

Dynamic visualizations for violence prevention

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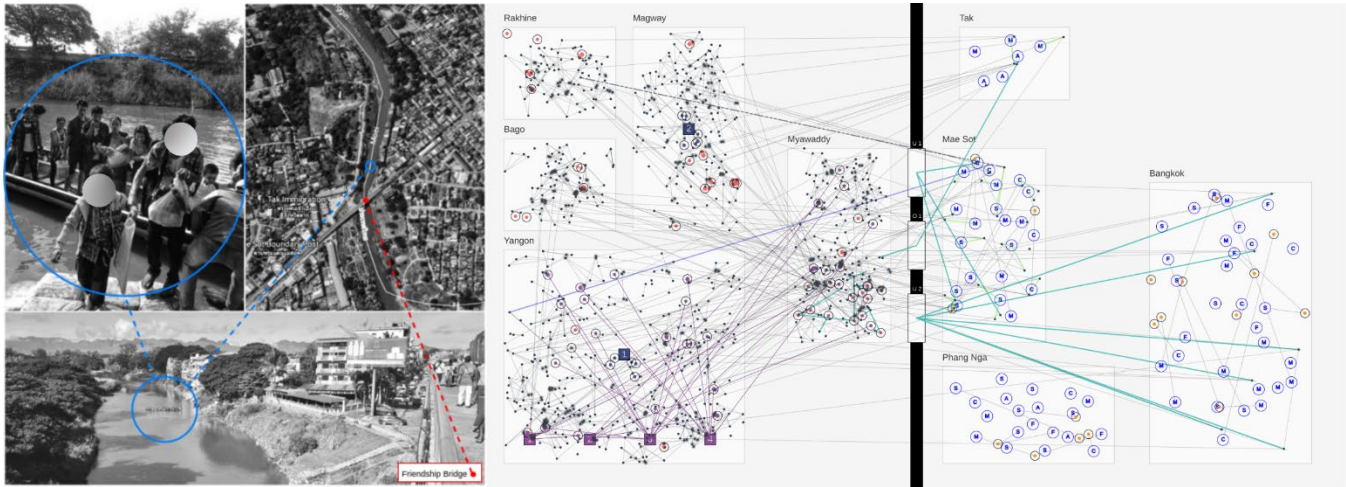


Figure 1: Migrants crossing the Myanmar-Thailand border at Mae Sot. (Left) A descriptive Agent-Based Model simulating migration. (right)

ABSTRACT

This poster documents the use of dynamic visualizations and data interfaces for an ongoing complex systems-based violence prevention intervention case study. The scope of project visualizations used span the development, implementation, and evaluation of a social simulation that models a ‘safer migration’ intervention in the context of low-wage labor migration between Myanmar and Thailand. This project employed dynamic visualizations at various stages, including, participatory social network data collection, mixed-methods social network analysis, conceptualization of violence and migration systems theory, generating and analyzing system and intervention simulations using agent-based modelling, and disseminating web-accessible outputs and findings for a wide audience.

Preliminary findings from this ongoing work suggest that using dynamic visual representations of complex systems as a research tool can lead to more pluralistic and interdisciplinary methodological approaches to knowledge production in the field of violence intervention research. Dynamic visualizations can serve as a conduit for empirical richness, a touchpoint for interdisciplinary collaboration, a visual check for model verification, and a supporting tool to assist with stakeholder validation of causal inference, and an instrument to inform intervention development through scenario testing.

Keywords: visualization, social network analysis, agent-based modelling, migration, violence, intervention development

1 INTRODUCTION

Visualization has evolved into a mature scientific field that has become accepted as a standard approach to knowledge production in a wide range of settings. Despite significant advances, there are still many persisting challenges and unaddressed questions for developing sophisticated, relevant, and novel scientific visualization solutions with minimum overhead. [1] This poster presents our work implementing bespoke versions of dynamic

system visualizations throughout the research lifecycle of a violence prevention intervention simulation case study. Dynamic and visual representations are especially fitting in this context as many public health researchers are adopting systems and complexity frameworks to address health challenges. [2,3,4] These complex challenges have not been well understood through traditional scientific representations, however, dynamic visualization offers a promising bridge between public health frameworks and complex systems methodologies.

2 VIOLENCE AND MIGRATION MODELLING NETWORK

The work presented in this poster is funded by the Economic and Social Research Council as part of their investment into social science research methods innovation (grant #: ES/V006681/1). An interdisciplinary team of social scientists and visualization specialists are leading this work in partnership with the newly formed Violence and Migration Modelling (VaMM) Network. The VaMM Network is an interdisciplinary cross-institutional group of researchers who are collaborating to develop innovative methods at the intersection of public health, complexity science, and data visualization. The network includes experts in a range of disciplines and domains, including, for example, violence and health, migration, intervention design and evaluation, agent-based modelling, computational art and design, and simulation visualizations. The primary aim of this ESRC-funded project is to develop a ‘proof of concept’ case study for the use of social simulation and complex system visualizations for violence prevention intervention development. This poster presents the key visualization outputs to date and the preliminary findings on the use of visualizations for complex systems research and intervention development.

3 CASE STUDY DESIGN

The case study, based on Dr McAlpine’s thesis [5], culminates in a theoretically informed, empirically based ABM that simulates, describes, and tests interventions aiming to preventing labor exploitation in the Myanmar-Thailand migration corridor.

