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We are happy to share this second issue of our Faculty Research Bulletin with you after the successful launch of the first issue in August 2013. It includes the latest news on the research projects, awards, publications, etc.

The importance of research in university rankings has become a central focus of the global higher education sector. The Faculty will continue to improve the quality of the research being done-this will be subject to the amount of funding it can mobilize- to improve its performance so as to reach “world class university” standards. However, in the process, the Faculty will not forget its mission of contributing to sustainable development of the country and of inculcating the responsibilities of global citizenship in our students and faculty.

A special thanks to the editorial team under the leadership of Associate Professor S. Venkannah for their commitment to publish this second issue.

Please take a few moments to review the research work being accomplished in the Faculty as reflected in the bulletin.

Happy Reading.

Prof T Ramjeawon
Dean, Faculty of Engineering
Following the success of the first issue (Jul/Aug 2013) of the Research Bulletin, the Faculty Research Advisory Committee was highly motivated to bring the second issue to you with up to date information on the research and consultancy conducted at the Faculty. The Research Bulletin is the link between the Faculty of Engineering and the stakeholders and the objective of this bulletin is to further develop the relationship for the betterment of the Mauritian industry and society.

The Faculty of Engineering is one of the largest Faculties at the University of Mauritius with six major Departments. Researchers at the Faculty have shown a real interest in publicizing their works but unfortunately the committee had some constraints and had to make a choice to meet the number of pages allocated to this issue as well as to maintain a balance between the different topics to be included. Feedbacks on the previous issue were requested and we have tried to take on board most of the views and hope that this issue meets your expectations.

The articles included in this issue have been selected by the editorial committee according to their importance to the local community. This Bulletin also includes a list of main research themes from each Department as well as a list of ongoing M.Phil./PhD research.

Research is dependent on funding and equipment which may hinder the progress of the study. The interaction between different stakeholders is primordial for research relevant to the local context. The Faculty wishes to thank funding agencies for their help and support. Companies and other institutions are welcome to collaborate on any idea that may enhance the research culture at the UoM. Research can also be started as undergraduate or postgraduate projects and companies may provide us with the relevant case studies which can be further studied.

This end-product would not have been possible without the unfaltering collaboration and support of all members of the team.

Given that the “only constant is change” (Heraclitus/Isaac Asimov), the committee is open to comments and views. You are most welcome to contact us for views and comments that will help us in making the next issue better.

The Editorial team wishes you a happy reading until issue 3 which is due in Aug/Sep 2014.
The Oil Crisis of 1973 triggered, particularly in the United States and Canada, energy conservation and energy saving programmes that were unknown before. And never to be matched thereafter. Energy efficiency, that is, getting more output with same energy input, spread along since then with world-wide technological evolution. If the USA were to have today the same level of energy efficiency as forty years ago, they would need 50% more energy. However, the Jevons Paradox, which dates as far back as 1865, has been evoked to support the view that energy efficiency does not per se lead to reduced consumption in absolute terms.

Financial benefits and environmental protection are the main drivers of energy efficiency campaigns today. But energy behaviours are complex, profoundly marked by lifestyles, background, income and education. Not to mention political and administrative obstacles. There is a mythical gap between the potential of energy saving and its actual materialisation, an ‘Energy Efficiency’ paradox.

In the same year as the Oil Crisis, Schumacher and Illich reminded us of the need of considering the limits of development. About the same time, Morin pointed out that the term ‘development’ in Social Science is contrary to its biological meaning where growth is genetically predetermined. He questioned the foundations of our very concept of ‘development’ relating it to a ‘cultural/civilizational crisis’ founded on the paradigm of Western humanism which denies all uncertainties, resting on the assumption that economic and technological development implies progress and prosperity for all.

It is right to question whether energy consumption should be increasing or decreasing in absolute terms. The positive correlation between economic growth and energy consumption has been evoked as a reason in favour of more consumption. However, the picture is complex depending on the energy supply mix, energy conversion and distribution as well as on the end-users including the needs and life-style of consumers. In the case of developing countries and emerging economies, the coupling between economic growth and energy consumption is stronger compared to the case of the USA or the EU, for example. However, it is a fact that monsoon rains in India or droughts in China, climate-prone events, may have more influence on average rural income than does national economic growth itself.

Another fundamental question relates to the policy importance given to Demand-Side Management (DSM). If we set as an ethical principle a limit to energy consumption in order to achieve Sustainability, it implies that energy demand at user/consumer end is to be controlled to meet a given energy supply mix, and not vice-versa. It can also be remarked that Energy Management (including DSM) represents a ‘no-regret’ tool, that is, the effort is worthwhile even if there is no such thing as climate change. This characteristic stems from a focus on ‘broader rational’, value-based ethics rather than on ‘market-driven’ economics and ‘false infinity and false sovereignty’ certitudes about the availability of resources.

‘Sustainability’ needs to be defined differentiating it from the possibly controversial concept of ‘Sustainable Development’ by referring to an explicit ethical dimension. The definition of ‘Sustainable Development’ from the Brundtland Report of 1987 continues to serve as an authoritative reference with a predominance of economic growth as the parameter for measuring development. It may be questioned whether the definition still holds if its reference to future generations becomes irrelevant. Also, for development to be ‘sustainable’, does it suffice, for
The Future of Energy Research in Mauritius: Where Should the National Priority Be?

example, to have recourse to new sources of energy or to apply pollution control to eliminate unwanted effects on the environment? Does a coal-fired power plant, for instance, become sustainable if there is no such thing as climate change? There is no ethical limit within the Brundtland definition nor is there the recognition of a limit to our systems. The ‘needs’ of current and future generations is also an ambiguous word used in the Brundtland Report.

Einstein, as far back as 1947, blamed the tragic fate of the scientist, turned into a ‘homo-oeconomicus’ whose investigations are recuperated by the ‘morally blind’ political power which is itself living in a world of ‘phenomenal economic concentration’. Even Marshall, the father of Neo-Classical Economics, as early as 1898, perceives that ‘ecological limits would again become important’. Energy-related research in Mauritius, and more largely in the region and in SIDS, should take into account uncertainties related to energy issues, the ethical imperative of Sustainability, and the need for recognizing development as meaning more than just economic growth. Such a vision may not interest short-sighted decision-makers, whether in academia, politics or business. But it is crucial to shift to a different paradigm if we want to have a sustainable future. We should not re-invent the wheel, but adapting and transforming into our context innovations from elsewhere should not be neglected. Above-all, we can learn from our mistakes and from those of others, leapfrog when needed and dare to address priorities of pertinence to our common good, not just profit-making commercial ventures. Here are some of the possible new opportunities for research in the energy sector:

- Climate change impacts in terms of temperature, cyclones, sea-level rise and flash floods pose a formidable challenge for buildings in small-island economies like Mauritius. Urban heat-island effect, reduced green cover and increasing dependency on fossil fuels for powering air-conditioning, in spite of the availability of local renewable energy sources, have characterized the relatively fast economic development of Mauritius over the past decades. With a very high population density of 617 inhabitants per km² and 1 million tourists arriving annually in a land area of only 2040 km², the sustainability of buildings in Mauritius is a critical issue. Research in the art and science of Energy Management as a tool to achieve sustainable use of energy in buildings in our context is a generic topic of high relevance.

- Energy efficiency indicators are used today to monitor and target energy efficiency progress. Multidisciplinary approaches are needed to gauge such evolution in terms of diverse economic, social and environmental parameters. Qualitative analysis, including local or even traditional knowledge, is being as useful as quantitative analysis in connection with uncertainty appraisal. Recognizing energy efficiency as a ‘no regret’ measure implies that participative methodologies involving multicriteria life-cycle scrutiny must be combined with thermo-economic analysis, for example.

- Energy behavior is now becoming a major field of research extending from the impact of social networks to that of smart-metering on energy consumption. Applied holistic research in the local context is needed involving social scientists along with engineers, mathematicians and even with inputs from civil society and policy-makers.

