Proceedings of the 22nd UK System Dynamics Chapter Annual Conference

Maintaining our links in the System Dynamics community

2nd April, 2020

Webinar

Proceedings edited by Dr Siôn Cave, Dr Jenny Morgan,
Hisham Tariq and Diego Bermudez

Issue 1

Timetable and contents

Morning	
9:30	**Reception** Participants are encouraged to log in early to have opportunity to test sound and video
10:00	Welcome to the morning session Siôn Cave (President of the UK Chapter of the System Dynamics Society)
10:10	Getting started with System Dynamics – Concepts and applications. Kim Warren (Strategy Dynamics)
12:30	**Conference Break** – featuring Posters from our Poster session Stretch your legs, have some lunch, and re-join us at 13:30hrs for our afternoon programme.
Afternoon	
13:30	Welcome by Chapter President Siôn Cave (President of the UK Chapter of the System Dynamics Society)
13:40	Modelling the true cost of home care in Northern Ireland Douglas McKelvie (Symmetric Scenarios) Sarah Wylie (Northern Ireland Strategic Investment Board) Donny Scott (Symmetric Scenarios)
14:15	***Featured poster:*** Payment Technologies System Dynamics Diego Enrique Bermudez Bermejo (Cardiff University)
14:20	Hybrid Systems Simulation Models for Transmission of Healthcare Associated Infections Nguyen Le Khanh Ngan (University of Strathclyde)
14:45	**Break** – *featuring posters from our Poster session*
15:00	Business System Blueprint: Establishing through a systemic approach a superior strategic differentiation to achieve a decisive and lasting competitive advantage. Laurent Kurylo (Eliande Consulting)
15:25	***Featured poster:*** Residential Energy Consumption: An End-Use Simulation Model Bilal Bugaje (University of Nottingham)
15:30	System Dynamics to investigate sustainable urban water management in the Ebbsfleet Garden City Irene Pluchinotta (University College London). Sangaralingam Ahilan (University of Exeter) Alessandro Pagano (Water Research Institute, Italy)
15:55	***Featured poster:*** Combining System Dynamics and Agent-Based Model to Study Transmission of Healthcare-Associated Infections in Long-Term Care Facilities Le Khanh Ngan Nguyen (University of Strathclyde)
16:00	***Chapter President: Announcements and Reflections*** Siôn Cave (President of the UK Chapter of the System Dynamics Society)
16:15	**Close**

Introduction

Welcome

A warm welcome to all the participants at our 2020 Annual Conference.

Firstly, I would like to thank you for taking part in today's event. Unfortunately, we had to reschedule the event from the University of Strathclyde at short notice and very much appreciate the flexibility of you all in moving to this online event. We felt that in these times of social distancing it was really important to maintain the links between us all in the system dynamics community. Also, please bear with us during the day – this is the first time we have run an event over the internet and there are sure to be teething problems at some point!

We have brought together a really interesting programme of presentations for today from eminent system dynamics and systems thinking practitioners and we hope that there is something for everyone.

We begin the day with a session specifically developed by Kim Warren to help those getting started in the field. From then onwards we have presentations from experts describing projects that are having a notable impact and pushing the field of system dynamics into new directions. Douglas McKelvie, Sarah Wylie, and Donny Scott will be discussing modelling the true cost of home care in Northern Ireland. Le Khanh Ngan Nguyen will be describing how hybrid models can be used to represent healthcare-associated infections. Laurent Kurylo will talk about applying systems thinking approaches to describe business blueprints. Finally, Irene Pluchinott and Sangaralingam Ahilan will present on their investigations into sustainable urban water management in the Ebbsfleet Garden City.

Throughout the day we will also be having a virtual poster session, where some of our student members will showcase the work that they are carrying out.

I would like to express my gratitude to all the presenters who have taken the time to present today and have been so open to presenting their material online.

Finally, I would like to thank the UK System Dynamics Policy Council for their contribution over the last year and for helping to arrange (and rearrange!) this event.

Keep safe and well,

Siôn Cave

President of the UK Chapter of the System Dynamics Society

UK Chapter of the System Dynamics Society policy council

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Presentation Abstracts

Getting started with System Dynamics – Concepts and applications.

Kim Warren (Strategy Dynamics)

Building system dynamics models to tackle time-based challenges and plans is now easier, faster and more reliable than trying to do the same thing with spreadsheets. The resulting models are also much easier for you and others to understand and to work with. Nor is it technically complex - it follows just a few basic principles, and uses simple arithmetical relationships between well-known real-world elements. It can even handle estimations in a very intuitive way.

