nanotechnology that does not use this family of instruments. SPM's however were developed mainly with a focus on applications to materials science, semiconductors and storage. With the emergence of nano-bio technology as a rapidly growing field of research, there is a burning need to develop an entirely new set of tools to understand , measure and quantify the nanoscale in biology. Indeed this need has been recognized by all the leading research Universities in the US.

We are creating the next generation of tools, and methods to probe the nanoscale in biology together with its underlying science. The areas where novel nanoscale tools are needed is vast; they range from tools for low cost high speed DNA sequencing addressing the 10 year NIH initiative ($1000 genome project) for personalized medicine to novel ways for in-situ protein sequencing. In the area of molecular biology, the ability to measure and understand the chemical activity and processes within living cells on the nanoscale will provide entirely novel capabilities. Such tools will undoubtedly provide new data, create new discoveries and help us understand the causes of diseases and may even help early diagnosis and cure. The tool sets that we are developing should also open up the possibility not only to measure the biological environment on the nanoscale but also to selectively modify that environment. The capability will enable scientists to investigate the action of specific drugs or enzymes on the functioning of living systems.

A. P. de Silva studied and taught at the University of Colombo, Sri Lanka and is now at the Queen's University of Belfast, Northern Ireland. With his co-workers, he introduced the field of molecular logic and generalized the luminescent PET sensor/switch principle. He contributed to the chemistry module of the OPTI™ blood gas/electrolyte analyzer (Optimedical Inc.), which has sales of 80 M USD so far. He was elected to the Royal Irish Academy in 2002. He won the Royal Society of Chemistry sensors award in 2008.

From Chemistry to Medical Diagnostics and Information Processing

Gareth J. Brown,[1] A. Prasanna de Silva,[1] Kaoru Iwai,[2] Gareth D. McClean,[1] Bernadine O.F. McKinney,[1] David C. Magri,[1] Seiichi Uchiyama[3] and Sheenagh M. Weir[1]

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Designed molecules of nanometric size allow us enter the subject of information handling. Chemical scientists have the skills to launch molecular vehicles to explore small inaccessible spaces and to send back raw or processed information that we can act upon in the real world, e.g. in a medical context.

The design of the molecules is as follows. Photoinduced electron transfer (PET) is the heart of photosynthesis and is a major channel of de-exciting excited states.[1] Luminescence is another such channel. The controlled competition of luminescence with photoinduced electron transfer (PET) can switch the luminescence 'on' or 'off' by chemical means (e.g. a cation C^+) in an easy, predictable manner. The modular nature of 'lumophore-spacer-receptor' systems is not only vital for the occurrence of PET (Figure 1), but also for the prediction of system characteristics such as colours of the optical signals and the concentration range of the chemical species.

The first-generation systems use a single chemical controller. These give rise to examples which monitor sodium levels in blood within millimeter-sized channels or the status of acidic compartments in micrometer-sized cells. Some of these even map proton distributions in nanometric spaces near membranes.[2] Notably, some of these serve wider society by operating in hospital intensive care units (Figure 2).[3]

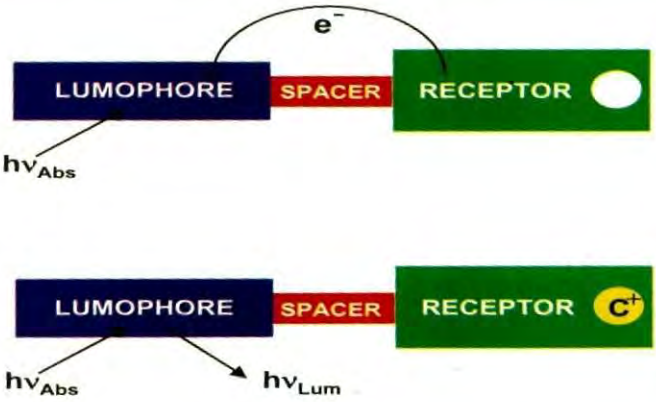

Figure 1. The behaviour of a 'lumophore-spacer-receptor' system with and without a cation C^+

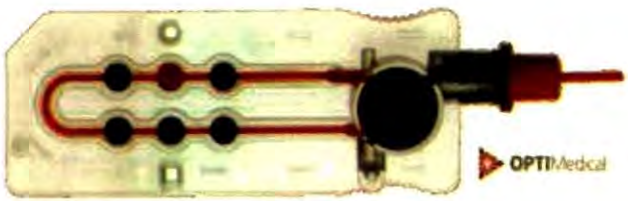

Figure 2. The OPTI™ blood electrolyte and gas analyzer sold by Optimedical Inc.

The second-generation systems use multiple chemical controllers. These form molecular-scale information processors[4,5] which employ chemical species as inputs, light as output and wireless interfacing to human operators. Some of these processors are self-assembled[6] and they operate comfortably in nanometer-sized regions near membranes,[7] These spaces are too small for the tiniest silicon-based electronic devices to enter. Such molecular logic devices are continually growing in complexity. Some of these have potential as 'lab-on-a-molecule' systems for intelligent medical diagnostics.[8] Others allow molecular computational identification (MCID) of nano/micrometric objects.[9] This is the first of such applications which addresses a problem that does not currently have solutions from semiconductor computing technology.

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Monte Cassim was appointed Vice-Chancellor of The Ritsumeikan Trust in January 2010. As Professor of College of Policy Science, Ritsumeikan University, he specializes in environmental science and health informatics, and is also attached to the Ritsumeikan Center for Sustainability Science. Prior to this, he served as President of Ritsumeikan Asia Pacific University for 6 years. He has been Honorary Visiting Professor at King's College London GKT Medical School since 2003. He joined Ritsumeikan as Professor in 1994. His research centers on earth-friendly and people-friendly technology development. He is currently working on climate change impacts on the agro-forestry sector and how we might respond proactively, looking at viticulture and viniculture in a pilot study conducted in Japan and New Zealand. He is also working to establish a network of biomedical researchers in the under an initiative termed MEDSYN ASIA, to prevent emerging diseases in Asia, such as gastro-esophageal adenocarcinoma, and to improve treatment of prevalent lifestyle related diseases, such as stroke. He teaches natural ecology, focusing on biodiversity regeneration in tropical ecosystems, and industrial ecology, with an emphasis on life cycle assessment and design. Together with private industry, he will establish a S&T incubator, the Digital Discoveries Research Collaboratory, in 2011.