- Forecasting and modeling future energy demand, including transport, is a critical topic in view of adequate and sustainable power systems planning. This requires understanding of non-engineering aspects like consumer behavior or climate data as well as having sound mathematical abilities. Such research has to consider specificities of our context. Local energy-environmental interactions should be further researched e.g. the link between standards and state of the environment as well as enforcement aspects.

- Vying with world leaders in wind power or photovoltaic technology development is not our priority. However, there are a number of research niches where Mauritius can strategically position itself by virtue of its competitive edge or the local/regional possibility of partnerships with global innovators; cold sea-water air-conditioning; bagasse/biomass/waste gasification; ocean energy; smart-grid/integrated power systems for small-islands; alternative electricity storage; sustainability multicriteria assessment and enforcement particularly for climate-change vulnerable SIDS; sustainable Energy Management e.g. for the tourist sector or for a biorefinery/flexifactory. Mauritius has to be involved in prospective technology watch along with strategic allies in these energy-related areas and be ready to be an early adopter of innovative breakthroughs to be applied in its context.
CONGRATULATIONS

To Dr Kavi Khedo

ICT Personality of the Year 2013 (Runner Up) awarded to Dr Kavi Kumar Khedo, Dept. of Computer Science & Engineering, by the Ministry of Information, Communication and Technology. This Award is conferred to an individual that has demonstrated exemplary growth and performance in the ICT industry in the year 2013 in Mauritius.

Short Course/ Training Programme Organised by the Faculty:

1. Short course on Coastal Engineering for the Ministry of Environment & Sustainable Development (October/November 2013)
   Contact person : Assoc. Prof. (M/s) M Nowbuth Civil Engineering Department.

2. Training Programme on Vehicle Fleet Maintenance and Management (October/November 2013)
   Resource Persons:
   - Mr Abdel Khoodaruth, Lecturer, Mechanical and Production Engineering Department.
   - Mr Vikash Oree, Lecturer, Electrical and Electronic Engineering Department
   - Mr Vivek Ramsurrun, Senior Mechanical Engineer, Ministry of Public Infrastructure

3. Training Programme on Supervisory Management (February/March 2014)
   Resource Persons: Mr D. S. Callychurn & Dr D. K. Hurreeram, Mechanical & Production Engineering Department.

4. Short course on AutoCAD 2008

5. Short Course on Electronic Engine Management for petrol and diesel engine
   Date: 25 January 2014 to 1 March 2014
   Resource Persons:
   - Mr Abdel Khoodaruth, Lecturer, Mechanical and Production Engineering Department.
   - Mr Vikash Oree, Lecturer, Electrical and Electronic Engineering Department
   - Mr Vivek Ramsurrun, Senior Mechanical Engineer, Ministry of Public Infrastructure

6. Training Programme on Energy Auditing for Buildings
   Date: 18 January 2014 to 22 February 2014
   Resource Persons:
   - Mr Abdel Khoodaruth, Lecturer, Mechanical and Production Engineering Department
   - Dr Mahendra Gooroochurn, Lecturer, Mechanical and Production Engineering Department
   - Mr Madoo Desha, Consultant in Energy Management

Forthcoming short course:

1. Short course on AutoCAD 2014
   Resource Person : Assoc. Prof. H Ramasawmy Contact details: haree@uom.ac.mu

2. Supervisory Management Training Programme.
   Resource Persons:
   - Mr D. S. Callychurn & Dr. D. K. Hurreeram Contact details: d.callychurn@uom.ac.mu

3. TQM: An Integrated Approach to Quality & Continuous Improvement
   Resource Persons:
   - Mr D. S. Callychurn & Dr D. K. Hurreeram Contact details: d.callychurn@uom.ac.mu

The Faculty can provide both award and non-award tailor made courses to meet your needs. Please do not hesitate to contact the Dean of Faculty of Engineering for more details.

Contact:
Prof. T Ramjawon, Dean of Faculty
ramjawon@uom.ac.mu
Dr Khedo, on behalf of the Faculty of Engineering, the Editorial team would like to congratulate you on your recent successes and thank you for having readily accepted to share your experience with the research community through this interview.

**What are your current research areas?**

My current research areas are wireless sensor networks, context-awareness, mobile computing, and ubiquitous computing. I am currently exploring innovative and practical solutions to problems of national interest such as the use of ICT in education, real-time flood monitoring and secure access control to information.

**Are there any challenges that you feel you have faced during your research works at the UoM?**

Indeed, the main challenge was that there were no other colleagues or teams working in the area of wireless sensor networks in Mauritius. Therefore, I was quite isolated and was not able to have discussions with others on the problem areas. Fortunately, through the ASD scheme, I have been able to link with a team at the Lancaster University, UK.

**Can you briefly describe some recent research projects that you have undertaken?**

I have recently completed an MRC funded research project entitled “Online Social Networks (OSNs) in Secondary Education”. In this experiments were carried out on the use of OSNs to conduct formal classes and observations were reported. I have been involved in another MRC funded research project entitled “A Secure Data Access Model for the Mauritian Healthcare Service”. The project consisted of designing and implementing a novel Role-Based Access Control (RBAC), supported by context-awareness, that can be applied in the Mauritian healthcare service, to control access to patients’ data. Moreover, I have been involved in a project where the use of WSNs for real-time monitoring of the hydrological conditions of rivers for flood forecasting and prompt warnings is investigated. The project described the design and deployment of a real-time flood monitoring system (RTFMS).

**How do you think that the research output of the University of Mauritius can be improved?**

First and foremost, I think that the teaching and administrative load of academic staff should be reduced. Academic Staff are involved in teaching, labworks supervision, project supervision, programme coordination, student counseling, preparation of lectures, correction of exam papers, invigilation, participation in committees and the list goes on. There is an urgent need to reduce the load of academic staff in order to allow them more time to conduct quality research. Secondly, more funding should be made available by the government and the industry for research.

**What kind of research do you think the University should be focusing on?**

We need to carry out cutting-edge applied research with the main objective to improve the life of the citizens of Mauritius. The research carried out should lead to innovative and practical solutions to problems of national interest.
Any advice you would like to provide to those who are thinking of embarking on a PhD programme?

First, you should have a good reason to do a PhD and you should be highly motivated. PhD students should be motivated to pursue the PhD by scientific and humanistic curiosity; the desire to contribute to the academic community, service to others, or personal development. The best reason of all to enroll in a doctoral program is because you want to become more intellectually engaged with and more critically sophisticated in the study of some issue or field.

What are your involvements at the international level in the research community?

I have published over 30 refereed research papers in prestigious international conferences and journals in Computer Science. My work has been cited several times by the international research community. I have been solicited to participate several review committees of international conferences and journals which include IEEE Africon 2013, IEEE ICIT 2013, InSITE 2011, IEEE WCNC 2012, ICIC 2007, WCSN 2007, COGNITIVE 2010, WILEY IJCS, IJCSSE, IJSNet, and IJCA.

To what extend your works have been recognized at the national level?

I was awarded the UoM Research Excellence Award (REA) which recognizes the outstanding young academic who has contributed significantly to promote research at the University of Mauritius. Moreover, I have recently been awarded the ICT Personality of the Year 2013 (Runner Up) by the Ministry of Information and Communication Technologies. This Award is conferred to an individual that has demonstrated exemplary growth and performance in the ICT industry in the year 2013 in Mauritius.

What are the future plans for your academic career?

I am currently in the process of constituting a team to work in the area of wireless sensor networks and setting up of a state-of-the-art research lab in the area. I am looking forward to supervise MPhil/PhD students in the area of wireless sensor networks. I intend to develop strategies to attract research funds from national and international funding agencies to conduct research projects that are of national interest. I am also looking forward to partner with prestigious institutions in the region to conduct applied research of mutual interest.
Abstract

Wireless sensor network (WSN) is an emergent class of extremely dynamic and complex environment on top of which a wide spectrum of applications is implemented. However, due to extreme resource constraints and lack of suitable programming abstractions, programming sensor networks is still a complex process. These constraints frequently drive developers to pursue vertically integrated and tightly coupled designs that are highly-optimized for specific scenarios. Vertically integrated designs consequently lead to less interoperable WSN applications. Tightly coupled designs render WSN applications less flexible. Middleware systems have been proposed to facilitate the development of WSN applications as well as to provide common application services. However, most existing middleware are application specific and thus inflexible. Furthermore, the problems of programming language interoperability and protocol interoperability in heterogeneous WSNs have not been fully considered by existing middleware.