This workshop will get you building a working model straight away, and show how those core principles work. We will also point you to a large resource of already-built models that capture very common structures that may arise in all kinds of different cases. Together, these inputs will give you a platform for going on to build more models of your own. You will only need to bring a PC of some kind (tablets just don't have the screen-space to build models) and we will get you online to use the software.

Kim Warren is an experienced strategy professional, teacher and writer. After 15 years in senior strategy roles in the petrochemicals, brewing, hotels and leisure industries, Kim joined the faculty at London Business School, to teach on MBA and Executive programs. Realising serious limitations with the strategy methods available, he developed the powerful strategy dynamics frameworks.

Kim's strategy dynamics work over many years has spanned business cases in most industries and regions of the world, assisting with both continuing plans and one-off challenges. Most recently, the method has proved to be transferable to non-business domains, including International Aid and the provision of elderly-care capacity. The approach is also providing a reliable platform for building confidence and raising finance for early-stage ventures.

Kim is author of the prize-winning *Competitive Strategy Dynamics* (Wiley, 2002), a major strategy textbook *Strategic Management Dynamics* (Wiley, 2008), and summary e-book now widely used in MBA and executive teaching – *Strategy Dynamics Essentials* (Kindle, 2011). He is also co-founder of Strategy Dynamics Ltd, which publishes "serious games" and other dynamics-related learning material for management, and the user-friendly modelling application, Sysdea.

Modelling the true cost of home care in Northern Ireland

Douglas McKelvie (Symmetric Scenarios)

Sarah Wylie (Northern Ireland Strategic Investment Board)

Donny Scott (Symmetric Scenarios)

The term 'social care crisis' is widely used in all parts of the UK, where each country has its own approaches to the challenges of looking after an ageing population with dignity, given severe funding constraints. Home care staff are in many ways the beating heart of the sector, and yet their pay is low, and working conditions can be insecure, scandalously so sometimes given the key contribution they make. The challenge is how to make the existing service sustainable whilst exploring user-led service redesign.

The Northern Ireland Social Care Council, along with the NI Health Department and its Health and Social Care Board, commissioned a System Dynamics model, exploring 'what is the true cost of care?' A wide range of stakeholders engaged in the modelling process: service users, carers, senior civil servants, commissioners, procurement & contracting experts, workforce development & regulation experts, service managers from public & independent sectors, statisticians & analysts, and service designers.

The resulting model puts service users at the top, and the care workforce as the foundation and enables a wide range of scenarios to be explored. The model shows how every part of the whole system is connected: if we improve pay and conditions, we can recruit staff more readily, turnover will slow down, we can provide more care, people will spend less time waiting, delayed discharges will be lower. Improved social care will cost more, but that might be more affordable than the current arrangements.

Douglas McKelvie works with Symmetric. After working as a social worker in Edinburgh, and then in social care workforce development and planning at UK level, Douglas discovered System Dynamics. Working closely with Eric Wolstenholme, for the past eighteen years he has used (mostly System Dynamics) modelling to explore a wide range of issues in health and social care, and other human services. His approach combines participative group model-building with a commitment to constructing running (quantified) models. Eric Wolstenholme and Douglas have recently written The Dynamics of Care (Springer, 2019), an account of a wide range of modelling projects in the UK care sector.

Sarah Wylie is the system dynamics lead in the Data Analytics Research & Exploitation (DARE) unit at the Northern Ireland Strategic Investment Board (SIB). The DARE unit in SIB was established in 2017 as a centre of expertise in data science and advanced data analytics. Sarah is a system dynamics modeler with a theoretical background in economics and in organizational sociology. Her modelling experience ranges across a variety of sectors including construction, international trade and finance, renewable energy, resettlement, and health and social care. She has previously worked in the Northern Ireland Department of Finance, and in other roles supporting various governments.

Donald Scott has worked with Douglas McKelvie on System Dynamic modelling projects for the last four years. He had previously managed a range of local authority social work services, encountering many of the typical challenges which would have been illuminated by a model.