A Sri Lankan national, Cassim has been resident in Japan since 1972. He graduated from the University of Sri Lanka's Faculty of Natural Sciences in 1970 with a bachelor's degree from the Department of Architecture. His post-graduate education was in Japan, where he received a master's degree from the Department of Urban Engineering in the Graduate School of Engineering at the University of Tokyo In 1976. He was in the doctoral programme of the same department from 1977-1982, when he left to join private industry after completing his doctoral course work. He has served in both the private and public sectors, including a nine-year period at the United Nations Centre for Regional Development (1985-1994), where he was Chief Researcher and UN Expert. Passionate about underdevelopment, he was one of the founders of Tools for Self Reliance Japan, an NGO which has taken tools, technologies and artisans from Japan to developing countries to work with impoverished communities since 1993. He loves blues music, fast cars and cooking…so beware!

Innovation beyond boarders: Creating a sustainable science and technology driven open innovation incubation ecosystem

Monte Cassim, *Vice-Chancellor, The Ritsumeikan Trust, and Professor (Health, Environment and Life Science) Ritsumeikan University, Kyoto, Japan*

The presentation centers on a science and technology-driven open innovation incubation ecosystem, the Digital Discoveries Research Collaboratory (DDRC), which was opened in November 2011 in north-eastern

Kyushu, Japan. A high-end super-computing and telecommunications infrastructure with secure data warehousing facilities underpins DDRC's research and development. Its first five years, 2011-2016, will center on developing and executing projects which apply advanced digital technologies in **five** trans-disciplinary domains, viz: **1.** Food, agriculture and environmental science; **2.** Health and medical science; **3.** Arts, culture and tourism development; **4.** Language, learning and expression; and **5.** Craftsmanship, manufacture and design. DDRC projects draw from the research expertise in the Ritsumeikan system and its affiliates within and outside Japan. These partnerships cover academia, industry and government.

The **first** part of the presentation looks at landmarks in the evolutionary, experimental process which led to the birth of DDRC. Here it identifies the factors that characterize each stage of the evolution and the nature of the open innovation system at DDRC, which has evolved out of this experience. The **second** part of the presentation will center on the projects that are part of DDRC and what is likely to emerge out of it in the future as an engine for growth and development. Selected projects of interest to Sri Lanka will be highlighted. The **third** concluding part will look at the relevance of this experience to Sri Lankan development and what partnerships can be created between Sri Lankan research institutions affiliated to the National Science Foundation and the research and development system around DDRC.

Sirimali Fernando is the Chairperson of National Science Foundation, Sri Lanka and Science Advisor to the Minister for Scientific Affairs. She is also the Professor of Microbiology, University of Sri Jayewardenapura, Sri Lanka.

Starting her career as a medical doctor in 1982, she has served as an university academic and researcher (26 yrs) and as science administrator for 7 yrs. She initiated and coordinated development and implementation of National Science, Technology and Innovation Strategy 2011-2015, National Biotechnology Policy and National Nanotechnology Policy. She conceptualized, initiated and coordinated the National Nanotechnology Initiative as a public private partnership. As a researcher she has developed molecular diagnostics and studied sero-molecular epedimeology of dengue, hepatitis, CMV, HIV, VZV and antimicrobial and anti-viral effects of traditional herbs. She had been involved in setting up of microbiology, virology, molecular biology and nanotechnology laboratories. She has over 55 indexed and peer reviewed publications and communications; 4 books and 4 chapters. She is a recipient of Presidential Awards for Research and awards for Best Paper at scientific sessions.

From Brain Drain to Brain Circulation

Sirimali Fernando, *Chairperson, National Science Foundation, Colombo07*

In my presentation I shall focus on what is brain drain, the impact of brain drain, the global and Sri Lankan situations and how to make a win-win situation out of it.

Brain Drain is a phrase first coined by the Royal Society, UK in 1963 when the UK was struggling to stem the exodus of its top brains to the USA. The International Labour Organization now defines Brain Drain as "a permanent or long term international emigration of skilled people who have been the subject of considerable educational investment by their own societies". In addressing this issue we need to distinguish skilled workers – with tertiary education or specialized training, such as teachers, nurses *etc.* from highly skilled workers such as researchers and university academics with post graduate qualifications. Obviously, a greater investment, longer time period and more resources are necessary to produce a highly skilled person.

Impact of brain drain is the effect it has on the complex relationship that exists among highly skilled personnel, technological innovations and economic growth. Technological developments have been the basis for economic growth since the industrial revolution. The economic growth became increasingly dependent on science as the means of innovating and organizing technological change. This process over the last five decades has led to the evolution of more

knowledge intensive high end technologies such as electronics, ICT, biotech and nanotech *etc.* This transformation has shifted the world towards a knowledge economy where Intellectual property and capacity play vital roles in global competitiveness of goods and services and wealth creation. In this backdrop, high tech value addition, especially to manufactured exports will enhance a country's competitiveness in the global market and its economic growth. It is the highly skilled personnel that can generate intellectual property and patents in high end technologies which are valued much more than those based on traditional technologies. Hence there is a high demand for them in the global market and it keeps on increasing.

The effect of Brain Drain on Sri Lanka is reflected in the poor contribution of Science, Technology and Innovation to economic growth with only 1.5% of exports from Sri Lanka having high tech value addition (compared to 70% from S. Korea, 56% from Singapore). The Brain Drain has led to a vicious cycle where a lower number of highly skilled personnel are available to train the required more highly skilled people; while Sri Lankan society has to bear the fiscal loss of heavy government investment on providing free education up to tertiary level.

At a global level the unidirectional pull from developed countries for skilled migration affect many developing countries. The US and the EU have clear targets for an educated, workforce development to ensure long-term economic competitiveness through clear migration policies to attract foreign workers in particular for those jobs requiring skilled and highly skilled labour. These industrialized countries offer temporary migration facilities for highly skilled workers, which can be adjusted based on labour market demands to provide more benefits, such as permanent residence and family reunification. The US Highly skilled visa - The H-1B programme (As per the Immigration Act of 1990), EU Blue Card Scheme and skilled migration scheme in Australia are few examples. The High global demand for Scientists and Technologists is reflected by the high proportion of foreign born personnel in the highly skilled workforce in the USA.

