GQM + Strategies in a Nutshell

Based on the book: V. Basili and others: Aligning Organizations Through Measurements. The Goal Question Metric + Strategies Approach. Springer, 2014.

Notes in Italian or in green color are written by the ISSSR course instructor.

GQM+STRATEGIES IN A NUTSHELL

Data is like garbage.
You had better know what you are going to do with it before you collect it.
– unknown author

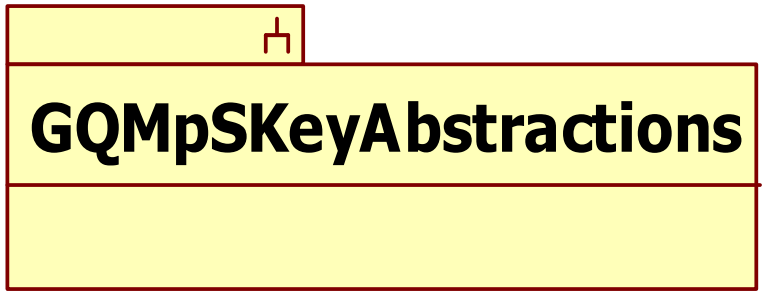
PROGETTO DEL CORSO 2017-2018

Vogliamo integrare ed estendere un sistema software, sviluppato in analoghi precedenti corsi, basato **GQM+Strategies** ™ (GQMpS o GQM+S).

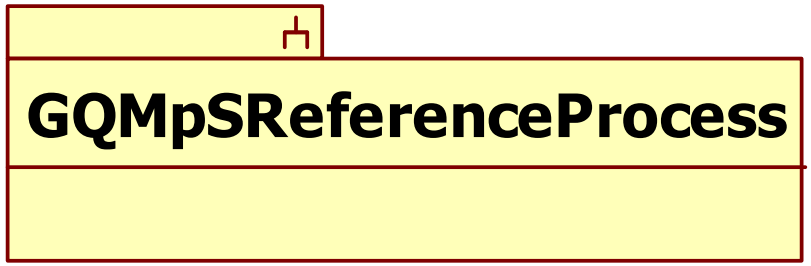
Il sistema dovrà consentire di **descrivere** fondamentali aspetti - quali **scopi** (“goals”) e **strategie** - di una organizzazione (“target organization”) e, se richiesto, dovrà facilitare il **controllo** della organizzazione target e supportare **scelte** - da parte dei **decisori** della stessa organizzazione - basate su **dati** così come via via **misurati** con il possibile ausilio del sistema stesso.

ELEMENTI CHIAVE

Le **astrazioni chiave** con cui avremo a che fare nello sviluppo di un tale sistema sono:

