



Systems Science: A short introduction

The simplest definition of systems science is that it is the study of systems. A system is an interconnected set of elements that is coherently organized in a way that achieves some goal. Thus an animal is a system and so is a football team! Systems exist in different forms, from simple to complex. These are seen in nature, society and in the sciences. By its very nature of considering several interacting elements, it is interdisciplinary and applicable in a wide spectrum of disciplines such as environmental sciences, engineering, biology and medicine. These approaches are increasingly being applied to understand complex social phenomena. Examples include power law distribution of casualties in wars, common features in behaviour of ants and traffic, similarities in predicting stock market crashes and earthquakes, the spread of HIV as well as obesity through social networks, and 'laws' that predict the growth of urban areas. The rapid advances in Systems Science has been partly spurred by the ability of modern computers to analyse unimaginable volumes of data, often in real-time (*i.e.* 'Big Data'), advances in mathematics, and the growth of 'new' forms of computing such as Wolfram's Mathematica (<https://www.wolfram.com/mathematica/>).

patterns created by flocks of birds due to interactions among birds. Each bird's movement is governed by a few simple rules in relation to each other and none are aware of the patterns created by the flock. The observable outcome (*i.e.* the patterns created by the flock) is more than merely the sum of behaviours of individual birds. Such systems also demonstrate feedback loops, a key area of study in cybernetics, which explains autonomy and apparent stability of systems by positive and negative feedback loops. Stimuli or influences from the external environment that disturb the system are compensated by negative feedback loops, and the system is therefore able to remain stable in a 'preferred' state.

Origins

A major contribution to the systems approach could be traced to the Systems Theory of Ludwig von Bertalanffy, a German scientist. Though he wrote extensively from the 1920s, his most influential book was *General Systems Theory: Foundations, development, applications* published in English in 1968. He critiqued mechanistic and reductionist thought which perceived the world through a clockwork mechanism that was deterministic, predictable, and linear. Linearity indicated proportionality, which means that the output from the system is proportionate to the input, and superposition, where the effects of the combined action of different inputs can be projected by dissecting the input-output relationships of the individual components. Instead he proposed that the properties of the 'whole' cannot be predicted by exploring the individual properties of its constituent parts, and that their interactions are vital to understand the behaviour of the 'whole'. An example of the systems approach is the emergence of complicated

Complexity Science (CS) emerged in the 20th century and advances these concepts further and explores particular types of 'open' and dynamic systems. CS recognizes features such as non-linearity, adaptation, lack of hierarchies, self-organization, and emergence in systems, and uses computer simulation as key tools of investigation. Such systems are known as complex adaptive systems (CAS), defined as "a collection of individual agents with freedom to act in ways that are not always totally predictable, and whose actions are interconnected so that one agent's action changes the context for other agents". A key institute that advances the application of complexity science in almost all spheres of human thought is the Santa Fe Institute in California (<http://www.santafe.edu/>).

The Sri Lankan situation

Sri Lanka has also taken a few steps in the fields related to mathematical modelling, systems approaches and simulation. The existence of a Centre for Mathematical Modelling (CMM-Department of Mathematics) and recent establishment of a Centre for Data Science (Department of Statistics) in the University of Colombo are encouraging advances. There are several private institutions exploring the use of 'Big Data'. The CMM organized an International Forum for Mathematical Modelling (IFMM) in March 2014 with a mini-conference on Mathematical Modelling and Systems Approaches in Urban Health and Dengue. The IFMM organized a one-week workshop in biological modelling in November 2015 in Colombo which was well attended.

Research teams in Sri Lanka have begun to use systems approaches to study epidemics of dengue, obesity and urban health, through growing collaborations between the Department of Mathematics of the University of Colombo, the Faculties of Medicine in Colombo and Sri Jayewardenepura, and the Department of Architecture in the University of Moratuwa. The National Science Foundation has developed links with the global research programme on Systems Approaches in Urban Health and Wellbeing of the International Scientists Union (ICSU) in Paris (see Pollock, Kevin. 2016. Policy: Urban Physics. *Nature* 531 [7594]: S64–66).