The total 1705 skilled workers that emigrated from Sri Lanka during 1971-1974 constituted 18% of the technical and professional personnel in the country at that time when the average for highly skilled migration for Asia was estimated to be around 5%. 60% of the Sri Lankan expatriates engaged in R & D abroad today have PhDs while only 23% of R&D Scientists in Sri Lanka possess a PhD. In our efforts to progress to a knowledge economy the demand for highly skilled workforce will escalate. This necessitates training, attracting and retaining personnel for highly skilled jobs, creation of more jobs for highly skilled personnel in the state and private sectors and competing for highly skilled individuals in the global market with competitive salaries and conducive working and living environments. The declining trend in the number

of R&D personnel in Sri Lanka is a concern. If we are to be at least, on par with the world average we need approximately 18,000 research personnel (i.e 4 times the present number of 4000) to be engaged in research today.

Mobility of highly skilled personnel is an increasing phenomenon with globalization, fueled by technological advancement. Brain Drain if neglected could result in a permanent and irreversible outflow of human capital. However, migration of highly skilled personnel can co-exist with cycles of emigration and return of national talent with enhanced skills as Brain Circulation. Many developing countries have used this for a win-win situation through appropriate policies, mechanisms and schemes

Sri Lanka has begun to engage the STI diaspora in a nation building process, especially through building scientific and technological diaspora networks, introducing schemes to engage the diaspora in STI activities and encouraging high-tech entrepreneurship. This would also encourage collaborative research programmes, assist in development of a highly skilled workforce, building STI capacities and enhancing knowledge and technology transfer systems in Sri Lanka. I hope this global forum will provide a sustainable platform for an effective brain circulation programme in Sri Lanka.

Chairpersons, Panelists and Rapporteurs

for

Breakout-Sessions/Panel Discussions

Food and Water Security

Dr. S.S.B.D.G. Jayawardene
Dr. Jaanaki Goonaratne
Dr. Shanthi Wilson
Dr. Collin Chartres
Prof. Vijaya Jayasena
Prof. Harsha Ratnaweera
Prof. K.B. Palipane
Mr. B.R.L. Fernando

S.S.B.D.G. Jayawardena, BSc Agriculture (Ceylon), MSc Agronomy (Kyoto) (1974-77), PhD Agronomy & Physiology, (Kyoto) (1980- 82), is the Chairman of the Tea Research Board and a member of the Governing Boards of Sri Lanka Tea Board, Tea Small Holdings Development authority, Tea Shakthi. In addition, he is a member of the National Salaries & Cadre Commission of the Government, the National Science Foundation National Committee and the Advisory Committee on Plantation Industry appointed by the Honorable Minister of Plantation Industries. In August 2010 he was appointed as a Director to the Board of Directors of Kegalle PLC. He joined Agricultural Research Centre as a Research Officer in 1968 and was promoted as the Deputy Director (Research) in 1997. Director General of Agriculture, Director, Tea Research Institute, Chairman, Coconut Research Institute, Advisor to the Honorable Minister of Plantation Industries, Advisor to the Honorable Minister of Agriculture, Chairman, National Institute of Plantation Management, Chairman, Tea Research Board in 2006.

In addition to the above, Dr Jayawardena was the FAO Consultant to the Consultative Group in International Agriculture Research on Bio diversity and IICA Consultant to the Government of Ghana on Horticulture Sector Development.

He has over 33 years professional experience covering agricultural research and development activities, human resource development, development of foreign funded projects, direct involvement in food security and poverty, alleviation programs of the country.

He has more than 100 co-authored publications. He has participated in more than 75 International Conferences related to agriculture, development, research management, food security, bio-diversity, environmental etc., in many countries in the world.

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Jaanaki Gooneratne PhD, Senior Deputy Director, leads the Food Technology Section of the Industrial Technology institute. She has 32 years of research experience and has made significant contributions in the field of food, nutrition and processing. Her areas of special interest are on fruits, vegetables and coconut and have made many nutritional formulations for industry. Her innovative work on the formulation of a natural lime fruit based isotonic drink won a National Award in 2010 for the best local technology introduced to the industry. She also has a number of publications in the field of nutrition and serves on many national level committees.

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Shanthi Wilson BSc Microbiology (University of London), PhD in Plant Pathology and Post Harvest Biology, (Cambridge), joined the CISIR (present ITI) in September 1983 and in 1992 was instrumental in establishing the first post harvest laboratory for perishable commodities in Sri Lanka. Dr Wilson's research is based on industry needs including post harvest loss assessment studies, development of maturity indices, and the protocols for export of fresh produce. Her team identified the cause and developed remedial measures for low temperature induced internal browning in pineapples.

Her current research interests focus on biological methods for minimizing loss and include the application of new tools emerging in the areas of molecular biology and nano-technology.

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Colin Chartres has a PhD on soil development from the University of Reading (UK). He is currently the Director General of the International Water Management Institute (IWMI). IWMI's vision is *Water for a Food Secure World* and involves solving water scarcity via increasing water productivity, reducing poverty and sustainable natural resource management. He has played a leading role in alerting the world to an emerging water crisis that will impact all water users and food security in many developing countries. Prior to joining IWMI in 2007, he was Chief Science Advisor to Australia's National Water Commission. There, his role included developing a national water information system, creating a national groundwater action plan and using scientific evidence to inform water policy options. Previously he held senior research and research management positions with CSIRO, the Bureau of Rural Science and Geoscience Australia and has also worked in academia and the private sector. He has published over 100 journal articles, technical papers and book chapters on natural resources management and is the senior co-author of the recently the book "Out of Water." published in 2010.

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Harsha Ratnaweera is a Professor in Environmental Engineering at the University of Life Sciences, Norway. He pioneered the Norwegian Institute for Water Research (NIVA)'s innovation activities and commercialization of R&D while also serving as the Director of International Projects during his 20 years carrier there. He has a PhD from the Norwegian University of Science and Technology (1992) and specializes in water resources management and water & wastewater engineering. He has worked in many countries and initiated 4 collaboration projects in Sri Lanka with Norwegian funds. He is a member of the Norwegian National Commission for UNESCO and headed it's Natural Science Committee.