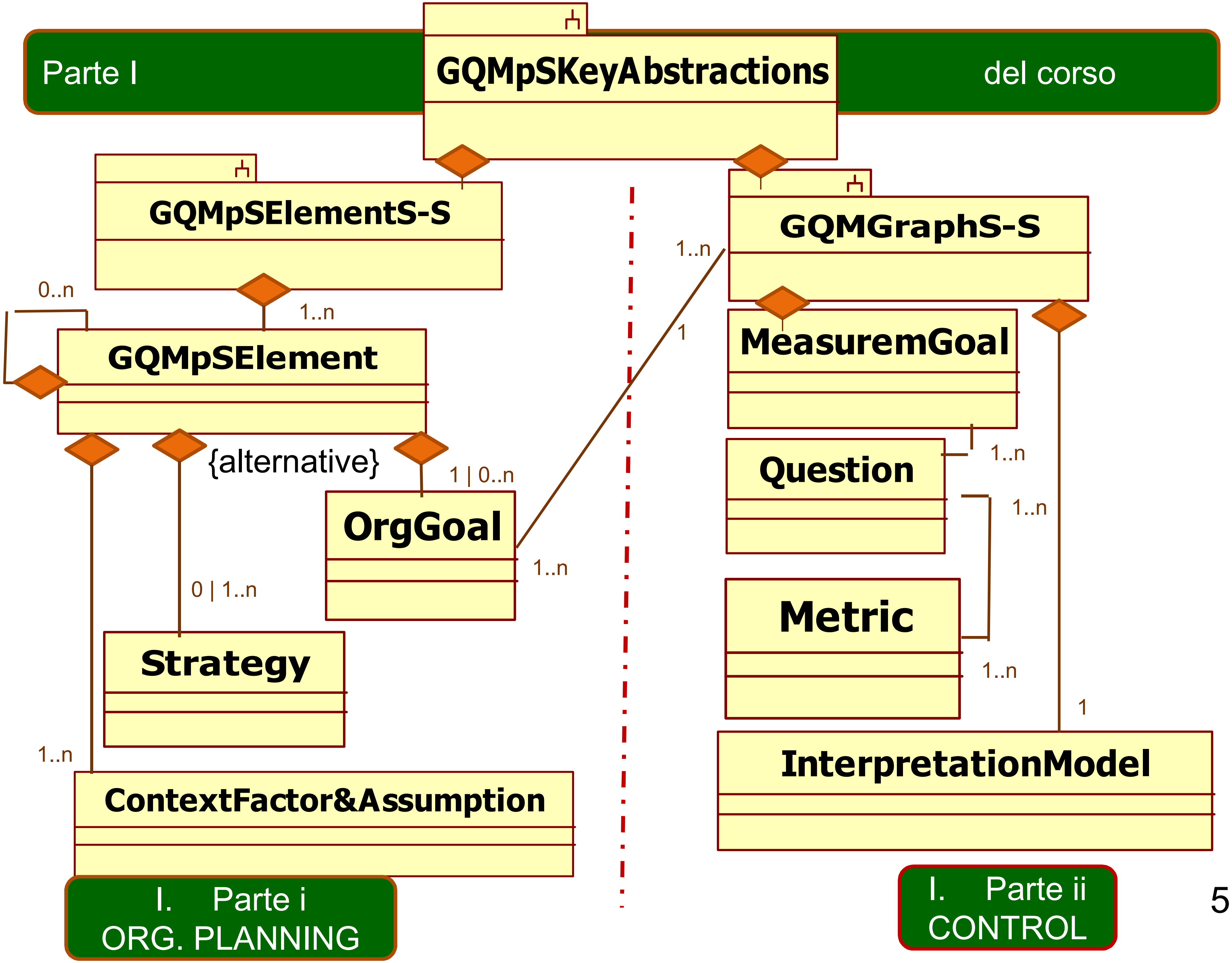


Parte I del corso

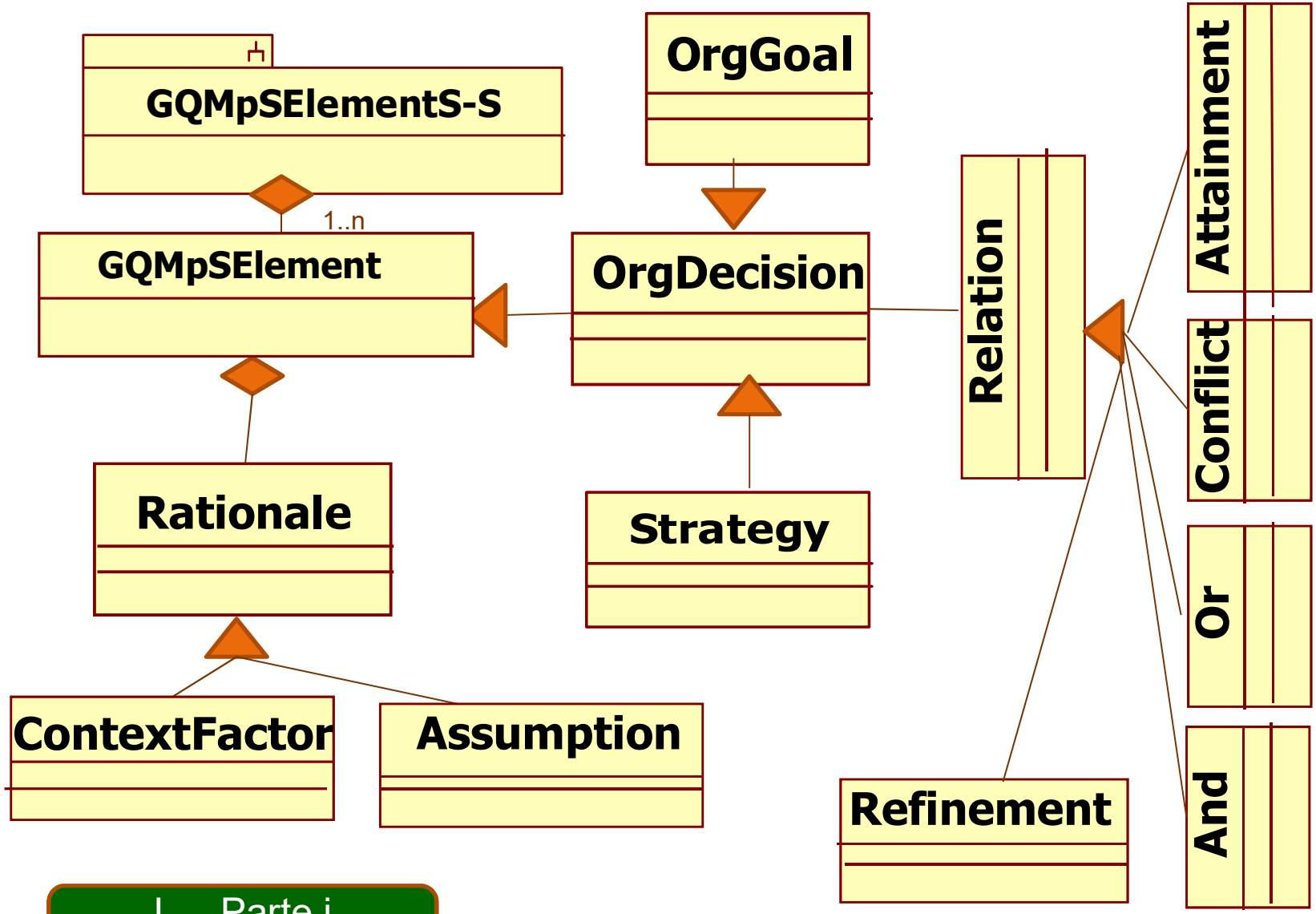


Parte II del corso

Parte II.Phases 3..4. Measurement plan. TargetOrgWorkflows



Parte I del corso



I. Parte i
ORG. PLANNING

Extension based on Watizaki et al. 2016, Skype meeting

ULTERIORI ELEMENTI CHIAVE
ELEMENTI CHIAVE ALTERNATIVI

Vedere successivo gruppo di lezioni su *Misurazione del software* e, in particolare, su *Software measurement ontologies* e relative trasparenze.

.1 THE BASIC IDEA

GQM+Strategies is an approach for *aligning* **goals** and **strategies** of an **organization** across different **units** through *measurement*.

GLOSSARY: SOME TERMS

GQM+Strategies is an approach for **aligning goals** and **strategies** of an **organization** across different **units** through **measurement**.

- **Goals** are future states the organization wants to achieve (e.g., in terms of its business).
- **Strategies** are any actions defined for obtaining these goals.
- **To align**: to obtain that all the units work in the same direction.

THE BASIC IDEA. **OUTCOMES**

An **outcome** is the description of the organization **goals**, **strategies**, and their **relationships**.

- **Goals** and **strategies** across all units are **linked** to each other.

In the full application of the approach, one more **outcome** is taking **evidence-based decisions**. In particular, the **major outcome** is a **strategic measurement programs** *allowing* for **data-based decision** to be made in the organization.

- **Measurement data** is collected for systematically *evaluating* **goal attainment** and the **success/failure of strategies**.

THE BASIC IDEA. **TWO MAJOR PERSPECTIVES**

Consistent with common practices in organizational management, the approach considers two major perspectives:

- **Organizational Planning**, and
- **Control**.

ORGANIZATION PLANNING

The ***Organizational Planning*** perspective ***specifies***:

- the **goals** (*G*) of an organization and thus what the organization strives to achieve;
- the means by which the desired goals are expected to be achieved, by specifying explicit **strategies** (*S*) that prescribe the course of action to be taken.

THE BASIC IDEA. TWO MAJOR PERSPECTIVES.

ORGANIZATION PLANNING

- Applying GQM+Strategies supports an ***iterative*** definition and alignment of goals and strategies across all organizational units within the application scope.

ORGANIZATION PLANNING

Organizational goals should be defined to be **measureable** and **achievable**.