Exciting times are ahead. An international conference on mathematical modelling and workshops on systems science approaches is scheduled for mid-2017. There are also plans to organize seminars for policymakers and researchers on systems science and mathematical modelling with participation

from the United Nations University and Institute of Urban Environment (IUE). Researchers are invited to submit papers to a special issue in the journal *Computation and Mathematical Methods in Medicine* on "Systems Science Approaches to Health in the Developing World". This is a peer-reviewed open access journal and some of us are the guest editors. Manuscripts are due on 9 December 2016 with the publication date scheduled for 28 April 2017. Further details are given in <http://www.hindawi.com/journals/CMMM/si/717214/cfp/>



The author, Prof Saroj Jayasinghe is Professor of Medicine, Faculty of Medicine, University of Colombo and a Honorary Consultant Physician, National Hospital of Sri Lanka, Colombo

Sectional Activities

Section A

- An article on "**Diabetes begets diabetes**" by Prof Chandrika Wijeratne, Faculty of Medicine, University of Colombo, was published in the *Daily News* newspaper on 28 April 2016 in commemoration of the World Diabetes day.
- The Newsletter of SLAAS section A was released in April 2016.
- A workshop on "**Statistics using SPSS software**" was conducted for researchers and academics on 14 and 15 May 2016 and was held at the Committee room of the SLAAS. Twelve persons participated in this workshop. The resource persons were Drs Carukshi Arambepola, Hemali Jayakody and Shreenika Welange. The workshop was organized by Dr Carukshi Arambepola.
- A lecture discussion on "**Palliative care**" was conducted for the nursing staff at the District General Hospital Kalutara on 20 May 2016. The event was organized by Dr Suresh Shanmuganathan and approximately 125 nurses participated. The resource person was Dr Ranjan Mallawarachchi, Consultant Oral & Maxillofacial Surgeon at District General Hospital, Kuliapitiya.
- A lecture discussion on "**Update on surgical removal of impacted teeth**" was conducted for dental surgeons on 23 May 2016. Around 30 persons participated. Dr Suresh Shanmuganathan organized this activity. The resource person was Dr Avintha de Silva, Registrar in Oral & Maxillofacial Surgery, Teaching Hospital, Kalubowila.



- An article on "**Maintenance of oral hygiene**" by Dr Suresh Shanmuganathan was published in *Veerakesari* Newspaper on 27 May 2016.
- A lecture discussion was held on "**Prevention of HIV**" for about 25 garment factory workers at a garment factory in Nugegoda on 14 June 2016. Dr Hemali Jayakody organized this lecture while the resource person was Dr Iresh Jayaweera, Registrar in Venereology, Ministry of Health, Sri Lanka.
- A lecture discussion on "**Management of bleeding issues in dental practice**" was conducted for 30 dental surgeons at District General Hospital Kalutara on 20 June 2016. The resource person was Dr Sandamal Jayasundera, Registrar in Oral & Maxillofacial Surgery, Dental Institute, Colombo. This event was organized by Dr Suresh Shanmuganathan.
- A programme was held for 50 farmers in Anuradhapura at the Post Harvest Research Center, Anuradhapura on 21 June 2016. This was organized by Dr Mayuri Thammitiyagoda.

Professor Daya Ahangama, Visiting professor, Department of Agriculture University of Peradeniya, discussed “**Rational use of pesticides/ weedicides in agriculture**”. Dr Swarnashika Thilakarathne, Director Post-Harvest Research Center, Anuradhapura spoke on “**Food hazards and safe food**”.

- A dog sterilization & vaccination programme was conducted at the Colombo Municipality office on 24 June 2016. Veterinary Surgeons, Drs H M R Kumari Dissanayake, Wasana Dharmawardena and Nadeema Ariyasinghe provided the services. Eight dogs (stray and owned) were sterilized and 35 anti-rabies vaccines were administered during this programme organized by Dr Mayuri Thammitiyagoda.



- A lecture on “**Environment and health**” was held for the membership of the Sri Lanka Dental Association on the 26 June 2016. Approximately 200 people participated. Dr Suresh Shanmuganathan organized this event. The resource person was Dr Enoka Suraweera, Consultant Community Physician, Ministry of Health, Sri Lanka.



- A lecture discussion on “**Mindfulness**” was conducted for all staff at the Institute of Oral Health, Maharagama on 19 June 2016. This activity was organized by Drs Nilantha Ratnayake and Hemali Jayakody. About 80 people participated. The resource person was Prof Wasantha Gunathunga, Professor in Community Medicine, Faculty of Medicine, University of Colombo.

