



SST-24 The Constraint Analysis Method



Returning to the hospital example, suppose that management now wants to understand why the new patient care protocol is producing inconsistent results.

Different explanations are offered. Some point to resource pressures, others to procedures, and others to staff behaviour. Each explanation highlights part of the problem, but none provides a complete picture.

Instead of focusing on a single cause, the analysis team decides to take a different approach. They define the system they are examining, identify the different types of constraint acting on it, and look at how these constraints interact.

They examine how resource availability affects decision-making, how procedures shape interaction, how cultural expectations influence behaviour, and how differences in judgement affect outcomes. They also consider whether these constraints are aligned or in conflict, and how they may have changed over time.

By working through the problem in a structured way, the team develops a clearer understanding of what is driving system behaviour and where changes might be made.



Formal Description

Constraint analysis is a structured method for diagnosing system behaviour by identifying, classifying, and evaluating the configuration and interaction of constraints.

The method proceeds through the following steps which are a simplification of the full procedure described in the source paper:

1. Define the system

- Specify system boundaries, the behaviour or function of interest and the relevant components (e.g., people, groups, organisations, institutions).

2. Identify constraints

- Determine the material, structural, cultural, biogenic, and agentic constraints acting on the system, as appropriate to the level of analysis.
- In the case of groups organisations, institutions, etc., biogenic constraints become functional constraints.
- Where cultural or biogenic/functional constraints differ significantly across the system, this should be reflected in the system components selected.

3. Classify constraints

- Distinguish between enabling conditions and inhibiting constraints.
- Identify the presence or absence of relevant conditions.

4. Analyse constraint interactions

- Examine how constraints influence one another across domains through causal interactions.
- Identify feedback between constraints.

5. Identify changes over time

- Analyse how constraints have shifted, including the introduction or removal of enabling or inhibiting conditions.

6. Assess current system behaviour

- Identify alignment and misalignment between constraints, reflected in feedback processes that stabilise or destabilise the system, and assess how this influences current behaviour.

7. Evaluate intervention options

- Identify potential changes to existing constraint configurations that may restore alignment.

N.B. Constraint analysis provides a diagnostic framework for understanding conditions of possibility rather than predicting precise outcomes.



Plain English Explanation

Constraint analysis is a step-by-step way of understanding how a system works and why it behaves as it does.

The first step is to define the system clearly. This means deciding what you are looking at, what its function is, and where its boundaries lie. Without this, it is difficult to identify which constraints are relevant.

It is also important to select the appropriate level of analysis by defining the system components in a way that matches the behaviour being studied.

For example, when analysing a nation, it is often more useful to treat sectors or institutions (such as government, industry, or education) as system components rather than individual people. At this level, components can be understood as having their own patterns of behaviour, shared cultures, and decision-making processes.

At higher levels of analysis, biogenic constraints are typically not considered directly. Instead, constraints become functional or purposive, relating to the roles and requirements necessary for the system to operate effectively.

Selecting an appropriate level of analysis ensures that constraint identification and interaction are meaningful and relevant to the behaviour being examined.

Next, you identify the different constraints acting on the system. These include: material conditions such as resources; structural arrangements such as roles and procedures; cultural expectations, and differences between individuals in their needs, capacities, and decision-making.

Once the constraints have been identified, you consider whether they enable or inhibit behaviour, and whether important conditions are present or missing. This helps to clarify not just what is happening, but why certain actions are possible or prevented.

The next step is to look at how these constraints interact. Some constraints reinforce one another, leading to stable and predictable patterns of behaviour. Others conflict, leading to inconsistency, tension, or change.

It is important to consider how the system has changed over time. Constraints may have been added, removed, strengthened, or weakened, and these changes often explain shifts in behaviour.

You then assess how the current combination of constraints produces the behaviour you observe.

This includes identifying whether the system is stable, under stress, or changing.