Hybrid Systems Simulation Models for Transmission of Healthcare Associated Infections

Le Khanh Ngan Nguyen (University of Strathclyde)

Transmission of healthcare-associated infections (HAIs) in long-term care facilities (LTCFs) possesses many distinct characteristics that are not well understood. While HAIs are primarily disseminated via contacts between healthcare workers and patients in hospitals, patient-patient and patient-visitor contacts play an important role in spreading HAIs in LTCFs. The increased risk of transmission through these routes results from frequent aggregation of residents in common areas and family visitation. Additionally, the elderly population living in LTCFs who are frequently readmitted to a hospital might acquire colonization or infection of resistant organisms while being hospitalised and transmit these organisms to other residents when returning to the LTCF and vice versa. Systems simulation modelling methods including system dynamics (SD), discrete-event simulation and agent-based models (ABM) have long been used to study the problems of HAIs in hospitals. However, the existing models do not capture the impacts of patient-patient and patient-visitor contacts and frequent hospital readmission of residents upon transmission of HAIs in LTCFs. Therefore, we develop a hybrid simulation model that combines the methodological strengths of SD and ABM to address this gap. ABM is used to model the transmission of HAIs in LTCFs taking into account heterogeneous contacts between individuals. The spread of HAIs in a hospital whose patients are transferred to and from the LTCF is modelled using SD. Information exchange between the SD and ABM components includes data on the number of patients transferred from one setting to the other, and their status of infection.

Business System Blueprint: Establishing through a systemic approach a superior strategic differentiation to achieve a decisive and lasting competitive advantage.

Laurent Kurylo (Eliande Consulting)

The basis of competitiveness can be activity-driven, resource-based, and value-oriented. However, performing efficiently activities, leveraging unique resources, and delivering a superior value proposition, although important, are rarely sufficient to establish an unchallengeable and sustainable competitive advantage. Competitors will always strive to copy others' best practices, key assets, and unique benefits. Sooner or later they will achieve the same, so that these confer at best a temporary edge but not a durable one. A Business System Blueprint enables to compete on the whole, not just the parts. It defines the underlying logic of a business model by representing how its different elements fit together and are balanced. With a Systems Thinking approach, it maps the contributions, synergies and trade-offs between the customer segments, value propositions, capabilities and enablers. This unique and well-though assembly creates both a strong differentiation and a high barrier to imitation, which provides a definitive and durable competitive advantage over competitors.

Laurent Kurylo is a seasoned strategic management consultant and executive MBA teacher with a "Big 5" background, who applies Systems Thinking in its consulting engagements and delivers training on systemic approaches. He has assisted many companies in the US and in Europe in a wide range of technology-oriented and innovation-driven industries in the areas of strategy definition, business model innovation, and business transformation, and innovation management. Laurent holds a postgraduate degree in Artificial Intelligence from the École Nationale Supérieure de Télécommunications de Bretagne and a M.S. in Computer Science from the Institut Supérieur d'Électronique du Nord. He also holds a Staff Officer Diploma from the École Militaire de Paris..

System Dynamics to investigate sustainable urban water management in the Ebbsfleet Garden City

Presenters:

Irene Pluchinotta[1], Sangaralingam Ahilan[4]

Authors:

Irene Pluchinotta[1], Alessandro Pagano[2], Tudorel Vilcan[3], Sangaralingam Ahilan[4], Leon Kapetas[5], Shaun Maskrey[6,7], Vladimir Krivtsov[8], Colin Thorne[6] and Emily O'Donnell[6].

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Growing urban populations, changes in rainfall patterns and ageing infrastructure represent significant challenges for urban water management. Consequentially, there is increasing risk of future water scarcity, and a critical need for research into how cities should adapt to become more resilient to these impacts under an uncertain future. Within this context, a participatory modelling process was initiated in late 2017 to investigate the sustainable urban water management challenges in the Ebbsfleet Garden City and explore potential solutions to these using a System Dynamics approach.

The development of a participatory System Dynamics Model (SDM) for the Ebbsfleet Garden City has allowed us to explore sustainable urban water management in a more structured way, and to understand where crucial future policy interventions might be best focused. This method was useful for supporting decision-making at a strategic, system-wide level and exploring the long term consequences of alternative strategies, particularly those that are difficult to include in quantitative models (e.g. socio-institutional changes). While a SDM can be developed by experts alone, building it collaboratively allows it to benefit from the knowledge base held by local stakeholders, and results in a collective learning process. This talk summarises the extensive participatory process that led to the co-development of a SDM that was used to investigate a number of physical measures and policy interventions which could impact on future sustainable urban water management in the Ebbsfleet Garden City.

