Sociotechnical Challenge Modelling

Design Method Guidance

Tyler Reinmund

February 2, 2026

Contents

Introduction **3**
Interested to learn more? . . . 3
Cite this document: . . . 3

Materials **4**
Sociotechnical Challenge Cards . . . 4
Countermeasure Planning Worksheets . . . 4
Facilitator Guide . . . 4
Sociotechnical Challenge Modelling Workbook . . . 5
Sociotechnical Challenge Modelling Presentation . . . 5

Background **6**
The Machine Learning-Enabled Care Pathway . . . 6
Example Use Cases . . . 6
Sociotechnical Challenges . . . 8
Gather Data Challenges . . . 8
Interpret Output Challenges . . . 9
Initiate Action Challenges . . . 10
Cross-cutting Challenges . . . 11

Process Guidance **13**

Activity 1: Challenge Identification **14**
Input . . . 14
Steps . . . 14
Output . . . 14

Activity 2: Countermeasure Planning **16**
Input . . . 16
Steps . . . 16
Output . . . 16

Introduction

Sociotechnical challenge modelling is a co-design method for teams who plan to implement machine learning-enabled tools (*ML tools*) into health and social care pathways. It allows teams to anticipate how *sociotechnical challenges* may occur within their projects.

Sociotechnical challenge modelling allows teams to answer two questions:

1. How may sociotechnical challenges arise in our current plan?
2. How will we mitigate these sociotechnical challenges?

This document provides guidance on how to use sociotechnical challenge modelling to anticipate and address sociotechnical challenges.

Interested to learn more?

🎓 Read the research:

Tyler Reinmund, Lars Kunze, and Marina Denise Jirotka. 2026. Sociotechnical Challenge Modeling: A Design Method for Responsible AI in Healthcare and Social Welfare. In *Proceedings of the 2026 CHI Conference on Human Factors in Computing Systems (CHI '26), April 13– 17, 2026, Barcelona, Spain.* ACM, New York, NY, USA, 20 pages. https://doi.org/10.1145/3772318.3790547

Tyler Reinmund, Lars Kunze, and Marina Jirotka. 2026. *Sociotechnical Challenges of Machine Learning in Healthcare and Social Welfare.* arXiv:2601.11417 [Preprint]. https://arxiv.org/abs/2601.11417

✉ Contact us: tyler.reinmund@jesus.ox.ac.uk

Cite this document:

Reinmund, Tyler. 2024. Sociotechnical Challenge Modelling. https://treinmund.quarto.pub/sociotechnical-challenge-modelling/

Materials

This page presents the materials required to perform sociotechnical challenge modelling.

Sociotechnical Challenge Cards

The sociotechnical challenge cards are used to identify potential challenges that may arise when developing and deploying a machine learning tool in a health and social care setting. The cards are available to download at the following link:

- Sociotechnical Challenge Cards (Printable)
- Sociotechnical Challenge Cards (Figma)

Countermeasure Planning Worksheets

The countermeasure planning worksheet is used to generate an actionable mitigation plan to address the identified sociotechnical challenges. The worksheets are available to download at the following link:

- Worksheet download (PowerPoint)

Facilitator Guide

The facilitator guide provides detailed instructions on how to conduct the sociotechnical challenge modelling workshop. The guide is available to download at the following link:

- Facilitator Guide (PDF)
- Facilitator Guide (Word)
- Facilitator Guide (Markdown)

Sociotechnical Challenge Modelling Workbook

The sociotechnical challenge modelling workbook is used to document the challenges identified and the countermeasures prioritised during the workshop. The workbook is available at the following link:

- Worksheet download (Excel)

Sociotechnical Challenge Modelling Presentation

The sociotechnical challenge modelling presentation provides a template to document the challenges identified and the countermeasures prioritised during the workshop. The presentation is available to download at the following link:

- Presentation (PowerPoint)

Background

This page introduces several key concepts important for understanding sociotechnical challenge modelling. These concepts include:

- The Machine Learning-Enabled Care Pathway
- Sociotechnical Challenges

The Machine Learning-Enabled Care Pathway

The **Machine Learning-Enabled Care Pathway** outlines a high-level structure for using ML tools in health and social care. It consists of three stages:

Example Use Cases

> **The ML-Enabled Care Pathway in Children's Social Care**
>
> In a children's social care agency, practitioners use a ML tool when prioritising referrals. When call screeners receive a referral, they gather information about the child and family and input those details into the ML tool. The ML tool then generates a risk score between 1 (low risk) and 10 (high risk). Using the risk score and other information known about the current allegation, the call screener decides whether to accept the case. Depending on the call screeners' decision, the case is either screened-out or passed along to a case worker for further investigation.

