

# GQIM and Assurance Cases



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# Topics

What is an assurance case?

What is GQIM?

How do they complement each other?

How can they be used together?

# GQIM and Assurance Cases

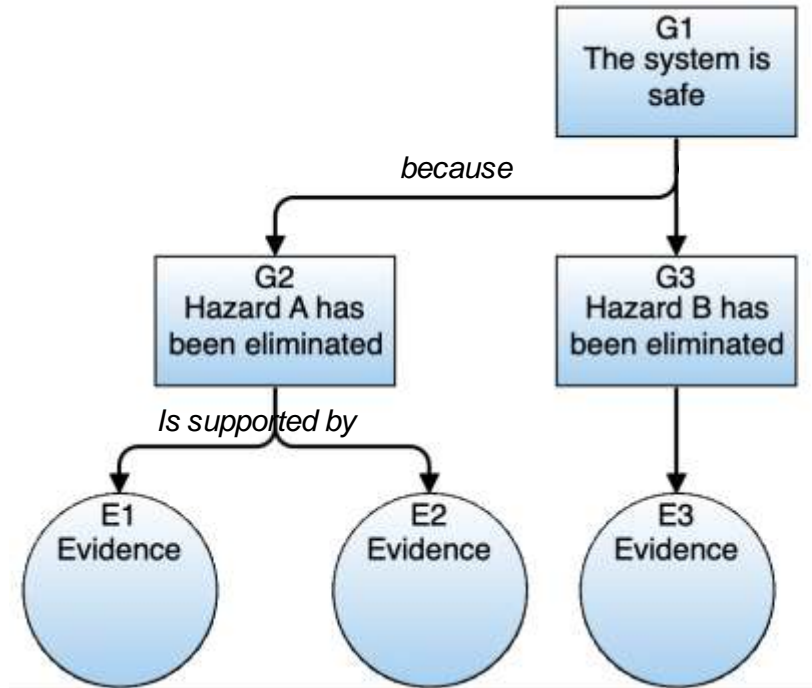
The GQIM\* methodology is a structured **workshop** that takes the participants through a set of steps to elicit business goals to develop a measurement plan

Assurance Cases record a structured **argument** supporting claims with evidence

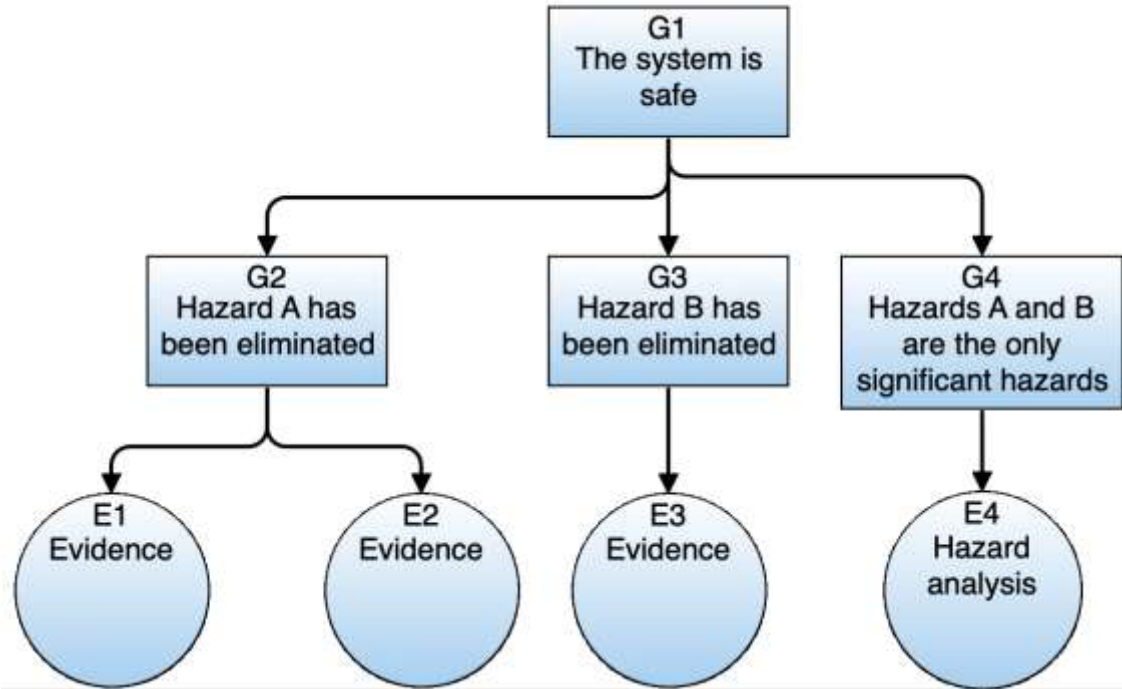
AC evidence can be gathered in accordance with a measurement plan developed by GQIM