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Vijay Jayasena obtained his PhD at Kansas University in the USA and currently employed at Curtin University in Australia. Main research focus is the development of novel healthy foods to address major global food related issues of hunger and malnutrition as well as obesity, diabetes cardiovascular diseases with special focus on food security. Most of the projects are conducted in collaborations with academic/research organizations in Indonesia, Thailand, India, Malaysia and the USA. More than Aus $2 million worth projects have been conducted during the last 5 years. He holds 2 international patents. Some of the research findings have been commercialized.

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Mr. Bimmy Dhanapala
Dr. Lareef Zubair
Prof. S.B. Tennakoon
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During his 40 year career at the University of Peradeniya, he held positions of Head of Department of Botany (4 times) and Dean, Faculty of Science. His research areas are: i) biological nitrogen fixation and biofertilizers; toxin producing cyanobacteria; and biofuels from Jatropha, cellulosic biomass and cyanobacteria.

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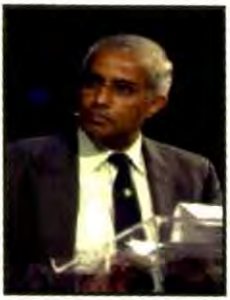
Bimmy Dhanapala, is a results-oriented serial entrepreneur successful in multiple business ventures in the US for the past 15 years. He is the co-founder of Ecothinc a recently established company focused in promoting green products & technology globally. He is actively involved in the US green movement for the past decade and is looking to expand into Sri-Lanka. He held several senior executive positions in various companies where he obtained his business and investment experience. He attended Trinity College Sri-Lanka and obtained his Certification in Mortgage Investing, (CMI) at the Open University in Florida. He currently lives in Los Angeles with his wife.

(Photograph not available)



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He has made many presentations in international forums and has many publications to his credit. He is a member of the international group of CP experts. He is a qualified energy Consultant and an EMS auditor. He is a corporate member of many national & international professional institutes.

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Nanditha Hettiarachchi BSc (Moratuwa), M.Eng, D.Eng (Kobe University) **Research area:** ***"Vibration assisted machining of hard to cut materials"*** Initially, a device that can be attached to a milling machine and perform "Circular vibration milling" was designed and developed during my studies. The milling device is used to vibrate a cutting tool along a circular locus, in addition to conventional tool rotation motion. By using the attachment, it was proven that the finished surface quality of hard to machine materials such as hardened steel and Inconel 718 could be improved and tool wear could be reduced. Then a ***"Circular vibration planning attachment"*** was designed, fabricated and tested. Both attachments were made with collaboration of *Mori Seiki Co. Ltd,* A leading machine tool maker in Japan.

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Kapila Jayasinghe graduated in 1984 from University of Moratuwa and joined the same university as an assistant lecturer in 1984. He obtained his masters degree and PhD. in 1986 and 1991. At preset he holds the post of Senior Professor of Electronic and Telecommunication Engineering at University of Moratuwa.

(Photograph not available)

Shantha Prasanna Jayasinghe Obtained 2nd Class Honours in BSc Engineerig in the field of Mechanical Engineering From University of Moratuwa. He is involved in using software for design and manufacturing development. Completed post graduate training on " **Mechatronics & Its Applications"** in Hyderabad. Currently he is the Technical director in the Department of Design, Fabrication and Consultancy to Industry at National Engineering research and Development Centre of Sri Lanka (NERDC). He is also managing the Mechatronic s laboratory at the NERD center.

(Photograph not available)

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Karnika De Silva is working as an Industrial Materials Specialist at Materials Accelerator (MA), University of Auckland, NZ. The vision of MA program is to grow NZ high tech export companies by providing a one-stop shop called multi materials innovations. Karnika holds a PhD from University of Aston, UK and has worked in many countries on various R/D projects. Before migrating in 2001, she worked at RRISL as DDR(Technology) and won a merit award for her contribution to manufacturing Industry. She has also opened up opportunities and provided consultancies to SL industrialists to supply value added products to NZ/Australian markets.

Natural Resources

Prof. Tuley De Silva
Dr A L Jayewardene
Prof. Ruchira Cumaranatunge
Dr Nimal Chandrasena
Dr Nimal Gamage
Prof Gomika Udugamsooriya
Dr N Ishwaran
Prof L M V Tilekaratne
Dr Radhika Samarasinghe
Prof E D De Silva
Prof. Ajith Abeyasekera

Tuley De Silva Visiting Professor, University of Sri Jayewardenepura, Guest Professor, Pharmaceutical University of Shenyang, China Director/ R&D Consultant, Link Natural Products Ltd.Member, Board of Management of the National Science Foundation Fellow of the National Academy of Sciences of Sri Lanka (Former Professor of Chemistry and Dean of the Faculty of Applied Science, University of Sri Jayewardenepura), Retired Special Technical Adviser, Chemical Industries Branch, UNIDO,Vienna, Former Co-Coordinator of Subprogramme on Medicinal and Aromatic Plants of the International Centre for Science and Technology in Trieste, Italy, .Visiting Professor & Senior Research Fellow, Department of Chemistry, University of Maryland, USA,Former Director, Bandaranaike Memorial Ayurveda Research Institute of Sri Lanka Pioneered research on ayurvedic drugs specifically formulation and standardization. Managed projects on medicinal and aromatic plants and healthcare products in developing countries, Collaborated in Research on medicinal and aromatic plants with the University of Utrecht, Netherlands and Postgraduate Research Institute, University of Karachchi, Pakistan. Pioneered research on ayurvedic drugs specifically formulation and standardization. Managed projects on medicinal and aromatic plants and healthcare products in developing countries, Collaborated in Research on medicinal and aromatic plants with the University of Utrecht, Netherlands and Postgraduate Research Institute, University of Karachchi, Pakistan

Nimal Gamage graduated in 1980 from the University of Moratuwa Sri Lanka and obtained an MS and PhD from Oregon State University USA. He served on the Faculty at Oregon State University and the University of Colorado Boulder and was a Scientist at the US National Center for Atmospheric Research, focusing on Computational fluid dynamics and distributed data collection. Making a switch from Academia to industry he joined Agilent Technologies, working on Software and hardware based solutions for Network Quality Assurance and Management. He holds patents in Wireless Quality of Service methods that have been deployed at many telecom service providers. He was the Chief Architect for the Communications Solution Division. Subsequently Nimal worked at Integware as the Chief Architect and Product development lead, developing product life cycle management solutions for the Pharma, Nutraceutical and Medical device industries. Currently he serves as a Senior Architect at Computer Associates/Nimsoft developing cloud and SaaS based Quality Assurance solutions for the enterprise market.