In this thesis, a flexible and interoperable publish/subscribe middleware, named MiSense, is proposed. MiSense has a layered architecture that reduces complexity by offering well-defined, services-specific interfaces to the rest of the system. The MiSense middleware enables interoperability between WSNs and access networks by providing programming language interoperability and protocol interoperability. MiSense provides a pluggable framework that allows WSN applications to have fine-grained control over core middleware services and application developers can flexibly change these services. MiSense is made as generic as possible in order to support a large spectrum of WSN applications. Moreover, the middleware is compliant with the Object Management Group (OMG)’s Data Distribution Service (DDS) standard.

MiSense implements a publish/subscribe communication model. While most traditional publish/subscribe systems have tightly integrated filtering, routing and forwarding mechanisms, MiSense decouples the communication mechanisms from the publish/subscribe core. The publish/subscribe core is independent of the routing protocols used in the network and is agnostic to the underlying addressing model. Through the concept of attachment, the addressing models have been separated from the publish/subscribe core. MiSense enables different addressing schemes by tunneling address information as attachments between a subscriber and a publisher. By exposing the choice of the protocols to the application designer, MiSense allows the adaptation of the publish/subscribe service to the specific needs of the application.

The flexibility of the MiSense middleware to support different sensor node platforms, communication protocols and interaction patterns has been demonstrated experimentally. The performance and accuracy of the different middleware services have been evaluated. The results show that MiSense exports significant performance tradeoffs to the application in an easy-to-use fashion. Moreover, the communication model is general and flexible enough to support different interaction patterns, and the execution time overhead is acceptable. In a wider context, this thesis’s contributions provide advances toward plug and play sensor network systems that can be flexibly parameterised for application-specific tasks.

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Main Supervisor : Prof. R K Subramanian
Abstract

The explosive growth of wireless services and the increasing demands for high data rates have given rise to broadband communication systems. Radio channel is plagued by multi path propagation which causes frequency selective fading and interference. As radio spectrum is shared and is a limited resource, it is important for networks to respond to randomly fluctuating conditions by adapting the allocation of resources in an efficient, fair and scalable manner. Orthogonal Frequency Division Multiplexing (OFDM) is a modulation scheme specifically designed to facilitate high speed data transmission over frequency selective fading channels with flexibility to subcarriers allocation. OFDM has key advantages over other widely used wireless access techniques as the radio channel is divided into many narrow bands, low rate, frequency- non selective subcarriers, so that multiple symbols can be transmitted in parallel, while maintaining a high spectral efficiency. Each subcarrier can deliver information for a different user, resulting in a simple multi access scheme OFDM exhibiting high resilience against the inter symbol interference introduced by multi path propagation.

Resource allocation based on channel state information is known to be very powerful method for improving the spectral efficiency of OFDM systems. Resource allocation for multiuser OFDM systems is normally tackled through traditional approaches but these optimisation techniques are nonlinear and computationally intensive to solve as complexity increases exponentially with constraints and the solution space is too large to be solved by classical algorithms. Furthermore classical methods give suboptimal solution. In the past decades, evolutionary algorithms have emerged as a revolutionary approach for solving optimization problems. Intelligent algorithms have been proposed for subcarriers, bits and power allocation but these have been limited to single objective optimization. These objectives are conflicting and can best be solved by multi-objective optimization using evolutionary algorithms, an efficient way to find multiple Pareto-optimal solutions simultaneously in a single run.

In this thesis, the primary novel contribution is the use of state of art multi-objective evolutionary algorithms (MOEAs), in the allocation of resources (bits, subcarriers and power) to the OFDM system. Initially, the elitist Non-dominating Sorting Genetic algorithm (NSGA II) is used and tested over wireless channel modelled as frequency selective channel with Rayleigh multipaths and the results compared with efficient Strength Pareto Evolutionary Algorithm (SPEA), classical methods and single objective optimization algorithm using performance metrics of generational distance for convergence, spread metrics for diversity and computational time. The results reveal that the NSGA II is less computationally intensive, faster and has superior performance.

Another novel approach is the use of multi-objective particle swarm optimization (MOPSO) algorithm for the resource allocation problem. In this case the results obtained are inferior to the NSGA II algorithm but MOPSO is faster. Using the concept of crowding distant computation and mutation operator borrowed from NSGA II, the performance of the MOPSO algorithm is improved and results are comparable to the NSGA II. Comparison study with classical method and particle swarm optimization (single objective optimization) further confirmed the improved and better performance of the modified MOPSO.

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Due to the fact that evolutionary computation algorithms developed have poor correlation between fitness of parent and offspring, and the total dependency on choice of suitable operational parameters for successful results, has motivated the birth of another type of evolutionary algorithm known as Estimation Distribution Algorithm (EDA). This new class of algorithms generalizes GAs by replacing the crossover and mutation operators with learning and sampling from the probability distribution of the best individuals of the population at each iteration. The system evolves in such a way that the relationship between the variables involved in the problem domain are explicitly captured and exploited. The EDAs have been studied, tested and adapted as multi-objective optimizer (termed as MOEDA) for allocating resource in the OFDM

Extensive tests have been performed on the selected MOEAs, the NSGA II, MOPSO and MOEDA, using performance metrics and surface attainment and resource has been allocated by a fuzzy best compromise non dominating solution. It has been found that the NSGA II algorithm is competitive for low population size problem attaining a performance of 95% of the optimal value. The MOEDA takes advantage of larger search and provides better result with increased population size. The MOPSO algorithm maintains a constant lower performance compared to the NSGA II and MOEDA, as it is hindered by non dynamic change of its operational parameters.

In addition simulation results show that the selected MOEAs have improvement of 5 dB over classical methods and 7 dB for non adaptive modulation OFDM system. Therefore, the tested NSGA II, modified MOPSO and MOEDA are alternate tools for efficient allocation of resource in OFDM system.

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Main Supervisor : Prof. H. C. S. Rughooputh
In today's globalized world, there is a growing concern for incorporating sustainable development in decision-making processes. Applying therefore life cycle thinking to the three pillars of sustainability, through the overarching Life Cycle Sustainability Assessment (LCSA), offers a suitable and holistic approach to providing sustainable solutions to various challenges including solid waste management.

Presently, in Mauritius, the disposal of the annual rising quantities of solid wastes is one of the challenges being faced by the Government, as the only landfill of the island is nearing completion. In parallel, over 104 million used Polyethylene Terephthalate (PET) bottles, which usually occupy large volume in landfill, has to be disposed of yearly. With an expected annual increase of 2.5% of used PET bottles in waste, their disposal is becoming a nuisance to the environmental landscape. A considerable amount of used PET bottles are disposed of in watercourses, remote areas and barelands, where in addition to being eyesores they give rise to numerous environmental and health related problems. A holistic approach from the environmental, economic and social perspectives, through LCSA, on the disposal alternatives of used PET bottles is therefore warranted to find a sustainable disposal method in Mauritius.

The aims of the present study were to assess the environmental impacts occurring during the life cycle of PET bottles and to determine a sustainable disposal method among four selected disposal alternatives of used PET bottles in Mauritius. The disposal scenarios investigated were: 100% landfilng (scenario 1); 75% incineration with energy recovery and 25% landfilng (scenario 2); 40% flake production (partial recycling) and 60% landfilng (scenario 3); and 75% flake production and 25% landfilng (scenario 4). It should be noted that scenario 1 is hypothetical, while scenario 3 is the present disposal route. Scenarios 2 and 4 are future scenarios based on recent developments in solid waste sector in Mauritius.