> **The ML-Enabled Care Pathway in Health Care**
>
> A US hospital system recently deployed a ML tool to predict which patients are at risk of developing sepsis. The ML tool analyses patient data, such as vital signs and lab results, to generate a risk score. When a patient's risk score exceeds a certain threshold, the ML tool sends an alert to the patient's care team. The care team then decides whether to intervene and provide additional care to the patient.



Gather Data

Collecting relevant data and inputting it into the ML tool. Data may be collected automatically, such as through sensors in care homes, or manually, as in during interviews or observations.



Interpret Output

Using the gathered data, the ML tool generates an output, such as a risk score or treatment recommendation. This output must then be interpreted by a professional.



Initiate Action

Based on output, an individual or group of professionals make a decision and take action.

Figure 1: The Machine Learning-Enabled Care Pathway

Sociotechnical Challenges

Sociotechnical challenges are the consequence of interactions between technical and social factors as ML tools are put into routine use. These challenges represent mismatches between the organisation of care work and how a ML tool works.

Through our research, we have identified 10 different types of sociotechnical challenges for ML tools in health and social care. Each challenge is likely to arise at a different stage of the ML-Enabled Care Pathway (Figure 1).

We have distilled these challenges into separate concepts which indicate the stage at which the challenge is likely to arise, its title, a description, an example, and sensitising questions.

Gather Data Challenges

Challenge 1: Data Inconsistencies

Data on which the ML tool makes predictions are inconsistent with the expected structure, type, or unit.

Example
A local authority uses a ML tool to identify risks among adult social care service users by analysing case notes. Different social workers write case notes at varying levels of detail and length, affecting the ML tool's performance.
Questions

- Is there any variation in the way we collect data?
- What processes and procedures do we have in place that guide data gathering?
- What skills, techniques, and tools do we need to gather and prepare data into the required format?

Challenge 2: Poor Environmental Conditions

The physical workplace environment in which the ML tool operates directly affects the quality of data it processes.

Example
A ML tool is used in a hospital to analyse images of patients' eyes to detect disease. A technician takes a picture of a patient's eye in a poorly lit room leading to a low quality image.
Questions

- Does the ML tool use any data that is affected by environmental factors (e.g., lighting, temperature)?
- What aspects of our workplace environment may affect the data analysed by the ML tool?

Challenge 3: Data Restrictions

Access to the data on which the ML tool generates predictions is restricted.

Example
A ML tool is used by a local authority to determine how likely older adults living in the community are to fall. But, due to the data protection concerns of service users, the ML tool cannot use factors such as age or gender to make predictions.
Questions

- What internal or external policies affect which input data we can use?
- Are we reluctant to share data with other groups or organisations? Are other groups or organisations reluctant to share data with us?
- What variables do we want the ML tool to use but currently cannot?

Interpret Output Challenges

Challenge 4: Mismatched Objectives

The objectives considered by stakeholders when making decisions differ from the variable predicted by the ML tool.

Example
Case workers prioritise short-term risk by screening-in referrals to a care agency if they consider a child to be at risk of abuse. The ML tool prioritises long-term risk by screening-in referrals if it predicts that the child will be re-referred to the care agency at some point in the future.
Questions

- What is the outcome that stakeholders consider when making care decisions?
- What is the outcome that the ML tool is trying to predict?
- What outcome do we want stakeholders to consider when making care decisions?

Challenge 5: Hidden Predictors

Stakeholders rely on contextual information not captured in data to assess the validity of the ML tool's predictions.

Example
A ML tool is used in a hospital to predict whether a patient is likely to have a successful surgery. Rather than only rely on the tool's predictions when making a decision, surgeons also consider factors unrelated to patients' conditions, such as their own workload.
Questions

- What factors do we consider when making care decisions?
- What factors (i.e., variables) are considered by the ML tool when making predictions?
- What happens if a person's decision is different from the tool's prediction? Who is accountable if things go wrong?