\* GQIM: Goal, Question, Indicator, Metric

# A Notional Assurance Case (in GSN)



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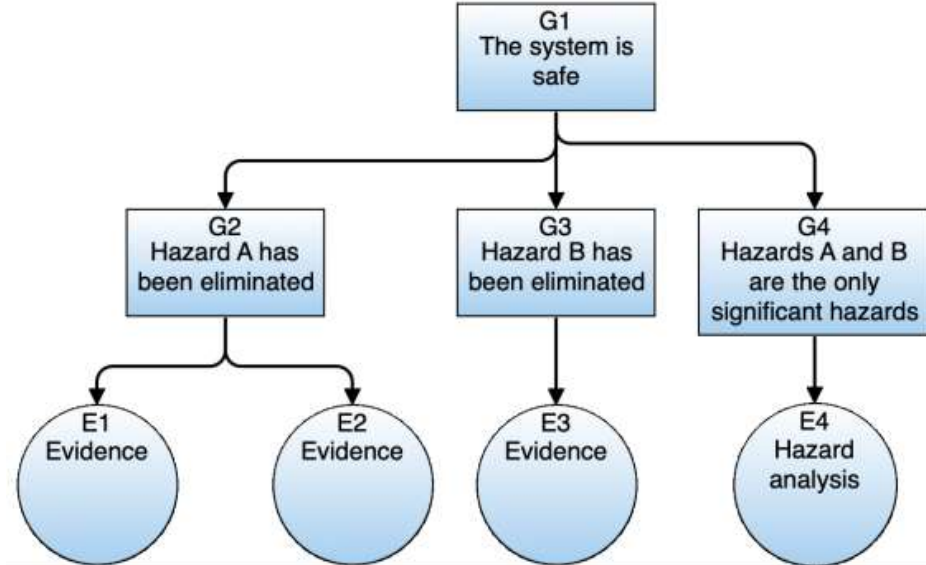


# A Notional Assurance Case (in GSN)

Given the evidence, how confident should we be that G1 has been achieved? Why?

What does it mean to have confidence?

What could be done to improve confidence? Why?



# What is Confidence?

Confidence: the degree of belief that a claim holds

- Possible Measures:
  - Absence of doubt (80% of doubts eliminated)?
  - Probability of operational failure or accident (e.g.,  $P(\text{Failure}) < 20\%$ )?
    - On demand – 80% of the time you make a demand, it succeeds?
    - Over some period – a mission of 100 hours is 80% likely to succeed?
  - Some combination of probability of failure and consequence of a failure?
    - Safety integrity levels
    - Residual risk
- Can vary among different holders of the belief

# What is Confidence?

## Confidence changes over time

- As more is known, i.e., as *uncertainty* decreases (more knowledge)
  - While developing a system
  - While investigating a system (building a case)
  - As you discover counterevidence
- Degrades with time
  - As assumptions are invalidated (e.g., system environment or usage changes)
  - As confidence in evidence decays (e.g., will tests still pass?)