LCSA tool is a combination of three assessment tools: Life Cycle Assessment (LCA), Life Cycle Costing (LCC) and Social Life Cycle Assessment (S-LCA) that measure the three dimensions of sustainability. Among the named tools, LCA is the only tool to be ISO standardized. LCA is a dynamic tool embracing several areas of applications and with multiple improvements needed such as: on development of tools for consequential LCA, methods for assessment of impacts on ecosystem services from land use and impacts from water use, and weighting methods. LCC on the other hand, is less developed than LCA. Recently, a code of practice on LCC has been published, where Environmental LCC was recognized as the LCC type that can be suitably integrated within the sustainability framework. The challenge, however, still remains on quantifying the external cost. S-LCA is a very young research discipline and there is still much scientific work that needs to be conducted before it reaches a status comparable to that of Environmental LCA. A recent development is the publication of the Guidelines on S-LCA of products. The central problems in S-LCA are how to relate the social indicators (social impact assessment) quantitatively to the functional unit of the product-system, and how to restrict to a manageable number the many social indicators proposed. Altogether, as the three tools are still under development, LCSA is thus a new t901 which requires methodological development. LCSA

Continued next page
is in fact an extension of the life cycle assessment with several challenges including: how to maintain consistency within the system boundaries and functional unit; and the weightings to be attributed to the three sustainability criteria to integrate the three tools.

In the present study, ISO standardized LCA methodology was applied to assess the environmental impacts occurring: during the life cycle of PET bottles and on the four disposal alternatives, using the SimaPro 7.1 software. Comparative LCCs of the disposal scenarios were conducted using the recent Code of Practice on LCC whilst comparative S-LCAs were carried out based on the UNEP/SETAC Guidelines for Social Life Cycle Assessment. For comparative S-LCA, a new and simple social life cycle impact assessment method was developed for aggregating inventory results. Finally the methodology proposed to work out LCSA was to combine the three assessment tools: LCA, LCC and S-LCA using the Analytical Hierarchy Process.

Assembly and use phase was found out to be the dominating phase in the life of PET bottles and the highest environmental impacts occurred during electricity generation. Comparative LCA, LCC and S-LCA results indicated scenario 4 (75% flake production and 25% landfilling) to be the favoured disposal route from environmental, economic and social perspectives. The LCSA results confirmed that scenario 4 was the sustainable disposal method of used PET bottles in Mauritius. Scenario 1 was found to be the worst scenario. As scenario 4 is a future scenario, recommendations have also been made in the study on how to reach 75% collection hence flake production rate.

Further research is needed for development of a regional database that will among others; provide sets of weightings to be attributed to the three domains of sustainability. This will equally facilitate the development of an ISO standardized methodology for the LCSA tool.

Contact Person
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Main Supervisor : Prof. T. Ramjeawon
The Faculty of Engineering organized a Research Seminar on the 23rd January 2014 to disseminate some of the research works completed by academic staff of the Faculty. The following topics were presented.

<table>
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<tr>
<th>Title of Project</th>
<th>Investigators</th>
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<tr>
<td>Assessment of the Productivity Monitoring and Performance Management (PM)(^2) System within Manufacturing Companies in Mauritius</td>
<td>Assoc Prof D K Hurreeram, Assoc Prof A Ruggoo (FoA) &amp; Mr D S Callychurn</td>
</tr>
<tr>
<td>Pose and Light Invariant Face and Ear Recognition System</td>
<td>Assoc Prof S Baichoo, Dr S Baichoo &amp; S M R A Elaheebocus</td>
</tr>
<tr>
<td>Building a Biometric Database of Palmar and Dorsal Hand Patterns</td>
<td>Mrs M Heenaye-Mamode Khan, Mr N Pavaday &amp; Mr Gobin</td>
</tr>
<tr>
<td>Production and Characterisation of New Fibrous Structures for Commercial Applications</td>
<td>Dr N Kistamah &amp; Mr J Chummun</td>
</tr>
<tr>
<td>Investigate and Forecast the Future Energy Demand and the Potential Renewable Energy to Mitigate GHG Emission</td>
<td>Dr D Surroop</td>
</tr>
</tbody>
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Another Research Seminar was organized on the 20th February 2014 in collaboration with the Department of Applied Sustainability and Enterprise Development. The theme of the seminar was “MOBILISING CAPITAL FOR SMEs: CHALLENGES AND OPPORTUNITIES”. The session was chaired by Assoc. Prof. S Rosunee (Department of Applied Sustainability and Enterprise Development) and the panel members were:

- **M/s Adeela Peer**, Research Student, University of Mauritius
- **Mr. Amar Deerpalsing**, President of the Small and Medium Enterprise Federation
- **Mr. Saman Goorah**, State Bank of Mauritius
- **Mr. Patrice Maveyraud**, Vice-President of the South Business Angels Associations
- **Mr. Hussein Rassool**, Product Development Specialist in Islamic Finance at CIM Global Business Mauritius

Other research seminars will be organized during the year on specific themes.

**MRC FUNDED COMPLETED PROJECTS**

1. **A Secure Data Access Model for the Mauritian Healthcare Service**
   Investigators: Dr Moonian, Dr Khedo, Dr (Mrs) Baichoo, Mrs Cheerkoot, Mr Doomun, Mrs Nagowah, Mrs Cadersaib, Mrs Anuja Meetoo-Appavoo.
   Completed in October 2013.

2. **Experimental enzymatic degumming of raw fibres from banana trunks and pineapple leaves and characterisation of the degummed fibres**
   Investigator: Dr N Kistamah
   Completed in October 2013
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<th>Title of Project</th>
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<tr>
<td>A Sustainable Green-Computing Framework for Clusters of ICT Equipment</td>
<td>Mr Doomun &amp; Dr Gukhool</td>
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<tr>
<td>Setting up a data warehouse for infectious diseases</td>
<td>Dr (Mrs.) S Baichoo, Assoc Prof. Moonian, Prof. Y. Jaufeerally-Fukim &amp; Mrs. Z Mungloo-Dilmohamud</td>
</tr>
<tr>
<td>Automatic Suspect Behaviour Recognition System</td>
<td>Assoc Prof S Baichoo, Mrs M Heenaye-Mamode Khan &amp; Mr S Puudaruth</td>
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<td>Assessing the Durability of Low Strength Concrete Using Coal Bottom Ash as a Partial Aggregate Replacement</td>
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OTHER SOURCES OF FUNDS

FUNDING AGENCY: NATIONAL INSTITUTES OF HEALTH (USA)
- Research title: H3ABioNet
- Investigators: Prof. Y. Jaufeerally-Fakim, Dr. O. Moonian, Dr. (Mrs.) S. Baichoo, Mrs. Z. Mungloo-Dilhamud

FUNDING AGENCY: MAURITIUS SUGAR INDUSTRY RESEARCH INSTITUTE
- Research title: An Irrigation Management Information System for Sugar Cane Plantations
- Investigators: Assoc. Prof. Oveeyen Moonian, Assoc. Prof. Sunilduth Baichoo, Dr. (Mrs.) Shakuntala Baichoo, Mrs. Zahra Mungloo-Dilhamud.
PROPOSED RESEARCH THEMES

MAIN RESEARCH THEMES

Each department has a long list of research fields and themes, representing the breadth of research interests of academic staff. The Engineering field consists of innumerable specialized areas many of which are multi-disciplinary. Staffs are also engaged in contract research and participate in national research groups to provide guidance to policy makers on national projects, such as the Maurice Ile Durable Project. Some departments work in close collaboration with overseas universities on different areas of research.

Table 1: Main Research Fields

|---|---|
Laboratory classes in Electrical Engineering are often hampered by safety issues, as students have to work on high voltage lines. Additionally, with the increased access to tertiary education, providing hands-on practice for students is adding strain to existing infrastructures. The availability of web-based technologies has opened the way for new avenues in the academic arena. Students do not need to be physically present in the lab to perform the experiment. The real lab with real electrical systems and instrumentations can now be remotely operated through the internet. Weblabs offer students an opportunity to work from anywhere and at any convenient time as long as they have access to a computer connected to the internet.