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Nimal Chandrasena, BSc, PhD is a Theme Leader and a Principal Consultant/Ecologist, specializing in the management of watershed catchments and waterways, invasive species and vegetation. He has played major planning roles in Australia developing Plans of Management for various natural assets, and has led many muti-disciplinary R&D projects on improving catchments through rehabilitation of damaged ecosystems and through revegetation. In 2003, he won the prestigious *NSW Premier's Award* for Environmental Rehabilitation. In 1990 He was awarded an international award for the 'Most Outstanding Young Biologist(Sri Lanka)'

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Gomika Udugamasooriya BSc (Colombo), PhD (Wayne State University) has been involved in natural products as well as structure based and high throughput combinatorial approaches in drug discovery over 15 years. His current research is focused on developing drug leads for both diagnostic and therapeutic applications in cancer.

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L.M.V. Tilekaratne BSc (Colombo), DPhil (Oxford) is interested in the study of small molecule probes of both synthetic and natural origin to study protein function as a basis for drug design and drug discovery. This involves synthesis of biologically active natural products and their analogues, structural optimization of natural products for improving pharmacological properties, and isolation and characterization of biologically active natural products.
They are also interested in the synthesis of redox-active molecular probes to be used as electrocatalysts in sensors to detect thiols and neurotoxins electrochemically.
'Scratching the surface for Drugs'
Traditionally terrestrial plants have been the major source of natural products for development as drug candidates. However many important drug candidates have been isolated from microorganisms. Two recent examples are epothilones, important microtubule stabilizing anticancer agents, originally isolated from cellulose degrading soil bacterium and the selective histone deacetylase inhibitor largazole isolated from marine cyanobacterium living on coral reefs.

(Photograph not available)

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E.D.De Silva BSc (Colombo), PhD (Hawaii), is the Senior Professor / Chair in Organic Chemistry, University of Colombo, Sri Lanka. His main research interests are centered on the isolation and structure elucidation of biologically active metabolites from marine invertebrates, terrestrial plants and endophytic fungi and marine chemical ecology. He has over 40 publications in reputed international scientific journals. He is the recipient of number of awards for his scientific achievement that include Presidential Awards for scientific research Awarded by the president of Sri Lanka, General Research Committee Award of the Sri Lanka Association for the Advancement of Science and Natural Resources Energy and Science Authority of Sri Lanka Merit Award for "Chemical Investigation of Sri Lanka Soft Corals. He was also awarded the prestigious inaugural P.P.G.L. Siriwardene Gold Medal for his contributions in marine natural products research by the Institute of Chemistry Ceylon.

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Palawinnege Ruchira Tharangini Cumaranatunga obtained BSc in Zoology from the University of Sri Lanka, Vidyalankara Campus in 1977 and PhD in Fish Reproductive Biology from University of Aston in Birmingham, U.K. She is a Senior Professor & Chair Professor of Fisheries Biology, Dept. of Fisheries & Aquaculture, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna. She has been the Founder Dean, Faculty of Fisheries and Marine Sciences & Technology (2005 to 2008) and Head, Department of Fisheries Biology. She was instrumental in the preparation of the Syllabus for Fisheries Biology for BSc General & Special Degrees in the Faculty of Science, University of Ruhuna (1990 to 2005). Prof. Cumaranatunga was awarded the Commonwealth Academic Staff Scholarship to U.K. (1982), Commonwealth Academic Exchange Scholarship (1991) tenable in Singapore and Malaysia and Fulbright Senior Research Scholarship (1996). She is also the recipient of Ruhuna University Vice-chancellor's Award for highest grant recipient (1984 & 1987) and Zonta women of Achievement for Education (2006). She was Section D - President (2003), Vice-president (2002), Secretary (2000) Committee member (1998 to 2004) and Governing Council Member (2003, 2004, 2006, 2007, 2010, 2011) of SLAAS.

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Radhika Samarasekera BSc (Colombo), PhD (IACR-UK). Dr Samarasekara's Research expertise includes; plant, microbial and marine natural products and biotechnology, organic synthesis, bio-pesticides, bio-assay techniques, formulation, standardization and quality assurance of consumer care products and essential oils and spices. Currently she is involved in R&D on microbial-based pesticides to develop biological agents for control of mosquitoes and agriculture pests. Recently her group is instrumental in the commercialization of *Bacillus thuringiensis israelensis* (*Bti*) technology for mosquito control specially dengue control in Sri Lanka developed through extensive multidisciplinary R&D and matching investment initiatives with private sector.
She has published 95 research articles.

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Lakshman Jayawardene BSc (Peradeniya), PhD (Sri Jayawardanapura) worked as a research scientist first at the Ceylon Institute of Scientific and Industrial Research (CISIR) in natural products and agro industries for 21 years and emigrated to USA in 1989. At the University of California, San Francisco campus he was a researcher in clinical pharmacy, performing drug analysis in human specimens using LC-MS-MS methods. Retired after after 20 years and was invited to join Link Natural as a consultant.

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Natarajan Ishwaran, BSc (Zoology) and MSc (Ecology) from the University of Peradeniya, Sri Lanka; and Ph.D. (Wildlife Biology and Management) from Michigan State University, USA. 30 years of experience in teaching, research and international co-operation in wildlife conservation and protected areas planning and management. Staff of UNESCO since 1986, working for the World Heritage Convention as well as ecological sciences focused programmes such as the Man and the Biosphere (MAB) based in Paris as well as in UNESCO, Jakarta, Indonesia (1993-1996). Work experience and achievements in negotiating technical and financial benefits, particularly for less developed countries, for biodiversity conservation, protected area management, sustainable development and related global agendas. He is presently the Director, Division of Ecological and Earth Sciences, UNESCO, Paris.