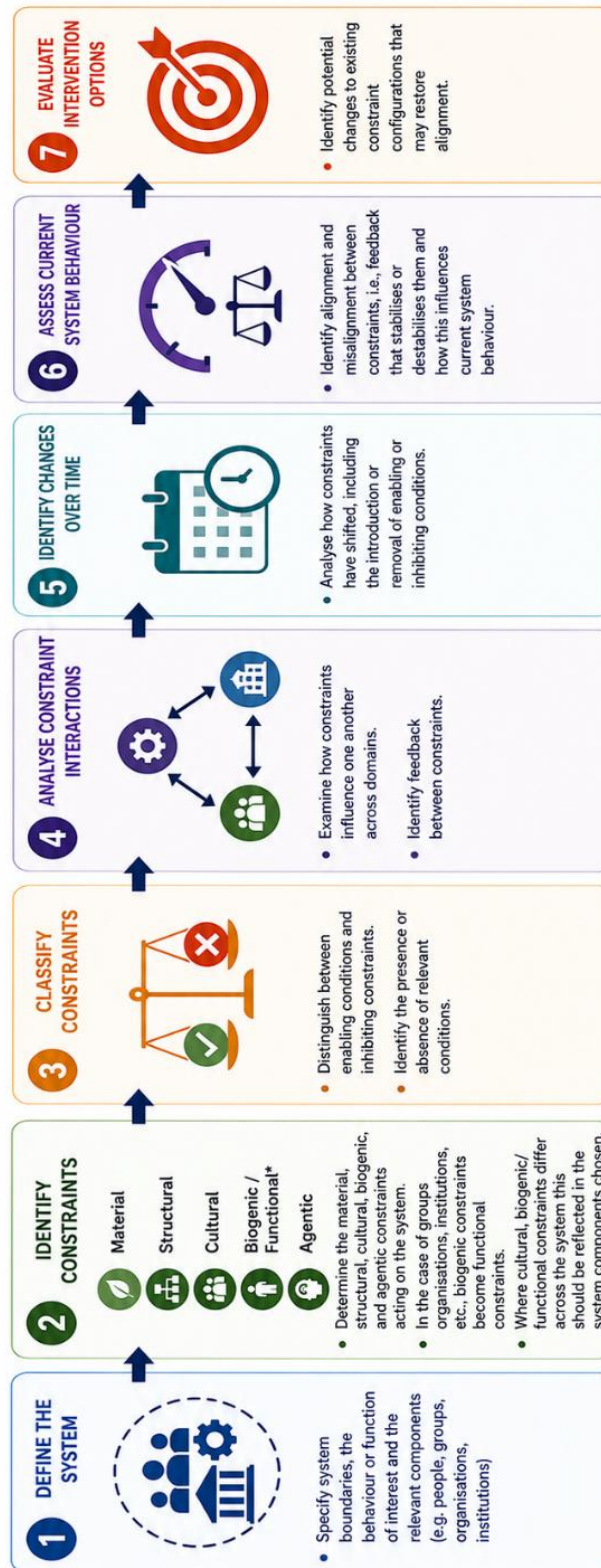
Finally, you consider how changing constraints might improve system. Rather than trying to change behaviour directly, constraint analysis focuses on changing the conditions that shape behaviour. This might involve introducing enabling conditions, removing inhibiting constraints, thus improving alignment between different parts of the system.

A useful way to visualise this is to think of the system as moving within a landscape. In this landscape, stable patterns of behaviour are like valleys, where the system tends to settle and remain.

Unstable conditions are like slopes or ridges, where behaviour is more variable and difficult to sustain. Changes in constraints can shift the position of the system in the landscape, making some patterns more stable and others less so. In this way, system behaviour can be understood not just as a set of actions, but as movement between more or less stable regions over time.



THE CONSTRAINT ANALYSIS METHOD



LEVEL OF ANALYSIS: This method focuses on system level constraints (material, structural, cultural). Where necessary, analysis may consider how variation in agentic constraints across individuals or groups influences system behaviour.

* Biogenic constraints become functional constraints in the case of groups, organisations, institutions, etc.