3.1 Literature reviews

We conducted a series of literature reviews to inform the case study design. First, we reviewed the literature to formulate a rich multi-level theoretical framework of a ‘complex labor migration system’ informed by micro-, meso-, and macro-migration theories (e.g., migration decision theory, -network theory, -industry theory, etc.). Following this, we conducted three methodological reviews: a systematic review of ABMs on migration or modern slavery, a systematic review of ABMs on violence, and a background review on ABM visualization techniques.

4 VISUALIZATIONS TOOLS

As part of this simulation methods case study, we developed four dynamic visualization tools, each with a unique audience and added value to the research process. These visualizations are summarized in Table 1 and detailed in the following sections.

Table 1. Visualization tools: audience & added value to research

Tool	Audience	Added value to research process
Data collection: SNA survey	interviewee, interviewer, analysts	reduce cognitive load, safe and efficient, multimodal narrative capture, real-time pattern recognition for probing
Data analysis: mmSNA interface	analysts	reduce cognitive load, in- and cross-case analysis, multimodal data exploration and filtering
Descriptive ABM	interviewees, interviewers, analysts, audiences	model verification, dynamic visualization of emergent processes and outcomes
Intervention simulation ABM	interviewees, interviewers, analysts, audiences, users	touchpoint for intervention design, safe and ethical experimental analysis, accessible audience-centered model interface(s)

4.1 Interactive Data Visualization & Collection Tool

The literature reviews informed the model conceptual framework, guided the data collection, and supported the model calibration. We chose a mixed-methods social network analysis (mmSNA) approach and created an OpenDataKit-based data collection tool for mapping ego-centric networks during interviews. Interviews were audio recorded to capture rich narratives and enable quality checking. The multilingual tool (Burmese/English) was co-developed, built, user-tested, and finalized on-site with migrant workers in an interdisciplinary context of co-production.

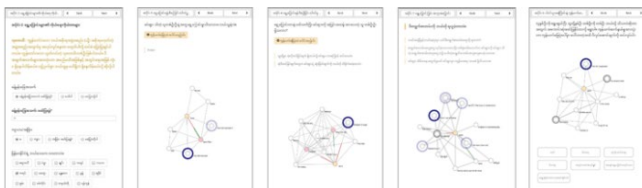


Figure 2: Participatory network mapping tool.

4.2 Interactive Data Visualization & Analysis Tool

During the 8-month data collection phase, we also developed an offline browser-based data analysis tool that used D3.js to visualize individual networks in detail and allow for easy cross-case comparison of network structures to identify patterns. This mmSNA interface informed the intervention model design, including the agent types/attributes, interactions, timesteps, and spatial representations. It led to visual representations of migrants as individual subjects and as populations.

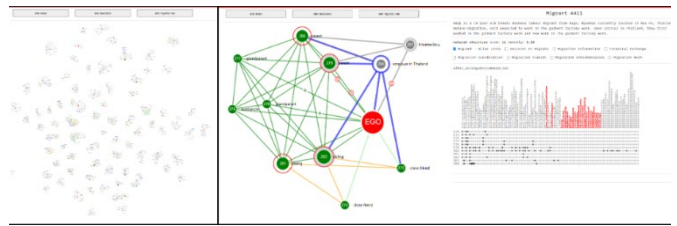


Figure 3: Dynamic audiovisual data analysis tool built with D3.js.

4.3 Agent-Based Model for Description + Intervention

As noted by Epstein (2008), the practice of modelling has multiple aims beyond the often-assumed aim of prediction. These aims include description, explanation, discovery, and education. [6] The two ABMs aim to describe and discover system behavior.

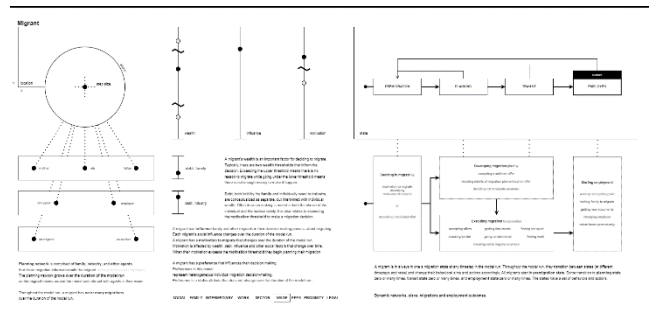


Figure 4: Conceptual diagram representing the migrant agent type.

We chose a two-phased approach to ABM development. First, we produced an empirically rich descriptive ABM of the labor migration system in context. Second, we conducted experiments in this model to explain and test cocreated in the process of forming an ‘intervention simulation’ created model to experiment with how the system might change under different intervention scenarios. At the descriptive modelling stage, literature reviews, data collection, and mixed-methods analysis informed the development of a descriptive conceptual model. The descriptive conceptual model was then translated into a computational model in JavaScript using the p5.js visualization library. (Figure 1) This computational model was reviewed by several audiences before moving on to the current intervention simulation modelling stage where we are conducting a desk-review on ‘safer migration’ interventions in Thailand to inform the design of intervention scenarios to test using the initial descriptive model.

5 CONCLUSION AND ONGOING WORK

Dynamic visualization tools played a critical role in bettering this research by key reducing interviewees’ cognitive burden, facilitating participatory data collection, enabling the collection of a complex dataset of actors and interactions, enhancing interviewers’ qualitative probing, facilitating researchers’ pattern recognition during analysis, and increasing data and model comprehension for viewers. Going forward we look to develop other ways to better assist migrants and policy makers with navigating complex systems of migration. These final research outcomes will be shared publicly as an experiential interactive installation.

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