Section C



- A seminar on the “**Use of electronics in the field of agriculture**” was conducted at the SLASS auditorium on 19 May 2016. This event was jointly organized by Sections B and C and the resource person was Eng. Nuwan Balasuriya, Department of Electrical & Computer Engineering, Open University of Sri Lanka. Around 50 individuals from various disciplines participated. The resource person was invited by participants from several agricultural institutes to educate the staff in their institutes on Agrotronics.

- A guest lecture on “**Empowering the nation through renewable energy**” was held on 17 March 2016 at the SLASS council chamber targeting the innovative and dynamic audience looking at modern aspects for solution to the energy crisis. The resource person was Dr (Eng) T L Pradeep, Department of Civil Engineering, Open University of Sri Lanka, who has wide experience in many fields such as energy, hydrology and environment. Over 70 participants from various disciplines participated and they were able to clarify many problems related to energy management and auditing with regard to using solar power.

targeting the innovative and dynamic audience looking at modern aspects for solution to the energy crisis. The resource person was Dr (Eng) T L Pradeep, Department of Civil Engineering, Open University of Sri Lanka, who has wide experience in many fields such as energy, hydrology and environment. Over 70 participants from various disciplines participated and they were able to clarify many problems related to energy management and auditing with regard to using solar power.



Section D

- A three month programme was initiated to enhance knowledge and impart hands on training in “**Ornamental fish culture**” among students in selected secondary schools in the Matara District. The awareness program was conducted on 17 May 2016 at St. Mary’s Convent, Matara. Resource persons were Senior Professor Ruchira Cumaranatunga, Faculty of Fisheries



and Marine Sciences & Technology, Department of Fisheries and Aquaculture, University of Ruhuna, Mr W P R Chandrarathna, National Aquaculture Development Authority of Sri Lanka, Mr W U I Lanerolle and Mr Viraj Udayantha, Department of Fisheries and Aquaculture, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna. Students from ten selected schools (7-10 from each) participated in the awareness program. Equipment to establish an ornamental fish tank at each school were donated. This is a collaborative programme between SLASS Section D and the Zonal Education Office, Matara coordinated by Dr D H N Munasinghe and Ms K K T Dilrukshi. The programme is sponsored by Harischandra Mills Pvt. Ltd.

Section E1

- Workshop on “**Combined mathematics for A/L students**” was conducted by Ms Dinushiya S Rodrigo, Senior Lecturer, Department of Mathematics, University of Sri Jayewardenepura on 18 March 2016 at the Eheliyagoda Central College. Approximately 120 AL students in the Eheliyagoda region participated in this one day workshop. Here, students had the opportunity to gain knowledge by solving problems interactively with the resource person. The programme was coordinated jointly with the Department of Education, Sabaragamuwa Province.



- A guest lecture on “**Discovering new particles**” was conducted on 22 June 2016 at the Department of Physics, University of Sri Jayewardenepura. Prof Sally Seidel (Professor of Physics, University of New Mexico, USA) conducted the lecture. About 60 participants including academics and final year undergraduate students participated, at the end of which the speaker had a special discussion with the students regarding graduate admission to US Universities. The programme was coordinated on behalf of Section E1 by Dr I Wanniarachchi jointly with the Physics Society of the University of Sri Jayewardenepura.

Section E2

- A workshop on “**Tips for writing statement of purpose for international fellowship applications**” was conducted by Prof Bimali Jayawardena, Professor, Department of Chemistry, University of Kelaniya on 6 April 2016, at the Faculty of Applied Sciences, University of Sri Jayewardenepura. The activity was held with the participation of about 60 undergraduate students who are planning on applying for a fellowship in a foreign university. The event was coordinated by Dr Chayanika Padumadasa.



- A workshop on “**Improving your graduate school application: few tips**” was conducted by Prof Bimali Jayawardena



on 19 May 2016 at the Faculty of Science, University of Kelaniya. Around 70 demonstrators/teaching assistants and 4th year undergraduate students of the Faculty of Science, University of Kelaniya participated. Dr Shashikala Rajapakse coordinated the event.

- A workshop was organized on “**Management practices for laboratories**” at the Faculty of Science, University of Kelaniya on 25 May 2016 with the participation of 47 lab technicians and lab attendants of the Faculty of Science, University



of Kelaniya and laboratory staff members from the Department of Chemistry, University of Ruhuna. Drs Sashiprabha Vithanarachchi, Chamari Hettiarachchi, M. N. Kaumal from the Department of Chemistry, University of Colombo and Dr Thashika Rupasinghe from the Department of Industrial Management, University of Kelaniya served as resource persons who covered the topics of Basic skills in a laboratory setup, Laboratory management (Biological sciences), Laboratory management (Physical sciences) & Team work, Leadership and Project management, respectively, at the workshop. Dr Shashikala Rajapakse and Prof Bimali Jayawardena coordinated the event.