Challenge 6: Decision Point Disconnect

The intended user group does not come in contact with the ML tool when making care decisions.

Example
A ML tool is used in a hospital to support decisions for whether a patient should undergo surgery. Yet, the clinicians who are the intended users of the ML tool make most of their decisions in the wards and rarely come in contact with a computer.
Questions

- Where are the intended users of the ML tool when they make care decisions? Do they have easy access to a computer?
- How are the outputs of the ML tool being disseminated to those making care decisions?

Initiate Action Challenges

Challenge 7: Insufficient Causal Information

Stakeholders attempt to use a ML tool to answer cause-and-effect questions for which it was not designed.

Example
Social workers try to use the variables included in a ML tool to consider what interventions would most likely reduce a service user's risk of falling. But, the ML tool was only designed to predict the probability that someone will fall and cannot answer the social workers' question.
Questions

- What sort of cause-and-effect questions are we interested in?
- Was the ML tool designed to be able to answer those questions?

Challenge 8: Value Conflicts

Use of the ML tool reveals conflicting interpretations of organisational values among stakeholders.

Example
A ML tool is used in a hospital to identify individuals eligible for a preventive care programme. Different stakeholder groups in the hospital debate what amount of human control over the ML tool would reduce the risk of errors.
Questions

- What values and motivations are most at stake when using the ML tool?
- Are there disagreements or conflicts over these values and motivations?
- How do we typically resolve value conflicts in our organisation?

Cross-cutting Challenges

Challenge 9: Disrupted Workflows

Use of the ML tool challenges existing workflows and lines of communication.

Example
A ML tool is used in a hospital to identify patients who may be at risk of sepsis. Clinicians traditionally relied on seeing and speaking with patients to make a diagnosis. Now, sepsis diagnoses are made without any patient interaction.
Questions

- Is there a specific process or workflow that must be followed when using the ML tool?
- How does this workflow align with our existing care workflows?

- Do stakeholders have flexibility in deciding how they follow the tool's workflow?

Challenge 10: Limited Understanding

Stakeholders possess limited understandings of how the ML tool functions.

Example
A ML tool is used in a hospital to analyse X-ray images to identify lung cancer among patients. In some instances, the radiologists do not know why the ML tool flags an area in the image as abnormal tissue.
Questions

- What do different stakeholders know about the ML tool?
- What does each group need to know about the ML tool?
- Does the interface provide any clues about how the ML tool functions?
- How can we help stakeholders learn about the ML tool?

Challenge 11: Additional Labour

Use of the ML tool demands additional, previously unperformed work.

Example
A ML tool is used by a local authority to predict a child's risk of maltreatment. To use the ML tool, social workers have to manually type in the child's family information as an input for the tool to generate a prediction.
Questions

- What tasks are needed to prepare the data that is used by the ML tool to make predictions?
- What tasks are required to over-ride the tool's predictions?
- Are the benefits of using the ML tool greater than the costs?
- Are there incentives in place for people to perform the necessary tasks?

Process Guidance

This page presents guidance on how to perform sociotechnical challenge modelling.

Sociotechnical challenge modelling involves two activities: Challenge Identification and Countermeasure Prioritization.

Activity 1: Challenge Identification

Objective: Anticipate how sociotechnical challenges may arise.

Input

- An understanding of the care pathway in which the ML tool is (or will be) used.
- The Sociotechnical Challenge Cards.
- A piece of paper or digital document for constructing a Severity x Likelihood matrix.
- The Sociotechnical Challenge Modelling worksheet.

Steps

1. Create a Severity x Likelihood matrix on a piece of paper or digital document.
2. Draw a card from the **Sociotechnical Challenge** deck.
3. Discuss the "sensitizing questions" on the card to consider how the challenge may arise in your own project.
4. Using a Severity x Likelihood matrix (Figure 1), plot the challenge card according to how severe the consequences would be if it occurred and how likely it is to occur.

5. Repeat steps 2-4 for each challenge card.
6. Open up the Sociotechnical Challenge Modelling worksheet.
7. Document the challenges identified during previous steps within the worksheet.

Output

1. Written responses detailing potential challenges and their implications for your project.
2. A prioritized set of sociotechnical challenges according to their severity and likelihood.