Example 1 – Healthcare System

1. Define system

Patient care delivery within a hospital (clinical staff, management, procedures, patients)

2. Identify constraints

- **Material:** staffing levels, time availability, equipment
- **Structural:** approval procedures, clinical protocols, reporting hierarchies
- **Cultural:** professional norms (e.g. risk aversion, deference to authority, standards of care)
(*Optional deeper level*)
- **Agentic:** variation in clinical judgement and decision-making under pressure

3. Classify constraints

- **Missing enabling condition:** sufficient time for assessment and decision-making
- **Enabling condition:** established clinical protocols supporting safe practice
- **Inhibiting constraint:** complex or multi-stage approval procedures
- **Absent inhibiting constraint:** limited mechanisms to prevent workload overload or decision delays

4. Analyse constraint interactions

- **Material + Structural → delays**
Limited staffing and time combined with complex procedures slow decision-making
- **Structural + Cultural → cautious behaviour**
Protocols and hierarchical approval structures, reinforced by risk-averse norms, discourage deviation or rapid escalation
- **Structural feedback:**
Delays in one stage of care create bottlenecks that propagate through the system

5. Identify changes over time

- Increased patient demand has reduced available time per case
- Staffing pressures have intensified workload
- Procedures have become more formalised, increasing complexity

6. Assess current system behaviour

- **Misalignment:**
Resource constraints (time, staffing) are misaligned with procedural complexity and demand
- **Feedback dynamics:**
Delays generate further delays (destabilising feedback through bottlenecks)
- **Outcome:**
Inconsistent care quality and delayed decision-making

7. Evaluate intervention options

- **Introduce/strengthen enabling conditions:**
 - Increase staffing levels
 - Allocate protected time for critical decisions
- **Reduce/enhance inhibiting constraints:**
 - Simplify approval procedures
 - Introduce escalation pathways to bypass bottlenecks
- **Reconfigure structure:**
 - Redesign workflows to reduce dependency between stages
 - Improve coordination mechanisms across teams



Example 2 – Transport System

1. Define system

Transport service delivery across a rail network (infrastructure, operators, scheduling system, passengers)

2. Identify constraints

- **Material:** infrastructure capacity (track availability, signalling limits)
- **Structural:** scheduling system, timetables, routing rules
- **Cultural:** expectations of punctuality and reliability
- *(Optional deeper level)*
- **Agentic:** operator and controller decision-making under pressure

3. Classify constraints

- **Missing enabling condition:** sufficient spare capacity to absorb delays
- **Enabling condition:** established scheduling system enabling coordination
- **Inhibiting constraint:** network bottlenecks at key junctions
- **Absent inhibiting constraint:** limited buffering or redundancy to prevent delay propagation

4. Analyse constraint interactions

- **Material + Structural → delays**
Limited capacity combined with tightly coupled schedules increases sensitivity to disruption
- **Structural + Cultural → pressure on operators**
Strict timetables combined with punctuality expectations influence operational decisions
- **Structural feedback:**
Delays in one part of the network propagate through interconnected schedules

5. Identify changes over time

- Increased passenger demand has reduced available capacity margins
- Timetables have become more tightly optimised, reducing flexibility
- Expectations of punctuality have remained high or increased

6. Assess current system behaviour

- **Misalignment:**
Capacity constraints are misaligned with scheduling intensity and demand levels
- **Feedback dynamics:**
Small delays are amplified through the network (destabilising feedback)
- **Outcome:**
Reduced reliability and increased variability in service delivery

7. Evaluate intervention options

- **Introduce/strengthen enabling conditions:**
 - Increase infrastructure capacity
 - Add schedule buffers or recovery time
- **Reduce/enhance inhibiting constraints:**
 - Remove bottlenecks where possible
 - Introduce stronger operational controls to limit delay propagation
- **Reconfigure structure:**
 - Redesign timetables to reduce interdependence



Provenance and Links

This module builds on:

- The constraint framework developed in *Constraint Analysis: A Causal Framework for Understanding and Influencing Complex Systems* (Challoner, 2026)
- The Enhanced Morphogenetic Cycle (Challoner, 2026) (interaction of structure, culture, and agency)
- Systems theory and feedback concepts
- Intervention and system change

Practical Exercise

Applying Constraint Analysis

Think of a system you are familiar with. What is its primary function?

Work through the steps:

1. Define the system
2. Identify at least three different types of constraint
3. Classify them as enabling or inhibiting, and note any missing conditions
4. Identify at least one important interaction between constraints
5. Describe the resulting behaviour
6. Suggest one possible intervention based on changing constraints

Reflection:

- Does analysing constraints provide a clearer explanation than focusing on a single cause?

Which step did you find most difficult, and why?