Title

The Qualitative Systems Exploration Model (QSEM): A new framework to support the structural analysis of Causal Loop Diagrams within participatory System Dynamics

Authors

Adam Hulme[1,2], Duncan Radley[3], Andrew D. Brown[4], Jefferson K. Rajah[5], Birgit Kopainsky[5], Loes Crielaard[6], Harriet Koorts[7], James Nobles[8].

[1]Adam Hulme
Southern Queensland Rural Health (SQRH)
Faculty of Health, Medicine and Behavioural Science
The University of Queensland
Baillie Henderson Hospital campus
Corner Hogg and Tor Streets, Toowoomba
PO Box 24, Harlaxton, Queensland 4350
Australia

[2]UniSC Thompson Institute
The University of the Sunshine Coast
12 Innovation Pkwy, Birtinya, QLD 4575
Australia

[3]Duncan Radley
Obesity Institute
School of Sport
Leeds-Beckett University
Headingly Campus
Leeds, LS6 3QW
United Kingdom

[4]Andrew D. Brown
Institute for Health Transformation
School of Health and Social Development
Deakin University
1 Gheringhap St, Geelong, Victoria 3220
Australia

[5]Jefferson K. Rajah
System Dynamics Group
Department of Geography
University of Bergen
Postboks 7802, 5020
Bergen
Norway

[5]Birgit Kopainsky
System Dynamics Group
Department of Geography
University of Bergen
Postboks 7802, 5020
Bergen
Norway

[6]Loes Crielaard
Department of Public and Occupational Health
Amsterdam UMC
Amsterdam
The Netherlands

[7]Harriet Koorts
Institute for Physical Activity and Nutrition (IPAN)
School of Exercise and Nutrition Sciences
Deakin University
221 Burwood Highway
Burwood Geelong, VIC 3125
Victoria
Australia

[8]James Nobles
School of Health
Leeds-Beckett University
Leeds
LS1 3HE
United Kingdom

Paper overview

This paper introduces the Qualitative Systems Exploration Model (QSEM), a new semi-quantitative framework for systematically interpreting and analysing Causal Loop Diagrams within participatory system dynamics. QSEM is applied at late-stage model conceptualisation and offers researchers and modelling practitioners a set of tools and techniques to improve transparency and reproducibility in model assessment, ensuring that component and feedback structure selections are traceable and well-justified. Throughout its three core phases: (i) System Factor Classification; (ii) Loops of Interest; and (iii) Archetype Identification and Analysis, QSEM integrates with established Group Model Building scripts to facilitate structured participant engagement and collaborative sensemaking. Real-world application is demonstrated in a commissioned government project aimed at understanding factors influencing dietary choices and food systems, where the framework helped identify potential policy-relevant system drivers. Future directions involve applying QSEM in other projects, evaluating its robustness, consistency and scalability, refining archetype detection, enhancing data visualisation, and exploring dedicated software solutions to expand its utility in qualitative SD.

Funding information

This work was supported by an Australian Research Council DECRA Fellowship: DE240100095 (Hulme).