Dr Irene Pluchinotta is a research fellow at the Institute for Environmental Design and Engineering of the Bartlett School of Environment, Energy and Resources, University College

London. She is an environmental engineer using System Dynamics and Operational Research methodologies to support decision-making processes for environmental policies, sustainable water management strategies and urban planning for resilient cities. Based on a double PhD in environmental engineering and computer science, her work provides formal approaches to decision-makers involved in multi-stakeholder settings, working on group modelling approaches and structured stakeholders' engagement activities. She develops case-based research, designing and leading several participatory modelling workshops for generating and evaluating policy alternatives in case studies across Europe.

Dr Sangaralingam Ahilan is a research fellow in the Centre for Water Systems, University of Exeter. He has a civil engineering background with research interests in the mathematical modelling application in water and environmental engineering problems. Dr Ahilan obtained a PhD from University College Dublin, Ireland where he researched on influences of the floodplain on Irish flood estimation procedures. Over the last 10 years, he has worked on several high-profile EU and national research projects in Ireland and the UK. Dr Ahilan is currently involved in UK EPSRC funded research project on 'Achieving Urban Flood Resilience in an Uncertain Future', his research focuses on the catchment scale rainwater management on water supply augmentation and urban flood resilience, and urban water system modelling to integrate water, wastewater and material fluxes in the UK cities. Dr Ahilan is also an editor for Journal of Water and Climate Change, IWA Publishing.

Webinar Poster Session

Payment Technologies System Dynamics

Diego Enrique Bermudez Bermejo (Cardiff University)

The research delves into the complexity of payment logistical systems by looking at specific current available technologies dynamics (e.g. cash, debit and credit card, mobile, biometric) by using a broad systems approach. This approach includes the application of systems thinking, system dynamics and engineering (Forrester 1961; Senge 1991; Checkland and Poulter 2000).

Mainly, to understand the factors involved in the adoption and use of these technologies through specific environmental case studies (e.g. U.K., China, Sweden); considering social, technological, economic (e.g. business cycles), ecological, political, legal, and ethical (STEEPLE) perspectives to determine the right mix of payment technologies based on the stakeholders' characteristics (Ballou 2004; Johnson et al. 2014).

The expected results of this analysis are the identification of the factors that affect the adoption and use of payment technologies according to the environmental characteristics that feed back into the system. The environmental characteristics will not only be assessed in terms of experts 'opinions but will be based on historical information of transactions and further forecasting and simulation of possible scenarios, in the systems engineering phase.

Combining System Dynamics and Agent-Based Model to Study Transmission of Healthcare-Associated Infections in Long-Term Care Facilities

Le Khanh Ngan Nguyen (University of Strathclyde)

Transmission of healthcare-associated infections (HAIs) in long-term care facilities (LTCFs) possesses many distinct characteristics that are not well understood. While HAIs are primarily disseminated via contacts between healthcare workers and patients in hospitals, patient-patient and patient-visitor contacts play an important role in spreading HAIs in LTCFs. The increased risk of transmission through these routes results from frequent aggregation of residents in common areas and family visitation. Additionally, the elderly population living in LTCFs who are frequently readmitted to a hospital might acquire colonization or infection of resistant organisms while being hospitalised and transmit these organisms to other residents when returning to the LTCF and vice versa. Systems simulation modelling methods including system dynamics (SD), discrete-event simulation and agent-based models (ABM) have long been used to study the problems of HAIs in hospitals. However, the existing models do not capture the impacts of patient-patient and patient-visitor contacts and frequent hospital readmission of residents upon transmission of HAIs in LTCFs. Therefore, we develop a hybrid simulation model that combines the methodological strengths of SD and ABM to address this gap. ABM is used to model the

transmission of HAIs in LTCFs taking into account heterogeneous contacts between individuals. The spread of HAIs in a hospital whose patients are transferred to and from the LTCF is modelled using SD. Information exchange between the SD and ABM components includes data on the number of patients transferred from one setting to the other, and their status of infection.

Residential Energy Consumption: An End-Use Simulation Model

Bilal Bugaje (University of Nottingham)

Behaviour of occupants is a major determinant of residential energy consumption. Some challenges in the research include divergent understanding of behavior, and a dichotomy between studies seeking to understand the impact of behavior on energy and studies seeking to model a realistic energy consumption. The aim of this study is to create an end-use simulation model of residential energy consumption that is driven by general properties of occupants' activities as proxy for behaviour, such that the model is statistically realistic and directly interpretable to real world activities. The study may show the impact of activities on energy consumption. The method is System Dynamics based on Agent Based architecture with discrete variables. The guiding principles include: emergence; transparency and communicability; and interpretability. The model is built in two related phases: the first phase creates the model and carries out validity tests; the second phase aims to validate the model's output with field data.