Weblabs, is a remote laboratory comprising of software and hardware tool that enables students to remotely access real equipment located in the university as if they were in a hands-on-lab session. Another advantage of using Weblabs is that it allows experiments to be performed in electrical installations where the danger of electric shocks is predominant. The students will be able to look at and operate electrical systems that they are likely to encounter in their professional life without being physically present in the labs.

Electrical installation is a major subject of Electrical Engineering which is taught during vacation training for year 1 students at the University of Mauritius. This module is followed by BEng(Hons) EEE, ECE, Civil, Mechatronics and Mechanical students. Unfortunately, due to lack of equipment, space and staff, practical experimentation is limited. In this context, we are implementing web based lab experiments in connection with the study of low voltage electrical installations.

In the first phase of the research a model for electrical installations with different earthing configurations has been developed in LabView (Laboratory Virtual Instrument Engineering Workbench). Typically , the TT and the TN Earthing arrangements have been modeled and simulations have been carried out to investigate how students respond to the use of the LabView Software. A snapshot of the LabView front panel is shown in Figure 1. Students are able to

![Figure 1. Snapshot of the LabView front panel](image)
experiment different scenarios and understand why proper sizing of the protection device is critical to avoid any electrical accident.

Next, the required circuitry has been mounted so that the lab experiments can be conducted remotely. The setup for the proposed system is depicted in Figure 2. Real lab experiments have been developed and mounted with instruments and relays which can be operated and controlled remotely through data acquisition cards. The user will have to access a secure website where he can log in the system to perform or view the experiment.

A webcam is used to allow the user to view the setup and he/she will be able to interact with the electrical system through a customized Graphical User Interface (GUI). LabVIEW software has been developed by National Instruments and allows graphical user interface (GUI) for instrument control, data acquisition, and pre/post processing of acquired data. Additionally, LabVIEW has built in functions which allow for the software to be accessed through a web browser.

In the long run, the aim is for the university to collaborate and share their equipment with institutions that are currently using Weblabs, like the MIT iLab project, the Labshare Sahara project, or WebLab-Deusto that is available only in certain universities.

This project is supported by University of Mauritius internally funded Grant with Dr S.Goolaup and Mr R. Doomun as co-investigators.
The dismantling of trade barriers after the Uruguay Round, the speed of technological progress, migration of technical and professional work force and highly mobile multinational corporations seeking out new investment opportunities, have combined to drive globalisation and a sudden increase in competition. While prices continue to be a key factor, quality, speed and flexibility have gained more importance. Many upheavals triggered by globalisation have caused leaders to take a more interested look at the Small and Medium Enterprise (SME) sector. The economic slump in 1980’s also drew attention to its potentials (Kent, 1984). Such effects have brought similar concerns about the development of the Mauritian SME sector.

SMEs have been recognised as being vital for the health and growth of both high and low income economies through employment creation, elimination of poverty, diversification of business activities and investments, and by generating significant domestic and export earnings (OECD, 2004; Harvie & Lee, 2002; Edingburg Group; Beyene, 2002). The European Commission noted that SMEs are essential drivers in innovation and R&D. Because of their small size, they have the ability to respond flexibly to technological innovation, and the diverse and demanding nature of customer needs, and exploit niche opportunities. The Pacific Economic Cooperation Council (2003) noted that they can enhance the quality of human resources, nurture a culture of entrepreneurship, and foster creativity.

The definition of SMEs varies across countries and across sources reporting SME statistics. The term SME covers a heterogeneous group of businesses, ranging from a single artisan's handicrafts sold in the village market to sophisticated engineering firms selling in overseas markets. Commonly used criteria include number of employees, total net assets, sales and investment level (Edingburg Group). The definition in terms of employment is graduated upwards by the level of economic development (Wignaraja 2003). In terms of revenue, it varies based on the GNI per capita of the economy (Gibson T. & van der Vaart H. J., 2008). In Mauritius, a small enterprise is defined as one having an annual turnover of not more than 10 million MUR. A medium enterprise is one that has an annual turnover in between 10 million and 50 million MUR.

SMEs represent over 95% of enterprises in most countries, and approximately 60% of worldwide private sector employment (Ayyagari et al. 2011). In 2011, small businesses in Mauritius accounted for 44.5% of total employment, contributed to 37 % of GDP, and represented around 20 to 25% of total exports (Googoolye, 2011).

The worldwide recognition that the SME sector has to be supported is because they usually face numerous difficulties despite their number and their actual and potential contribution. These difficulties result from the external environment as well as inner weaknesses of the SMEs. Wignaraja (2003) pointed out that SMEs that are less likely or unable to adapt will have difficulty to survive without taking considerable actions. Challenges faced by SMEs are globally similar (WIPO, 2013), though the extents vary in different economies. The goal of this research is to find about the state of the export- and domestic-oriented Mauritian SMEs in general and also about certain specific aspects.

**SMEs in the EPZ Sector**

Since the Textile and Clothing (TC) manufacturing sector was affected by the end of the MultiFiber Agreement, the study was first initialised on SMEs in this sector to see how they were coping against fierce competition. The study examined if they were upgrading their capabilities, especially in designing and
merchandising, to meet the requirements of overseas retailers supplying higher niche markets and to target their own local market as a trial using such capabilities.

Domestic-Oriented SMEs
During local trade fairs, participating SMEs in the TC and non-TC sector, were asked how they were able to cope with the current situation, their difficulties, if they were able to upgrade their capabilities, what were their strategies, and if they received support from local institutions.

The Perception of Young Adults
Competition from cheap imports and access to markets being among noted difficulties faced by the SMEs, the perception of the youth on the locally available clothing items were examined. Their buying behaviour, their preferences in brands and their advice to the local manufacturers and suppliers were taken. These were attempts to conclude how the latter could better meet local consumers’ demands and understand the necessity of market research.

Mauritian Women Entrepreneurs As Role Models
While entrepreneurship world is a male-dominated one, studies show that women entrepreneurs have some other difficulties that usually prevent them from achieving that level. Thus, a few successful Mauritian women were taken as model to recount how they overcame these challenges and achieved success during a workshop organised for that purpose. In that same line, a page on the Web was created to provide new about success stories.

Mobilising Capital for SME Development
Across the globe, access to finance is cited to be among the major difficulties faced by SMEs that prevent their growth. A company’s financial needs vary during the various stages of its development. The accommodation to ease financial disbursement and country leaders’ financial support provided to help to SMEs was compared to the Singaporean model, ranked most business-friendly in the world.

REFERENCE


AN IRRIGATION MANAGEMENT INFORMATION SYSTEM FOR SUGAR CANE PLANTATIONS

Project Team: Assoc. Prof. Oveyen Moonian, Assoc. Prof. Sunilduth Baichoo, Dr (Mrs) Shakuntala Baichoo, Mrs. Zahra Mungloo-Dilmohamud.

ovn@uom.ac.mu (Research-based Consultancy Project funded by the Mauritius Sugar Industry Research Institute)

During summer, especially in the dry areas of Mauritius, Sugar cane plantations face low soil moisture content and thus have to be supported by irrigation. As is commonly known, sugarcane fields are not replanted after every harvest, but at the end of one crop cycle, which generally lasts for about seven to eight years, in most sugar estates in Mauritius. Thus for a large plantation area involving several fields, at a given point in time, some fields are likely to have newly planted canes whereas others will have canes planted in previous years and harvested one or more times. The effect of low soil water content on the crop varies with the age and the growth stage of the cane, with canes in the first year being more sensitive to variation in water contents. At the same time, older canes (called ratoons) can also tolerate low water content only to some level. Water for irrigation is limited and thus has to be optimally managed for the best possible benefits to the crop.

For the management of irrigation, large plantation areas are subdivided into irrigation sites, with each site consisting of a number of fields and covered by a number of irrigation devices. Each site has its own water availability that has to be managed in an optimum way.