- A guest lecture on “**Understanding how related RNA binding proteins exert different splicing outcomes**” was organised at the Department of Chemistry, University of Colombo, in collaboration with the Chemical Society of University of Colombo on the 1 June 2016. Dr Niroshika Keppitipola, Assistant Professor in Biochemistry at the California State University, Fullerton was the resource person. Forty participants including undergraduate students and members of the academic staff participated. Following her talk, Dr Keppitipola also discussed about the graduate application procedure for universities in the USA with the students. This event was coordinated by Drs Aashani Tillekaratne and N V Chandrasekeran.

- A guest lecture titled “**Why are pharmaceutical drugs very expensive? The inside story of drug discovery, development and approval process**” was conducted by Dr Sumedha Jayasena, consultant in Biotechnology for the pharmaceutical companies in USA on 3 June 2016. Around 80 participants including undergraduate students, teaching assistants and academic staff members participated. This event was coordinated by Drs Aashani Tillekaratne and N V



Chandrasekeran. This event was organised in collaboration with the Department of Chemistry

and the Chemical Society, both of the University of Colombo.

- The highlight event of the year 2016 for section E2 was held at the SLAAS Auditorium on 28 June 2016 with the participation of over 100 people from academia, industries and research institutes. The workshop was on “**Interdisciplinarity in scientific research: Commercialization and technology transfer**”. The workshop was inaugurated by the Chief Guest, Prof Sirimali Fernando, Chairperson, National Science Foundation, Prof Manjula Vithanapathirana, General President of SLAAS and many other distinguished guests.

The keynote address was delivered by Dr Ravi Fernando, Executive in Residence of the INSEAD Social Innovation Centre in France. The topic he spoke on was “**Creating a blue ocean market for Sri Lanka to establish global collaborations for technology transfer/R & D and commercialization**”. Starting off the technical session, Senior Prof Veranja Karunaratne, University of Peradeniya & Associate Director, Science and Strategic Relations at SLINTEC made a presentation on “**Nanotechnology research & innovation for national development**”. Dr Ravi Liyanage, CEO of The Kingdom of Raigam, Sri Lanka, delivered a talk on “**Why technology transfer is vital to the food sector in Sri Lanka?**”. Dr Shantha Walpalage, Department of Chemical and Process Engineering, University of Moratuwa presented on “**Polymer research - development and scale-up**”. The topic that Prof Ajith de Alwis, Department of Chemical and Process Engineering, University of Moratuwa & Project Director, COSTI, presented on was “**Incubating Ideas and innovations in food engineering & technology**”.

Dr Dharshan De Silva, Genetech Research Institute, shared his experiences and expertise on **"Harnessing biotechnology research & innovation for**



national development". Dr DU Mohan, Department of Human Resources Management, University of Kelaniya, concluded the workshop, with a presentation on "**Human resource management on technological innovation".**

The workshop created an opportunity to draw together research scientists, engineers, technologists, R&D and R&I personnel, managers and educationists on a common platform to discuss the role of interdisciplinary scientific research and technology transfer in Sri Lanka in national development.

The workshop was coordinated by Drs Jeewantha Premaratne and Shashikala Rajapakse

Section E3

- A workshop on "**Application of machine learning algorithms to dental patient records**" was conducted at the College of Community Dentistry for Dental Professionals on 25 July 2016. The resource persons from Section E3 including Dr Sidath Liyanage conducted this workshop at the Auditorium of the National Dental Institute.

Upcoming event:

- A workshop for ICT school teachers is planned to be held in August, 2016 at the Sabaragamuwa University of Sri Lanka conducted by Dr Senaka Amarakeerthi.

Section F

- A guest lecture on "**Impact of water pollution on human Health**" in collaboration with Section E2 was held on 23 June

2016 at the University of Kelaniya. Dr Jeewantha Premaratne was the resource person. The audience of about 100 comprised academics and students from various disciplines. The key stakeholders from public and private sectors for the formulation of a national policy for enhancing efficient use of water were identified.