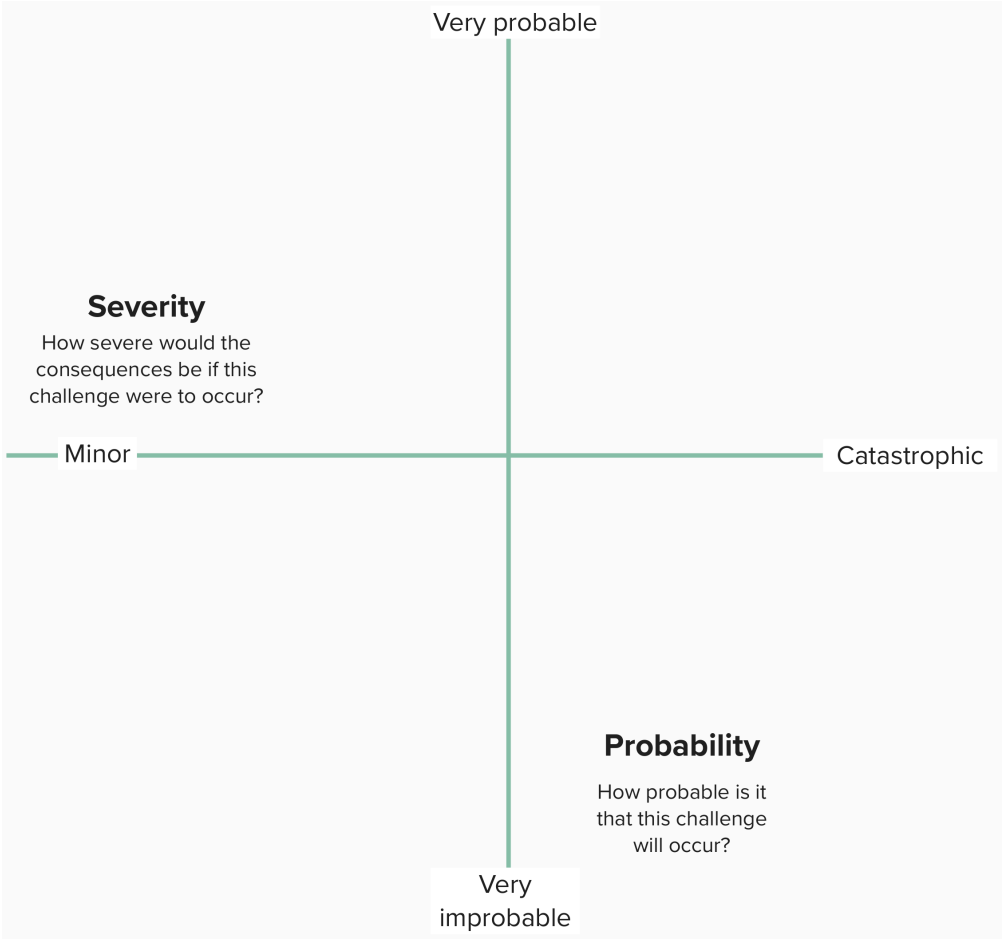


Figure 1: An example Severity x Likelihood matrix

Activity 2: Countermeasure Planning

Objective: Create a mitigation plan to address the prioritized sociotechnical challenges.

Input

- Sociotechnical challenges identified in the previous activity.
- The Sociotechnical Challenge Modelling worksheet.

Steps

1. Review the challenge to ensure a shared understanding and clarify any uncertainties.
2. Split into subgroups of 3-4 people and assign each subgroup to a challenge.
3. Receive a Countermeasure Planning Worksheet.
4. Create a mitigation plan:
    a. Write the challenge at the top of the worksheet.
    b. Set a timer for 8 minutes.
    c. Generate eight distinct countermeasures (one per minute) for the selected challenge.
    d. Present their ideas to the subgroup.
    e. Select at least three promising countermeasures based on potential impact and feasibility.
    f. Review predefined countermeasures and discuss any additions or modifications.
5. Present proposed countermeasures to the larger group for feedback.
6. Document the countermeasures in the countermeasures within the Sociotechnical Challenge Modelling worksheet.
7. Assign an owner to each countermeasure.

Output

An actionable mitigation plan for high-priority sociotechnical challenges.