The project undertaken consisted of developing a gis-enabled computerized system that allows for the prioritization of sugarcane plantation fields in terms of irrigation requirements at a given site on a specific day, so as to optimize water usage, while allowing for the best possible yield. The software developed considers a number of parameters such as the water obtained by the soil (through rainfall and irrigation), the evaporation rate, parameters related to water retention of the soil, the amount of water available for irrigation, plantation dates and last harvest dates of the canes for the different fields and detailed characteristics of the different irrigation devices being used. The need for irrigation is represented visually using GIS maps and different colours, namely red for dying fields, orange for fields with very low soil-moisture content, light-green for fields that have a reasonable soil-moisture content and require a little irrigation and dark-green for fields that do not require any irrigation.

The software allows irrigation site officers to perform inputs of information about their sites, such as fields and plantation details, water availability and characteristics of irrigation devices, daily information regarding the input of rainfall, evaporation over the last 24 hours as well as the amount of actual irrigation performed for each field over the last 24 hours. It uses the different parameters to determine the soil water content of different fields and provides a visual display in the form of a coloured map of the irrigation site, with different colours representing the irrigation requirement. The software also recommends the amount of irrigation to be performed for each of the fields based on the priority. It further recommends the setting of the different irrigation devices to achieve the amount of recommended irrigation.

The software caters for users with different access rights by providing different interfaces with different functionalities to users and also provides maintenance and backup facilities.

The project has been implemented and submitted to the client (MSIRI) for testing. After a period of strong interaction between the software development team and the MSIRI team, for debugging and fine-tuning the software, the project is now ready to be deployed on actual irrigation sites for real-life testing.
The World Commission on Environment and Development (1987, p. 8), headed by Gro Brundtland, defined sustainable development and sustainability as meeting “the needs of the present without compromising the ability of future generations to meet their own needs”. Environmental sustainability is thus becoming increasingly important and will have significant implications for businesses in the future. A survey by KPMG found that 47.7% of companies considered sustainability and corporate responsibility as an important driver of innovation (KPMG International, 2008). The report also claims that the scale of change required for environmental sustainability is likely to extend beyond current strategic planning horizons and companies will have to go through several planning cycles before new “sustainable” business models are fully implemented. This implies balancing complex social, economic and environmental issues. It is less clear however how sustainability might be realistically achieved in the face of the existing model of economic growth, which is inextricably tied to natural resource extraction, production and consumption.

Even though green manufacturing is on the agenda of the majority of companies, there is little knowledge on the strategic framework for environmentally sustainable manufacturing. With environmental changes and globalization, much emphasis is being laid on striking the balance between the changing world where energy and materials are becoming scarce and labour more abundant. Efforts made by researchers from as early as the 1960s promoted 'pollution prevention' (Dales 1968) and the IPAT equation: the multiplicative contribution of population \(P\), affluence \(A\) and technology \(T\) to environmental impact \(I\) (Ehrlich and Holdren 1971, Commoner 1972, Holdren and Ehrlich 1974, as cited by Fischer-Kowalski and Amman 2001). Dangayach and Deshmukh (2001), from their review of the literature on manufacturing strategies for over two decades, identified ‘green manufacturing’ as one of the issues which required further research exploration and they also reported that with manufacturing strategies in general, “there seems to be little research effort reported on a total system model for incorporating green manufacturing and its implications.” The current research is an attempt to develop this total system model.

The aim of this research is to develop a decision support system that will help companies (particularly SMEs) in developing and implementing evolutionary strategies for business and ecological sustainability. These decisions will be strategic in nature, affect several planning cycles and have long term implications for the organisation's competitive position. The ability to implement these decisions without undertaking reactive high risk and major changes is critical. The focus will therefore be on developing a holistic and multidisciplinary approach around the concept of "value cycles" linking markets, design, manufacture and logistics with technology, materials, business processes, legislation, social & cultural impact, economic impact and the environment. The resulting framework will enable companies to identify and develop the competencies that will determine the nature and type of flexibility required to respond to the scale and pace of change that businesses will encounter over the next forty to fifty years.

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INVESTIGATING THE BIO-ETHANOL PRODUCTION POTENTIAL OF LIGNOCELLULOSIC BIOMASS IN THE MAURITIAN CONTEXT

Mrs Pratima Devi Jeetah, Lecturer
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Main Supervisor: Prof R. Mohee;
Co-Supervisor : Associate Prof Kim Clarke

The fast rising industrialization and transportation has boosted up the demand of petroleum based fuels (Nigam and Singh, 2011; Agrawal, 2007). According to Mehmood et al., (2009), the EIA 2007 report anticipated that in the years 2015 and 2030 respectively, 97 million barrels and 118 million barrels of liquid fuels will be consumed on a daily basis. The result of an over-use of petroleum derived transportation fuels (which represents a share of 58% out of the 80% of the world’s primary energy requirement (Nigam and Singh, 2011) has led to the biological environmental degradation and global warming. It has also been predicted that annual global oil production would decline from the current 25 billion barrels to approximately 5 billion barrels in 2050 (Cheng, 2001). Khatib et al., (2012) concluded that energy demand is likely to grow at a “Business-as-usual” scenario. The exigency of the situation has forced the search for alternative, sustainable, renewable, efficient and cost effective energy sources. The focus primarily has been on the outlook for alternatives to the petroleum products. The global market for bio-ethanol has entered a phase of fast and transitional expansion as it is receiving extensive attention at international, national and regional levels (Sarkar et al., 2011).

Today, gasoline replacement by liquid ethanol produced from renewable resources is also becoming a high-priority goal in many other countries (Mats et al., 2005) and is the only proven commercial-scale renewable transportation fuel that has the potential to replace at least 10 percent of the nation’s gasoline supply (Dawson and Boopathy, 2006). Mauritius is trying to increase its bio-ethanol production since 50.4% of its primary energy consumption is attributed to the transportation sector (CSO, 2011) and this figure is expected to rise in the near future. In Mauritius the use of bioethanol can decrease the dependency of fossil fuel usage, especially in the transport sector which accounts for 50.4% (CSO, 2011) of the energy consuming sectors in the island. Mauritius being an agricultural island has a great potential for easily available lignocellulosic biomass. One of the major challenges for bio-ethanol production from lignocellulosic biomass is to optimize the combination of process engineering, fermentation technology, enzyme engineering and metabolic engineering (Hahn-Hägerdal et al, 2006).

Consequently, the aim of this study consists of comparing the efficiency of bioethanol production from Concentrated acid, Dilute acid as well as enzymatic hydrolysis to achieve the highest ethanol yield from five most abundantly available lignocellulosic feedstock in the local context with a view of broadening the energy portfolios in Mauritius.

References
INVESTIGATING THE BIO-ETHANOL PRODUCTION POTENTIAL OF LIGNOCELLULOSIC BIOMASS IN THE MAURITIAN CONTEXT

Central Statistical Office (CSO), 2011


THE AIR POLLUTION MONITORING UNIT
APMU

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Background
Launched in October 1998, it is a project developed by the Mauritius Cane Industry Authority (formerly Mauritius Sugar Authority) in collaboration of the University of Mauritius. A team, comprising of 1 technician, 1 technical Assistant and a driver is permanently attached to the APMU. Expert from USA (EMET Services) and UK (Monitor Labs Inc) provided training to the local team. The Unit is managed by the Dean, Faculty of Engineering with the assistance of the Head, Department of Civil Engineering.

The APMU has the competency to perform the following test:

- Ambient Air Quality (AAQ) monitoring using an environmental mobile laboratory.
- Continuous Source Emission Monitoring (CEM) using another environmental mobile laboratory.
- Particulate Matter (PM) sampling from stack emission.
- Indoor Air Quality monitoring using portable handheld instruments.

All the tests are performed as per US EPA standards and regulations. Two (2) mobile laboratories (Figure 1) carry the supply of calibration gases needed for calibrating the various analysers.