# Why Bother with Assurance Cases

An AC, as an explicit argument linking evidence to a claim:

- Explains why the evidence is meaningful
- Provides a basis for justifying confidence in the claim
- Makes it easier to find oversights and poor reasoning

Have been used for actual systems (i.e., value has been demonstrated)

- Invented in 1998 in Britain for safety critical systems
- Is now required in Europe in submissions for certifying some systems

ACs are typically used to get release approval for completed systems

- DevSecOps is a different (and new) use

# GQIM Concept and Precepts

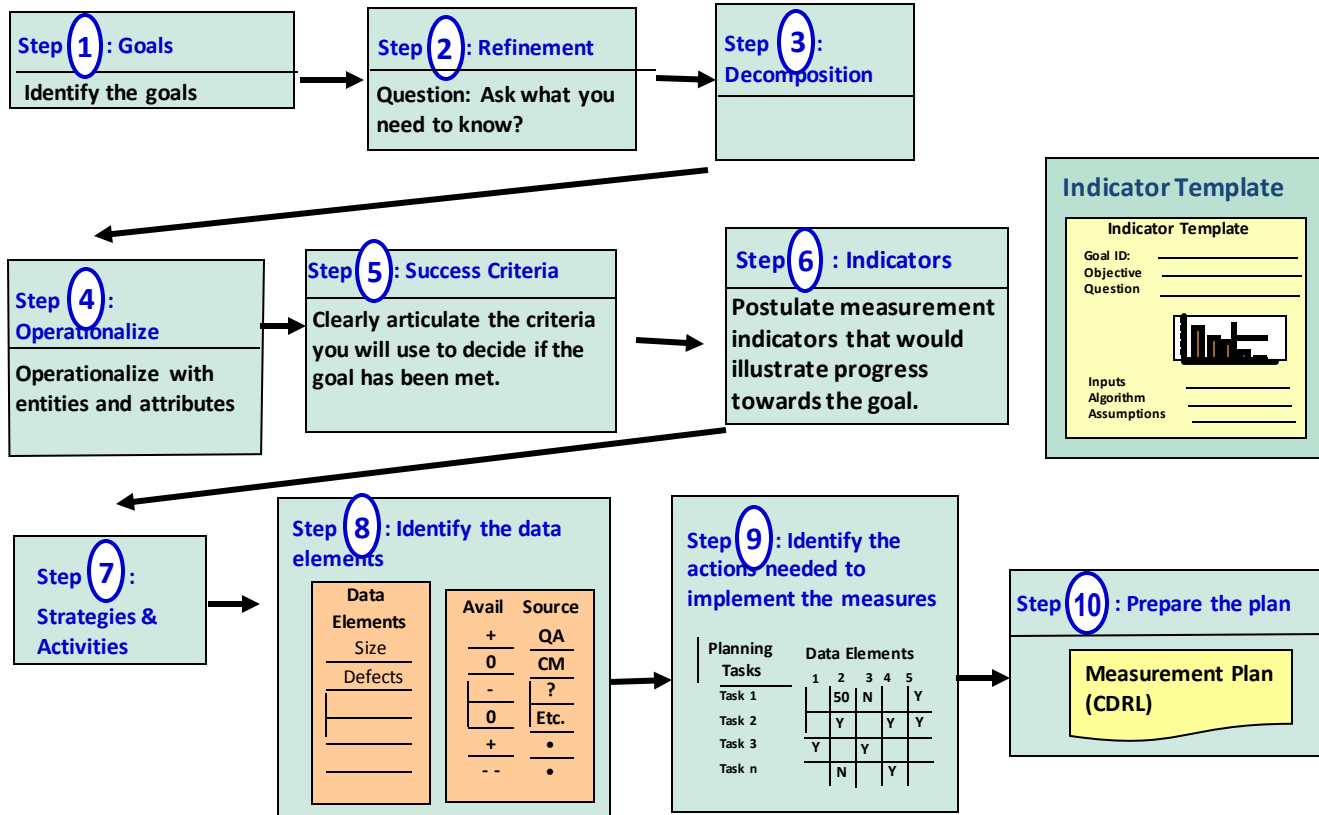
Concept: A methodology to convert a business goal into a measurement plan

The GQ(I)M method is based on 3 precepts, and it consists of 10 steps

The three precepts are:

- *Measurement goals* are derived from *business goals*
- *Evolving mental models* provide context and focus
- GQ(I)M translates informal business goals into *executable measurement structures*

# GQIM Workshop Process Steps



# GQIM Indicator Template

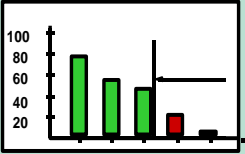
**INDICATOR TEMPLATE**

Measurement Goal # \_\_\_\_\_:

Objective \_\_\_\_\_

Questions \_\_\_\_\_

Visual Display



Input(s)