- A guest lecture on "**How to write a research article**" was successfully held on 30 June 2016 with the collaboration of Research Centre for Social Sciences, University of Kelaniya as part of one day Junior research training programme for final year students. Dr Hema Gunathilaka was the resource person and over 200 students participated.



Environment Committee



- A poster competition on “**Green practices**” among school children in the Gampaha District was held on 5-7 July 2016 at the Art Gallery of the University of Kalaniya. It was a joint venture by the SLAAS Environment Committee and the Organizing Committee of the National Conference on Green Practices 2016. The focus of the competition was to promote practice of the green concept in institutions and schools focusing environmental conservation, water conservation, energy/ waste management, recycling, reusing and reducing wastage. Winners of the school competition were awarded certificates and prizes at the National Conference on Green Practices held on 14 July 2016 at Waters Edge, Battaramulla. Lions Club Wattala sponsored the event.

Committee for the Popularization of Science



Medicinal Plant Garden Program

- The first program was held on 24 May 2016 at Dharmapala College, Pannipitiya, by Prof Chandarani Wijerathne, Drs R M Dharmadasa, Pahan Godakumbura and Ms Chameera Rajapakse. The second program was conducted on 23 June 2016 at Rajasinghe Vidyalaya, Bope and the third program at Horana Thaksila Central College, Horana on 14 July 2016 with Prof Chandarani Wijerathne, Drs Pahan Godakumbura, Manuja Hansini and Ms Chameera Rajapakse as the resource persons. 300-400 students participated at each one of these events.

Science Day Program

- Two Science Day Programs (SDP) for grade 9 and 10 students were conducted in Vavuniya and Anuradhapura, on the 28 and 29 of June 2016 respectively, under the sponsorship of John Keels Foundation (JKF), Sri Lanka. The program at Vavuniya, was hosted at Gamini Madya Maha Vidyalaya and the one at Anuradhapura was hosted at Valisinghe Harish-



chandra Madya Maha Vidyalaya. Drs Prasanna Galhena, A K Chandana, Pahan Godakumbura, Mr Dilum Perera, Mr Shashika Gunatilaka and Ms Apsara Rajapakse served as resource persons for both programs. The science day program at Anuradhapura featured an Astronomy program, conducted on the same night, led by Prof Chandana Jayarathne and his team.

Nature Diaries Program

- Awareness programs of the Nature Diaries were conducted in Kandy, Anuradhapura, Kurunegala & Matara districts in February 2016 and the evaluation programs were conducted by Professors C P D W Mathew and M J S Wijeyaratne on 9, 10 and 16 July 2016. Two hundred students from each district participated in the four programs. Prof Mathew sponsored the transportation cost of the participants and accommodation /other costs of the resource persons.

SLAAS Theme Seminar –2016

“Interdisciplinarity in Research, Education and Practice for Advancing Science and Society”



Prof Felicity Callard

*Reader in Social Science for Medical Humanities, Faculty of Social Science and Health, Durham University, UK will talk on “**Interdisciplinary Research across Life Sciences and the Social Sciences: the whys, hows, highs and lows of collaboration**”.*

Prof Moti Nissan



*Professor Emeritus, Department of Biology, Wayne State University, USA will speak about “**Interdisciplinary Journeys: A few Illustrations from the History of Ideas**”.*

Together with a panel of eminent Sri Lankan scholars including Prof Tudor Silva, Prof Ajith de Alwis, Prof Saroj Jayasinghe

Venue: ICTAD Auditorium (Institute for Construction Training and Development), “Sausiripaya”, 123, Wijerama Mawatha, Colombo 07

Date: 6 December 2016

Time: 8.30 am – 3.30 pm

Please reserve your seat now taking advantage of early bird discount

**Early bird registration
(up until 21 November 2016)**

Members **Rs 2500**

Non-members **Rs 3000**

Students **Rs 1000**

Late registration

Rs 3000

Rs 3500

Rs 1500

SLAAS Annual Sessions 2016

Venue: Faculty of Education, University of Colombo

Inauguration: BMICH Committee Room A on 5 December 2016

Scientific Sessions: 7-9 December 2016

Membership News

- Prof Manjula Vithanapathirana, General President of SLAAS was appointed as a Board Member of the National Science Foundation.
- Eng V Regunathan, General President elect was appointed as a Board Member of the National Salaries & Carder Commission.

to

If undelivered, please return to:

Sri Lanka Association for the Advancement of Science
120/10, Wijerama Mawatha,
Colombo 07