NEED FOR POLLUTION CONTROL

Awareness of the harmful effects of various air pollutants on materials, living organisms, and health has given rise to air pollution control. Both developed and undeveloped countries have been actively involved in this type of control and Mauritius as well is participating in this global effort to minimise or limit emission with the help of the air pollution monitoring facility.

Figure 1 – Mobile laboratory

AMBIENT AIR QUALITY MONITORING

Ambient air quality monitoring is the monitoring of the quality of the air which people breathe. An automated system equipped with analysers, measure the following parameters:

- \( \text{SO}_2 \) (sulphur dioxide),
- \( \text{NOx} \) (oxides of nitrogen),
- \( \text{O}_3 \) (ground level ozone),
- \( \text{CO} \) (carbon monoxide) and
- \( \text{PM10} \) (particulate matter below 10 microns in size, per cubic metre).

Continued next page
Measurements are based on dry absorption/emissions methods. The system is also equipped with meteorological sensors for wind direction, wind speed, humidity and atmospheric temperature and pressure. The analysers give real time measurements, which can be averaged over 15 minutes or more and stored in a data logger. Remote sensing of these data can also be made through a modem using the GPRS technology. The unit (Figure 2) requires a 240V AC, 13A power supply.

**CONTINUOUS SOURCE EMISSION MONITORING (C.E.M)**

This type of monitoring consists of analysing gaseous emissions from stationary sources, such as factory chimneys. This system is an automated mobile laboratory (Figure 3) equipped with analysers for gaseous emissions such as:

- SO₂ (sulphur dioxide)
- NOx (oxides of nitrogen)
- CO (carbon monoxide)
- CO₂ (carbon dioxide)
- O₂ (residual oxygen)

Sampling is made directly from a port, with a probe inserted into the stack via a heated sample line to give unbiased readings.

**PARTICULATE MATTER MEASUREMENT**

Particulate Matter (PM) is fine solid particles emitted together with the flue gas from chimneys, and measurements involve:

Quantifying the PM content requires technical expertise.

PM concentration in flue gas is determined using a computerised High Volume Sampler (Figure 4) to perform isokinetic sampling (sampling at the same speed as the flue gas speed) through a probe inserted in the stack.

**INDOOR AIR QUALITY**

Indoor air quality (IAQ) broadly refers to the environmental characteristics inside buildings that may affect human health, comfort, or
work performance. We monitor IAQ because we spend approximately 90% of our time breathing “indoor air”. Poor IAQ contributes to both short and long term health issues which can lead to decreased productivity and increased absenteeism. Portable equipments (Figure 5), are used to measure the following parameters:

- Room Temperature & Humidity
- Ventilation air flow
- Carbon Dioxide (CO₂)
- Respirable & Inhalable dust

Figure 5: Portable equipment for measuring indoor air quality

**OUR CLIENTS**

The Air Pollution Monitoring Unit receives requests for performing air quality tests from various organisations every year. The requests come from a wide range of industrial activities including sugar factories, Textile factories, Chemical factories, Cement processing factories, Stone crushing plants and others. These tests are performed as per various requirements, namely:

1. Assessment of compliance to environmental guidelines and/or standards.
2. Assessment of efficiency of boiler or power plant. (Need to modify air/fuel ratio)
3. Assessment of efficiency of existing pollution control equipment.
4. Use of primary data for the design of a new pollution control system.
5. Research
6. Covers a wide variety of industrial areas (Sugar, Chemical, Textile, Cement / Stone Crushing Plants, Consulting Engineers…)
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CONFERENCE PAPERS


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## CURRENT PHD PROJECTS

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<td>Prof K D Barber - University of Bradford, United Kingdom (<a href="mailto:k.d.barber@bradford.ac.uk">k.d.barber@bradford.ac.uk</a>)</td>
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<td>Prof L Sterling (<a href="mailto:lsterling@swin.edu.au">lsterling@swin.edu.au</a>) (Both Co-Supervisors)</td>
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<td>Mr Ragen A K (Chemical &amp; Environmental Eng Dept.)</td>
<td>Investigating the applicability of constructed wetlands for wastewater reclamation and reuse in the Mauritian domestic sector</td>
<td>Candidate's Committee: Assoc Prof M Nowbuth Assoc Prof R T Ramessur Assoc Prof A Ruggoo</td>
<td></td>
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<tr>
<td>Mr Rangolam Yatindra Kumar (EEED)</td>
<td>Evaluation of Commercially available solar modules for optimum photovoltaic system design in Mauritius</td>
<td>Prof K M S Soyjaudah (Main Supervisor)</td>
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<tr>
<td>Mrs Ramsamy-Iranah S D (DASED)</td>
<td>Investigation into Functional and Aesthetic Clothing and Fabrics for the Visually Impaired</td>
<td>Assoc Prof S Rosunee (Main Supervisor) Dr N Kistamah (Assoc Supervisor)</td>
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<tr>
<td>Mrs Seetohul Jeetendranath (CSE Dept.)</td>
<td>A Framework/Mechanism for Secure Communications in Ubiquitous Computing</td>
<td>Prof R K Subramanian (Main Supervisor)</td>
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<tr>
<td>Mrs SOOCHETA VAIDYA Anagha (Mrs) (DASED)</td>
<td>Investigation of Extraction, Processing and Potential for Product Development of “Pandanus Utilis” Leaf Fibre.</td>
<td>Assoc Prof S Rosunee (Main Supervisor) Prof M D Teli (Assoc Supervisor)</td>
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## List of PhD. Students