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Ajith M. Abeysekera, BSc. (Colombo), PhD (Belfast) joined the University of Sri Jayewardenepura in 1979 as a lecturer in chemistry. Appointed Professor of chemistry in 1992, and Senior Professor in 2002. Dean of the Faculty of Applied Science from 2005 to 2010. Director of the Bandarnaike Memorial Ayurveda Research Institue from 2003 to 2005. Post Doctoral fellow from 1978-1979 and 1985-1986.The Queen's University of Belfast,(synthetic and electro organic chemistry). 1981-1982.University of Utrecht, (Immunomodulation by ayurvedic medicinal plants). Fellow of the National Academy of Sciences of Sri Lanka Fellow of the Institute of Chemistry, Sri Lanka, Member of the Sri Lanka Association for the Advancement of Science Sri Lanka Association For the Advancement of Science award 1996, for outstanding contribution to Sri Lankan Science. His research interests are on Chemistry, bio-activity and standardization of ayurvedic drugs. Synthetic and physical organic chemistry. Over 75 publications and communications. CURRENT POSITION : On sabbatical leave from the university, working as a consultant to LINK NATURAL PRODUCTS, a herbal products manufacturing company.

(Photograph not available)

Benktesh D. Sharma Benktesh is a forest management professional with over 8 years experience in modeling and simulation of forest growth and yield, forest carbon inventory and analysis, forest harvesting, terrestrial carbon sequestration, forest management models, and process optimization. He also has expertise in the field of community based carbon forest management in developing countries from South Asia. His primarily areas of interests and expertise include forest growth and yield modeling, biomass utilization, forest operations, spatial analysis, carbon sequestrations, climate change and computer simulations. He uses advanced computing technologies of GIS, Remote Sensing and programming in related fields. He also has experience in teaching several core forestry courses both in US and in Nepal and experience in training human resources in the field of forestry and computer applications in natural resources to professionals and industry people.

He has given several different presentations on forest growth and yields, carbon sequestration and forest management to scientific communities, local institutions, and other stakeholders. He has conducted field work on forest inventory, carbon analysis and growth and yield prediction in several countries including US, Nepal, and India. He has worked in program planning, monitoring and evaluation, grant proposal writing of natural resources and worked with community based forest institutions. Benktesh has extensive experience using several of forest based models (FVS, PnET, BIOME, CO2FIX).

He has published over 10 papers in related fields in scientific journals, co-authored book chapters, presented in several of scientific meetings, and worked in developing computer systems, primarily in the field of forestry. Benktesh completed his B.Sc. majoring in Forestry in 2001, Master in Tropical Forestry with specialization in Silviculture and Forest Ecology in 2003 from Wageningen University and Research Center, Netherlands and is currently a Ph.D. candidate in Forest Resource Science at West Virginia University. His doctoral research works relates to modeling of forest harvesting and terrestrial carbon sequestration.

Nanotechnology and nanomaterials

Prof. Ravi Silva
Dr. Rohini de Silva
Dr. Shehan de Silva
Prof. Viranja Karunaratne
Prof. Ajith de Alwis
Dr. Challar Kumar
Prof. Yoon-Bong Hahn
Prof. Li-Chyong Chen
Dr. Upul Ratnayake
Dr. Nilwala Kottegoda

Challa S.S.R. Kumar is the President and CEO of Magnano Technologies and has seven years of industrial R&D experience working for Imperial Chemical Industries and United Breweries. He is currently the Editor-in-Chief of the journal-Nanotechnology Reviews. His main research interests are geared toward development of novel synthetic methods, including those based on microfluidic reactors, for synthesis of multifunctional nanomaterials for energy and biomedical applications. He is the winner of the 2006 Nano 50 Technology Award for his work in magnetic-based nanoparticles for cancer imaging and treatment. He has edited over 30 books and published close to 60 peer reviewed journal articles.

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Li-Chyong Chen is a Distinguished Research Fellow in the Center for Condensed Matter Sciences (CCMS) at National Taiwan University (NTU). She received her B. S. in Physics from NTU (1981), Ph D in Applied Physics from Harvard University (1989), and an honorary doctoral degree from Linkoping University, Sweden (2007). Prior to her current position, Dr. Chen had worked at General Electric Corporate Research and Development, Schenectady, NY (1989-1994). Over the last decade, her group at CCMS has established a strong program on low-dimensional nanomaterials and related hybrids, in particular, those formed by various vapor phase deposition techniques. She is also specialized in integrated micro-devices for optical, electrical, energy and sensing applications. Dr. Chen owns 9 patents and has written 8 book chapters and published over 270 papers in internationally referred journals, including *Nature Material* and *Nature Nanotechnology*. Her *Nature Material* 2006 paper has been selected as a Fast Breaking Paper and 6 other papers have also been listed as highly-cited papers by ISI. Dr. Chen has organized a number of professional meetings, among which the most significant one is her appointment as one of the four Meeting Chairs for the Materials Research Society (MRS) 2009 Fall Meeting, held in Boston. She has served on the Editorial Advisory Board of a few journals, including the *Critical Reviews in Solid State and Materials Sciences*, Taylor and Francis since 2004, and was also an Associate Editor for the *J. of Vac. Sci. and Tech. B-Microelectronics and Nanostructures* (2004-2006). Dr. Chen has received a number of domestic and international awards and honors, including the prestigious Outstanding Scholar Foundation Award (2011), a Laureate of the 22nd Khwarizmi International Award, Iran in 2009 and was elected as a Fellow of the MRS, USA in 2010.

Veranja Karunaratne is a Professor in Chemistry at the University of Peradeniya and the Science Team Leader at the Sri Lanka Institute of Nanotechnology. He has carried out research in synthetic organic chemistry, biologically relevant natural products from plants and lichens, lichen taxonomy, chemical ecology, nanotechnology, nanomaterials & nanocomposities. He has published over 100 papers in peer reviewed journals and presented over 145 abstracts at local and international conferences. In addition he has been an inventor of 16 patents or patent applications. He is a Fellow of the National Academy of Sciences, Sri Lanka & a Fellow of the Royal Society of Chemistry.

