Methodological Guide for the Information Flow Methodology, Draft v0.1

Mattias Brännström, mattias.brannstrom@umu.se

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Methodological Guide

Introduction to the Information Flow Model (IFM)

The Information Flow Model (IFM) is a framework designed to analyze decision processes within socio-technical systems. It provides a structured representation of how information moves and transforms, enabling the identification of potential biases, ambiguities, and impacts. The two core components of the IFM are:

- **Sites:** These are repositories of information or specific states where information resides. Examples include databases, documents, or decisions.
- **Channels:** These represent the transformations or actions that move information from one site to another. Channels may involve decision-making processes, calculations, or data transfers.

The IFM is represented as a Directed Acyclic Graph (DAG), where nodes correspond to sites and edges represent channels. This ensures a clear pathway from inputs to outputs, avoiding circular dependencies. By constructing and refining an IFM, decision processes can be systematically analyzed to uncover critical insights.

Notes on Stakeholder Involvement

Stakeholders play a vital role in steps 1 and 2. Use workshops, interviews, or surveys to:

- Validate the accuracy of the scaffold and refined model.
- Uncover ambiguities and alternative pathways.
- Ensure the model captures the real-world decision-making process.

Step 1: Constructing the Information Flow Model

The goal of this step is to create an initial scaffold of the decision process under analysis. This scaffold identifies key elements of the socio-technical system and organizes them into a DAG that represents how information flows. The aim is to capture the overall structure in broad terms, facilitating stakeholder engagement and input. Follow these steps:

1. Define the Scope of the Decision Process

- **What decision process are you analyzing?** Clearly define the scope and purpose.
- **Start and End Points:** Identify the starting information or input and the final decision or output.

2. Identify Sites and Channels

- **Sites:** Represent repositories of information or specific information states. For example, a database of candidates or an intermediary report.
- **Channels:** Represent transformations, decisions, or processes that modify or transfer information between sites.

3. Map the Decision Process

- Begin with known intermediary steps. What transformations occur between the start and end points? Break these steps into sites and channels.
- Name each site and channel descriptively to make the model understandable to stakeholders.

4. Build the Initial Graph

- Use the identified sites and channels to construct a draft DAG. Focus on clarity and completeness rather than detail.
- Stakeholder input is critical at this stage to ensure the model reflects the socio-technical reality.

Result: A scaffold of the information flow model, showing the decision process expressed as named sites and channels.

Step 2: Refining the Information Flow Model

In this step, the initial scaffold is refined to provide a more detailed and precise representation of the decision process. This involves examining each channel individually to understand its dependencies, outputs, and potential ambiguities.

1. Analyze Each Channel

For each channel in the model:

- **Describe the Process:** Clearly articulate how information flows from the source site (A) to the target site (B). Include any intermediate transformations.
- **Check Information Sufficiency:**
  - Is the information in site A sufficient to produce site B? If not, what additional inputs are required (e.g., reference information, rules, datasets)?
  - Amend the model by adding intermediate sites or inputs as needed.
- **Validate Outputs:**
  - Does site B contain only outputs of this channel? Remove any extraneous information.

2. Address Ambiguities and Alternatives

- **Identify Ambiguities:** Are there areas where the process is unclear or where multiple interpretations are possible?
- **Represent Alternatives:** If decisions can be made in different ways or with different inputs, include these alternatives explicitly in the model.

3. Ensure Model Validity

- Maintain the properties of a valid network. Ensure the graph remains a DAG, with clear pathways from inputs to final decisions.
- Use abstraction to simplify overly detailed sections of the graph. For example, group related sub-networks into a single channel if they represent one functional step.

Result: A refined and detailed information flow model that accurately reflects the decision process, capturing all dependencies and ambiguities.

Step 3: Assigning Types

With the IFM scaffold refined, this step involves assigning descriptive types to each site and channel to classify the kinds of information they represent and the transformations they undergo. Follow these steps:

1. Classify Site and Channel Types

- Examine each site and channel to determine their content and purpose.
- Assign descriptive types, starting with broad classifications:
  - **Structured or Unstructured:** Identify whether the information is structured (e.g., datasets with defined fields) or unstructured (e.g., free text, images).
  - **Lists and Sub-lists:** Determine whether the site contains collections of items (lists) or filtered subsets (sub-lists).
- Refine these classifications as needed, depending on domain-specific requirements.

2. Infer Channel Transformations from Types

- Use the input and output types of a channel to infer its transformation process.
- Identify key transformations such as filtering, ranking, aggregation, or abstraction.

Result: A typed information flow model that provides structured classifications of sites and channels, enabling deeper analysis of potential biases.

Step 4: Identifying and Mapping Biases

This step examines the typed IFM for potential biases introduced by transformations. Particular attention is given to the following situations:

1. Detect Bias Sources

- **Information Loss:** Abstract representations may fail to capture the richness of original data.
- **Unintended Information:** Implicit information (e.g., order in a list) may unintentionally influence outcomes.
- **Blocked Channels:** Situations where intended processes are unrealizable without additional resources or information.
- **Unintended Channels:** Alternate pathways that bypass the formal decision process.
- **Pre-existing Bias:** External biases in input data that propagate through the system.

2. Represent Bias in the IFM

- Highlight ambiguities or alternatives in the IFM as explicit decision points.
- Map potential biases to specific sites or channels for targeted analysis.

Result: An annotated IFM that identifies and categorizes potential biases, providing a foundation for mitigation strategies.

Step 5: Connecting Stakeholders and Impacts

The purpose of this step is to integrate stakeholder perspectives into the IFM and trace the impacts of decisions made within the system. This involves identifying stakeholders, categorizing impacts, and linking these impacts to specific biases or transformations in the IFM. Follow these steps:

1. Identify and Categorize Stakeholders

- **Identify Stakeholders:** Who are the primary and secondary stakeholders? For example, candidates, recruiters, or end-users.
- **Categorize Stakeholders:** Group stakeholders into meaningful categories, such as vulnerable populations, rejected candidates, or decision-makers.

2. Trace Impacts and Link to Biases

- Identify specific decisions or outcomes in the IFM that affect stakeholders.
- Assess the probability and severity of these impacts, using qualitative or quantitative methods.
- Link impacts to specific biases or transformations in the IFM. Highlight areas where vulnerable groups are disproportionately affected.

Result: A stakeholder-aware IFM that identifies and categorizes impacts, offering insights into how biases propagate through the system and affect different groups.

Step 6: Evaluating Mitigation and Design Options

The final step involves using the resulting model in order to assess the decision making system or explore strategies to address the biases and impacts identified in the previous steps. This includes applying targeted assessment methods and analyses, considering design improvements, and targeted mitigation measures.

1. **Design Improvements**
   - Eliminate or clarify ambiguities and alternatives in the IFM.
   - Modify or remove channels that introduce known biases.
   - Introduce additional control steps to improve decision-making transparency and fairness.
2. **Assessment Methods**
   - Use statistical tests and fairness metrics to confirm the presence and severity of biases.
   - Simulate alternative scenarios with synthetic data to evaluate potential outcomes.
3. **Mitigation Measures**
   - Apply fairness techniques, such as reweighting or post-hoc adjustments, to address biases.
   - Constrain mitigation efforts to channels or decisions linked to material stakeholder impacts.
   - Monitor for unintended consequences, such as adverse effects on other stakeholder groups.

Result: A set of prioritized design, assessment, and mitigation strategies that address identified biases and minimize stakeholder impacts.