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<th>NAME OF CANDIDATE</th>
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<th>EXTERNAL SUPERVISORS</th>
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<td>ABEL Patricia Julie (Ms)</td>
<td>(F/T)</td>
<td>Computer Modelling of the Thermo-Physiological Comfort of Single Layer and Multi-Layer woven Fabrics</td>
<td>Dr R Unmar (Main Supervisor) Assoc Prof S Rosunee (Assoc Supervisor)</td>
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<tr>
<td>AMEERUDDEN Riyad M (Mr)</td>
<td>(P/T)</td>
<td>Design and Optimisation of a PIFA Antenna Using Genetic Algorithms</td>
<td>Prof. H.C.S Rughooputh (Main Supervisor)</td>
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<td>BAYNATH Purvashi (Ms)</td>
<td>(P/T)</td>
<td>Username and Password Authentication through Keystroke Dynamics Artificial Neural Network / Neuroevolution and other evolutionary Algorithms</td>
<td>Prof K M S Soyjaudah (Main Supervisor)</td>
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<tr>
<td>BAKUNZI Theotime (Foreigner)</td>
<td>(F/T)</td>
<td>Face Image Reconstruction for Face Recognition</td>
<td>Assoc Prof S Baichoo (Main Supervisor)</td>
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<td>BEEHARRY Yogesh (F/T)</td>
<td>TEC Postgraduate Scholarship</td>
<td>Combined Iterative Source Channel Decoding Strategies for digital Communication Receivers</td>
<td>Prof K M S Soyjaudah (Main Supervisor) Dr T P Fowdur (Assoc Supervisor)</td>
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<tr>
<td>BHURTAH Insah(Miss) (F/T)</td>
<td>TEC Postgraduate Scholarship</td>
<td>Improving the Encoding Process of Low-Density Parity Check Codes for Novel Applications</td>
<td>Prof K M S Soyjaudah (Main Supervisor) Dr C Catherine (Assoc Supervisor) <a href="mailto:ccatherine@unix.utm.ac.mu">ccatherine@unix.utm.ac.mu</a></td>
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<td>BHURTUN Bhima Dev (F/T)</td>
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<td>Robust Image and Video Transmission Techniques</td>
<td>Prof K M S Soyjaudah (Main Supervisor) Dr T P Fowdur (Assoc Supervisor)</td>
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<tr>
<td>BOODOO-JAHANGEER Nazmeen (Mrs)</td>
<td>(P/T)</td>
<td>Evaluation of Biometric Techniques</td>
<td>Prof R K Subramaniam (Main Supervisor) Assoc Prof S Baichoo (Assoc Supervisor)</td>
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<td>BOODOO Sajaad (P/T)</td>
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<td>Improving the Performance of an Active Noise Control</td>
<td>Assoc Prof R Paurobally (Main Supervisor) (<a href="mailto:roshun@mech.uwa.edu.au">roshun@mech.uwa.edu.au</a>) Dr Y Bissessur (Assoc Supervisor)</td>
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<tr>
<td>BRIZMOHUN Ravina (Ms) (P/T)</td>
<td>MRC Postgraduate Scholarship</td>
<td>Life Cycle Assessment of Electricity Generating Systems in Mauritius</td>
<td>Prof. T. Ramjeawon (Main Supervisor)</td>
</tr>
<tr>
<td>Name</td>
<td>Scholarship Type</td>
<td>Project Description</td>
<td>Supervisor(s)</td>
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<td>BUNDHOO Muhammad Ali Zumar (F/T)</td>
<td>UoM Postgraduate Scholarship</td>
<td>Effects of Microwave and Ultrasound Irradiation on Energy Production from Anaerobic Digestion and Dark Fermentation of Municipal Solid Wastes</td>
<td>Prof R Mohee (Main Supervisor) Prof Mohamed Ali Hassen (Assoc. Supervisor)</td>
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<td>CHINNIAH Rishta (Mrs) (F/T)</td>
<td>TEC Postgraduate Scholarship</td>
<td>Investigation into the Use of B-Cyclodextrins for the Colouration of Wool and Wool Blends</td>
<td>Assoc Prof S Rosunee (Main Supervisor) Prof C M Carr - (Assoc Supervisor) <a href="mailto:christopher.m.carr@manchester.ac.uk">christopher.m.carr@manchester.ac.uk</a> <a href="mailto:chris.carr@manchester.ac.uk">chris.carr@manchester.ac.uk</a></td>
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<td>COONJAH Irfaan Muhammad (P/T)</td>
<td>Design and Analysis of a Modified Open SSH Virtual Private Network using UDP as base</td>
<td>Prof K M S Soyjaudah (Main Supervisor) Dr C Catherine- (Assoc Supervisor)</td>
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<td>CUNDEN Tyagaraja Sooprayen Modelly (P/T)</td>
<td>Generation of Electricity Using Wind Power in Mauritius</td>
<td>Prof K M S Soyjaudah (Main Supervisor)</td>
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<tr>
<td>DIGUMBER Varun Kumar (P/T)</td>
<td>Improving Genome Assembly and Sequence Alignment Algorithms using Cloud Computing</td>
<td>Dr (Mrs) S Baichoo Prof Y Jaufeerally Fakim (Both Co-Supervisors) Prof C A Ouzounis (Associate Supervisor)</td>
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<td>DURBARRY Assadullah (Mr) (P/T)</td>
<td>MRC Postgraduate Scholarship</td>
<td>Supporting QoS in Mobile IPv6 System</td>
<td>Dr O Moonian (Main Supervisor)</td>
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<td>ESMYOT Marie Annick Joanne (Mrs) (P/T)</td>
<td>Business Process Management System Implementation: A Model for Business Process Outsourcing Companies in Mauritius</td>
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<td>The Impact of Distributed Generations on the Mauritian Power Sector</td>
<td>Assoc Prof R Ah King (Main Supervisor)</td>
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<td>FELICITE Louis Eric Orlando (P/T) (PhD)</td>
<td>Humic Acid Generation and Nitrogen Volatization during Composting of Municipal Solid Wastes</td>
<td>Prof R Mohee (Main Supervisor)</td>
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<td>GUNASEE Sanjana Devi (Ms) (F/T)</td>
<td>TEC Scholar</td>
<td>Comparing thermo Chemical treatment of Solid Wastes using thermo gravimetric analysis</td>
<td>Prof. R Mohee (Main Supervisor) Assoc Prof J Gorgens (Assoc Supervisor)</td>
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<td>INDOONUNDON Deevya (Ms) (F/T)</td>
<td>Channel Dependant and Content Aware Multimedia Communication Strategies</td>
<td>Prof K M S Soyjaudah Dr T P Fowdur (both Co-Supervisors)</td>
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<td>LATCHOOMUN Lekhramsingh (P/T)</td>
<td>Leakage Reduction Control of the Water Distribution System in Mauritius</td>
<td>Assoc Prof R Ah King (Main Supervisor) Dr K K Busawon (Assoc Supervisor)</td>
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<td>MAUTHOOR Sumayya (Ms) (F/T)</td>
<td>TEC Scholar</td>
<td>Industrial Waste Management in Mauritius Using Recycling and an Industrial Ecology Approach</td>
<td>Prof. R Mohee (Main Supervisor) Mr P Kowlesser (Industrial Supervisor)</td>
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<tr>
<td>Name</td>
<td>Institution</td>
<td>Title</td>
<td>Supervisor(s)</td>
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<td>MIHILALL Yaswaree (Miss) (P/T)</td>
<td>MRC</td>
<td>Postgraduate Award</td>
<td>Prof. R Mohee (Main Supervisor)</td>
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<td>MOHABEEER Heman (F/T)</td>
<td>TEC</td>
<td>Neural Networks Intelligent Agents Using Neuroevolution for Emerging Communication Technologies</td>
<td>Prof K M S Soyjaudah (Main Supervisor)</td>
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<td>PEER Adeela Ahmad Iqbal (Miss) (F/T)</td>
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<td>Development and Marketing of a Clothing Brand for a Small and Medium Enterprise in Mauritius</td>
<td>Assoc Prof S Rosunee (Main Supervisor)</td>
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<td>PEERTHY Gayen (F/T)</td>
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<td>Elaboration de Méthodes d'évaluation des impacts environnementaux des principales activités anthropiques de l'Ile Maurice utilisant l'analyse de cycle de vie et l'analyse de cycle de vie hybride</td>
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<td>PEYRYE Muhammad Naushad (P/T)</td>
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<td>Selective Secured Network Coding with Error Correction Capabilities</td>
<td>Dr M A Hosany (Main Supervisor)</td>
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<td>RADHA Bhoomesh (P/T)</td>
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<td>Quantum - Inspired Algorithms for Power Distribution Optimization</td>
<td>Prof H.C.S Rughooputh (Main Supervisor)</td>
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<td>RAGPOT Prateema (P/T)</td>
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<td>Enhancing Digital Audio Transmission with Unequal Error Protection and Error Concealment Techniques</td>
<td>Prof K M S Soyjaudah Dr T P Fowdur (both Co-Supervisors)</td>
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<td>RAJCOOMAR Sachindev Avinash (Mr) (P/T)</td>
<td>MRC Award</td>
<td>Life Cycle Assessment and Economic and Social Evolution of Recycling in Mauritius</td>
<td>Prof. T Ramjeeawon (Main Supervisor)</td>
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<td>RAMDOO Mahendra (Mr) (P/T)</td>
<td>TEC</td>
<td>Energy Management: A Strategic Business Issue for Top Management in Mauritius</td>
<td>Prof K M S Soyjaudah (Main Supervisor)</td>
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<td>RAMTOHUL Avinash (Mr) (P/T)</td>
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<td>Devising an Information Security Solution including an Institutional Framework for the Implementation of Secure e-Government Transactions in Emerging African States</td>
<td>Prof K M S Soyjaudah (Main Supervisor)</td>
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<tr>
<td>SOOBHANY Nuhaa (Ms) (F/T)</td>
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<td>Comparative Assessment of nutrients and heavy metals content during the composting and Vermicomposting of the organic fraction of Municipal Solid Waste (MSW)</td>
<td>Prof. R Mohee (Main Supervisor) Assoc Prof V K Garg (Assoc Supervisor)</td>
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<td>Mr SOOBEN Darmanaden (P/T)</td>
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<td>Energy Efficiency Analysis in the Cold Chain in the food Industry in Tropical Regions</td>
<td>Prof R Mohee (Main Supervisor) Prof Francis Meunier - Conservatoire Nationale des Arts et Métier (Assoc Supervisor)</td>
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