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Ajith de Alwis B.Sc. (Moratuwa), Ph.D (Cambridge), MBA focuses upon research areas that include 'Triple Bottom Line approach for the Process Industry', Bioenergy systems, Industrial Biotechnology, Integrated Solid Waste Management, Food Processing Systems. He completed his Ph.D. at the University of Cambridge, UK following his B.Sc. (Eng) degree at the University of Moratuwa, Sri Lanka. He also has a MBA from Postgraduate Institute of Management, University of Sri Jayewardenepura, Sri Lanka. A Professor at the Department of Chemical and Process Engineering at the University of Moratuwa, he is also the Director of the UOM-Cargills Food Process Development Incubator. Prof. de Alwis is a member of Cambridge Philosophical and Commonwealth Societies, the American Institute of Chemical Engineers (MAIChE), the Editorial Board of the European Journal of Food & Bioproducts and the Lanka Biogas Association – of which he is the founding President. He was a Post doctoral research fellow at University of Reading and a Visiting Scientist at the Indian Institute of Science in Bangalore. Serves in many national committees including the CEA's committee on Implementation of Basel Convention. Also served as a Science Team Leader at Sri Lanka Institute of Nanotechnology (2009-11) and is the project team leader on establishing a regulatory framework for Nanotechnology in Sri Lanka and IDRC Project covering India, Paksitan and Sri Lanka.

Shehan de Silva, BEng(Hons), PhD(Surrey), MIETis a scientist and an entrepreneur completed his degree in electronics and communications at the University of Surrey, which was followed by a PhD in Nanotechnology at the same institution. Research activities have been in the areas of wireless bio-sensors based on vertically aligned MWCNT, functionalized for improved Transduction and SNR. Funded by the EPSRC (UK), this work has complemented his extensive work in the areas of Carbon Nanotube growth using thermal and Plasma enhanced CVD methods. Complementary expertise in the growth (CVD, DC/RF Sputtering), characterization (AFM,ESEM,XRD,EDX,UV-VIS-NIR,FTIR) and Focus Ion Beam, nano imprint patterning of materials at the nanoscale for Surface Acoustic Wave applications has enabled the fusion of MWCNT based bio-sensors to be interrogated wirelessly using RF backscatter energy scavenging. Prior work in RF, Microwave communications and embedded systems have resulted in a framework for a full repertoire of bio potential monitoring from passive to active Body Area/Sensor Networks. He has been a founding partner of a number of technology companies, and believes in value addition and process streamlining through use of relevant technologies.

Nilwala Kottegoda BSc (Peradeniya), PhD (Cambridge)

is currently involved in research activities spaning a range of areas and techniques including top down and bottom up nanomaterial synthetic approaches. Her current research interests are directed towards nanotechnology for agricultural applications, synthesis and characterization of magnetic nanoparticles and their applications, isolation and stabilization of commercially important natural products using nanomaterials, use of nanomaterials to improve and introduce new properties to latex based products, layered material polymer composites, synthesis of nanomaterials using natural resources. One of the main current research projects on slow release green fertilizer system based on nanomaterials received the National Science and Technology Award 2010 for the best innovation with commercial potential.

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Upul N. Ratnayake, BSc (Sri Jayawardenapura), PhD (Loughbrough-UK) after graduation joined the Rubber Research Institute (RRI) as a Research Officer in 1995 and obtained his PhD fromnLoughborough University, UK in the field of polymeric nanocomposites based on layered silicates. Currently he is a Senior Research Scientist at RRI and also seves as a Senior Scientist at SLINTEC.

He has authored/co-authored about 25 research publications. His main research interests are structure-property relationship and processing of polymeric nanocomposites based on different nanomaterials. Special attention is to develop functional elastomeric nanocomposite materials for different applications.

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Rohini M. de Silva is a Senior Lecturer in the field of Organometallic Chemistry and Nanotechnology in the University of Colombo, Sri Lanka. She obtained her BSc (Chemistry) with First Class Honours from University of Colombo, Sri Lanka. She received the Cambridge Commonwealth Trust (CCT) award and the Overseas Research Student (ORS) award to pursue her postgraduate studies at the University of Cambridge, England, and obtained her PhD in Organometallic Chemistry. Dr. de Silva received a fellowship from the Center for Advanced Microstructures and Devices (CAMD) of the Louisiana State University, USA to work on nanomaterials and nanotechnology.

Biotechnology

Prof. Rohan Jayasekera
Prof. Vajira Dissanayake
Dr. Anila Jayasekera
Prof. Preethi Gunaratne
Prof. Gemunu Gunaratne
Prof. Amitha Wickrema
Dr. Aravinda de Silva
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Rohan W Jayasekara MBBS, PhD, C.Biol, MSB (London) is the Senior Professor of Anatomy, Director of the Human Genetics Unit, and Dean of the Faculty of Medicine, University of Colombo. He is a Medical Geneticist by training. He pioneered the introduction of cytogenetics to Sri Lanka by establishing the Human Genetics Unit, Faculty of Medicine, University of Colombo in 1983. The Unit today is the leading centre for Medical Genetics in Sri Lanka engaging in undergraduate and postgraduate teaching, research, and providing genetic counseling and diagnostic services. Prof. Jayasekara was the chairperson of a committee appointed by the National Science and Technology Commission that drafted a National Policy on New Genetic and Assisted Reproductive Technologies in Sri Lanka. He has served in several national committees appointed by the National Science Foundation and the Sri Lanka Medical Council working on policy related issues in the field of bioethics.

Nimal Dissanayake B Sc (Agriculture), M.Sc (Plant Pathology), Ph D (Plant Health). Has 32 years of experience in rice research: Rice variety improvement, Plant protection, Fertilizer use efficiency, water use efficiency, stressed soil conditions and generation of cost reducing technologies. He is also the Sri Lanka representative for International Rice Research Institute, Philippines and collaborator in Global Rice Science Partnership (GRiSP)

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Amitha Wickrema Ph.D. currently directs the clinical cell manipulation and manufacturing facilities at the University of Chicago Hospital. These facilities prepare blood, bone marrow and cord blood stem cells as well as other types of cells for the treatment of patients with various malignancies and metabolic diseases ranging from leukemia to diabetes. In addition his nationally funded research program conducts research focused on normal and malignant hematopoiesis. His research group has developed a unique primary human blood cellular model for studying causes of anemia and early diagnosis of myelodysplastic syndromes, which mostly affects the elderly. He also directs a course on "Stem Cells & Medicine" at the Pritzker School of Medicine at the University of Chicago.