Data Elements \_\_\_\_\_

Responsibility  
for Reporting \_\_\_\_\_

Form(s) \_\_\_\_\_

Algorithm \_\_\_\_\_

Assumptions \_\_\_\_\_

Interpretation \_\_\_\_\_

X-reference \_\_\_\_\_

Probing Questions \_\_\_\_\_

Evolution \_\_\_\_\_

**Indicator Objective** – objective or purpose of the indicator.

**Questions** – list of questions that the indicator is trying to answer.

**Visual Display** – graphical view of the indicator.

**Perspective or Viewpoint** – description of the audience for whom this display is intended.

**Input** – list of data elements (measures) required to construct the display/indicator.

**Algorithm** – description of the algorithm used to construct the display/indicator.

**Assumptions** – list of assumptions about the organization, its processes, life-cycle model, and so on that are important conditions for understanding this indicator.

**Data Collection Information** – information pertaining to how, when, how often, by whom, and so forth the data elements required to construct the indicator are collected.

**Data Reporting Information** – information about who is responsible for reporting the data, to whom, and how often.

**Data Storage** – information on storage, retrieval, and security of the data.

**Analysis and Interpretation of Results** – information on how to analyze and interpret (as well as not misinterpret) the indicator.

# Why Use GQIM?

**Two thirds** of software measurement programs fail within the first **12-18** months.

**Failure is primarily due to organizational reasons, not technical reasons.**

Programs fail because they:

- Aren't tied to business goals
- Addressed someone else's question
- Are perceived to be unfair and therefore resisted
- Motivate an undesirable behavior
- Are not a natural activity of the work (cumbersome)

Or because

- No action is taken based on the numbers
- Missing sustained management sponsorship

# GQIM and Assurance Case Alignments

Start with the goals (claims)

Decompose goals into related hierarchical claims and supporting subclaims

Seek metrics (evidence) that support the goals

# GQIM and Assurance Cases: Some Key Distinctions

The GQIM is a structured **workshop** that takes the participants through a set of steps to elicit business goals to develop a measurement plan. Assurance Cases record a structured **argument** supporting claims with evidence.

GQIM focuses on using **measurement and visualization** to guide decisions. Assurance Cases focus on the **chain of reasoning** showing how evidence (more-or-less) supports a claim.

GQIM templates document a single indicator with measures from **actual system data**. The information in a GQIM template can serve as **evidence** in an assurance case.

GQIM precisely describes entities and measures, producing a **measurement plan**. Assurance Cases do not specify measurement **practices**.

The GQIM structured goal statement requires identification of who is **expected to use GQIM data and for what purpose**. Assurance Cases usually do not specify who is expected to use the case nor what they are using it for.

White paper being developed to discuss distinctions in more detail

# GQIM Strengths and Limits

## Strengths

- Workshop brings together multiple viewpoints
- Precise, structured statement of goals
- Evidence is explicit
- Evidence (metrics) can be reused
- Indicators support visualization of evidence
- Cost and timing of measurement is planned
- GQIM Template summary documents results

## Limits

- Each template defines a single indicator
- Individual templates do not provide an overall gestalt of the measurement approach
- Working artifacts are not formally structured or preserved*
- Justification for template elements is not preserved in formal justification
- Significance of evidence is not explicitly described

# Assurance Case Strengths and Limits

## Strengths

The structured argument:

- summarizes reasons and evidence for having confidence in a claim
- makes reasoning explicit and provides a reviewable artifact
- shows the significance of evidence (measurements)

The process naturally addresses exceptions, doubts, edge cases, and caveats

The validity of evidence can be explicitly argued

## Limits

Graphical notations only allow for terse descriptions of evidence requiring external links to details

Higher level claims are not directly measurable

Does not consider cost of obtaining evidence or identify how evidence is to be obtained

# Why Use ACs and GQIM Together?

Information consumers are often a separate group from the information producers

The opportunities for miscommunication include

- developing the right goals
- considering the overall set of goals and subgoals
- prioritization of required evidence
- selecting appropriate measures
- establishing a practicable measurement plan

# GQIM and Assurance Cases

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Assurance Cases record a structured **argument** supporting claims with evidence

AC evidence can be gathered in accordance with a measurement plan developed by GQIM