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Vajira H. W. Dissanayake MBBS, (Colombo), PhD (Nottingham) leads a research group in the University of Colombo focusing on genetics of reproductive disorders, especially pre-eclampsia, fetal growth restriction, and recurrent pregnancy loss. Prof. Dissanayeka coordinates MSc courses in Biomedical Informatics, Clinical Genetics, and Genetic Diagnostics in the University of Colombo and is a member of the Steering Committee of the Forum for Ethics Review Committees in Asia and the Western Pacific; President of the Health Informatics Society of Sri Lanka and President-elect of the Sri Lanka Medical Association. He was the principal investigator in the team that sequenced the first Sri Lankan Personal Genome.

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Aravinda de Silva, MPH, PhD completed the PhD in Cell Biology/ Virology at the Yale School of Medicine in the USA in 1992. Subsequently he did postdoctoral work in New York and Connecticut before joining the faculty at the University of North Carolina School Of Medicine in 1998. He is interested in arthropod vector-borne infectious diseases and my group currently works on Lyme disease and dengue fever. Their studies range from basic laboratory studies on microbial pathogenesis to more applied studies on vaccines and diagnostics. He is particularly interested in using science to build partnerships and to enhance research capacity in Sri Lanka. He has been collaborating with Sri Lankan colleagues at Genetech Research Institute and the Ministry of Health for more than 10 years.

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Anil Jayasekara BSc (Colombo), MSc Plant Physiology, (Calgary), PhD Plant Molecular Biology, (Calgary), 1993 has a research group involved in development of Transgenic Crops from local crop species and DNA marker assisted breeding for improvement of rice. He is also the Chairman of the National Committee on Biotechnology at the National Science Foundation.

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Preethi Gunaratne BSc (Colombo), PhD (Cornell) is a leading expert on genomics and transcriptomics who holds dual appointments on the faculties of the Department of Biology & Biochemistry at the University of Houston and the Department of Pathology, Human Genome Sequencing Center and Dan Duncan Cancer Center at the Baylor College of Medicine. As a member of the NHGRI-International Human Genome Project Consortium Dr. Gunaratne made the largest single contribution of cDNA sequences to the NCI-Mammalian Gene Collection in its' first phase. Dr. Gunaratne is now one of the leaders of NCI-The Cancer Genome Atlas Project microRNA analysis group for ovarian, colorectal and kidney cancers. The long-term goal of Dr. Gunaratne's research is to develop one of the first comprehensive functional genomics platforms for rapidly customizing therapeutic strategies to suit individual genomes. In collaboration with scientists at the Baylor College of Medicine Dr. Gunaratne's group has identified key microRNAs to be used as biomarkers and therapeutic agents for common reproductive diseases with enormous socioeconomic impact, such as ovarian, uterine, cervical cancer and endometriosis. Dr. Gunaratne's group has also developed novel gold nanoparticle conjugates and used these reagents to develop a unique collection of tumor suppressor microRNAs and genes for multiple cancers including ovarian cancer, neuroblastoma and multiple myeloma.

Prof. Preethie Gunaratne
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Gemunu Gunaratne BSc (Colombo), PhD (Cornell) is a Professor and the Associate Chairman of the Department of Physics at the University of Houston. He received his doctorate in Mathematical Physics from Cornell University and conducted postdoctoral studies at the University of Chicago before joining the University of Houston. His research interests include chaotic motions, pattern formation, quantitative finance, nanostructures, networks, and bioinformatics. One of his major current interests is genomic biomarkers for subtypes of cancer within a specific tissue. The work uses statistical invariants as well as recently developed mathematical techniques.

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Information and Communication Technology

Prof. Gihan Dias
Dr. Ruwan Weerasinghe
Dr. Sanath Panawennage
Prof. Athula Ginige
Prof. Suran Gunatileke
Prof. Lalith Gamage
Mr. T.R. de Silva

Gihan Dias PhD (UCD) MSc (UCSB) BSc Eng.(Hons) (Moratuwa). Prof. Dias graduated from the University of Moratuwa in 1985. He was awarded a doctorate in Electrical Engineering and Computer Science from the University of California in 1992. In addition to being a Professor in the Dept. of Computer Science and Engineering, University of Moratuwa, he serves as the Domain Registrar and CEO of the LK Domain Registry. He has led the Internationalised Domain Names (IDN) task force in Sri Lanka, and is a member of the IETF IDNA working croup and the Unicode Consortium. He was a pioneer in the introduction of networking in this country, and was the Manager of the Lanka Education and Research Network - LEARN from 1995 to 2003. In 2003/04 he was a founder Programme Director of the Information and Communication Technology Agency of Sri Lanka (ICTA). He is currently the Director of the Centre on Localised Applications at the University of Moratuwa. He has assisted many public and private organisations to build and secure their networks, and is the advisor to TechCERT, the first and leading computer security readiness team in the country.

Chitranganie Mubarak holds a second class (upper) in Chemistry from the University of Colombo. With over 20 years' experience in formulating and implementing national Programmes for export development and promotion, Chitranganie has spear-headed several key export oriented initiatives besides coordinating several donor-funded programmes of the EDB. As Director / TradenetSL, the e- commerce arm of the Sri Lanka Export Development, Chitranganie was responsible for introducing several ICT solutions for facilitating the rural entrepreneur and has played a key role in launching the country's pioneering on-line trading platform.

Athula Ginige B.Sc. (U of Moratuwa), Ph.D (U of Cambridge) has expertise in computer vision, multimedia information systems, Web Engineering, eTransformation, and design of software applications that can evolve with changing requirements. He has widely published his research work in these areas. Currently he is working on an International Collaborative research project to develop next generation Social Networks known as Social Life Networks. These are mobile based information systems for people in the middle of the pyramid. Many of his designs have been adapted by enterprises.

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