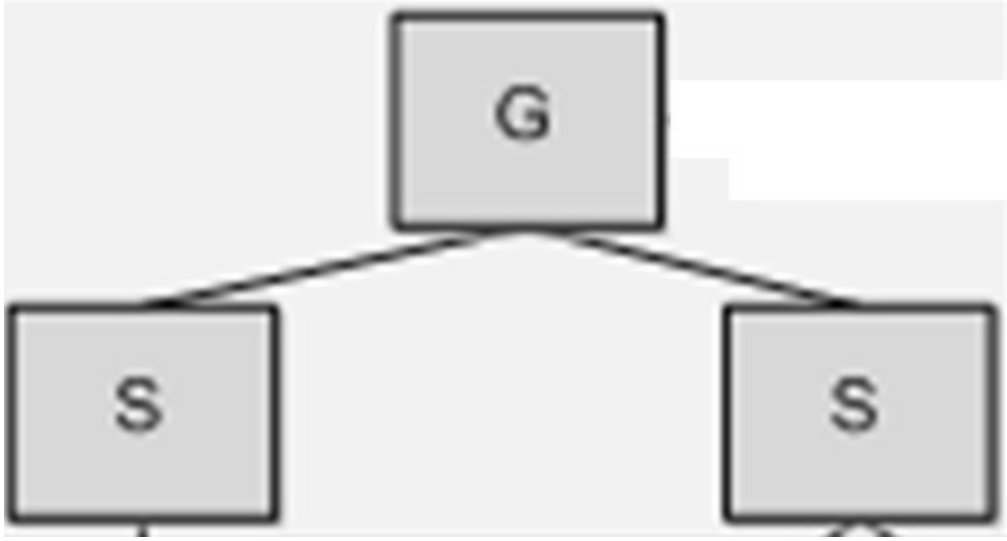
Example HL goals might be:

- To improve customer satisfaction, e.g., +% in Δt1
- To increase market share, or e.g., +% in Δt2
- To reduce production costs. e.g., -% in Δt3

THE BASIC IDEA. TWO MAJOR PERSPECTIVES.
ORGANIZATION PLANNING

Strategies are defined and selected with the purpose of ***achieving*** the defined goals.

FROM GOALS TO STRATEGIES



ORGANIZATION PLANNING

RATIONALE

Goals and strategies are typically defined in the context of a **specific organization**, where the amount of potential options is limited by organization-specific capabilities or constraints.

ORGANIZATION PLANNING

RATIONALE

In order to account for those organization-specific constraints, **context factors** and **assumptions** are specified during the definition of goals and strategies.

Context factors and assumptions provide a rationale for selecting and linking a particular set of goals and strategies in the context of a specific organization and its organizational environment.

Information about context factors and assumptions is attached to the goals and strategies at each level.

THE BASIC IDEA. TWO MAJOR PERSPECTIVES.

ORGANIZATION PLANNING

FROM GOALS TO STRATEGIES & RELATED RATIONALE

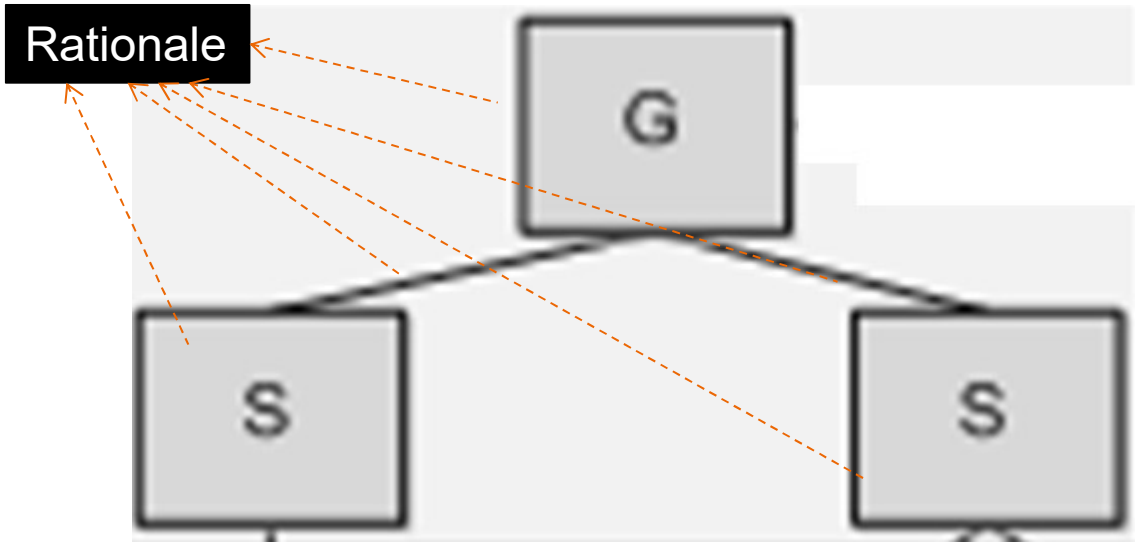


Figure 2.1.L GQM+Strategies: Organizational Planning perspective

ORGANIZATION PLANNING

FROM STRATEGIES TO LOWER LEVEL GOALS

Based on an initial set of goals and strategies, further lower-level goals are defined.

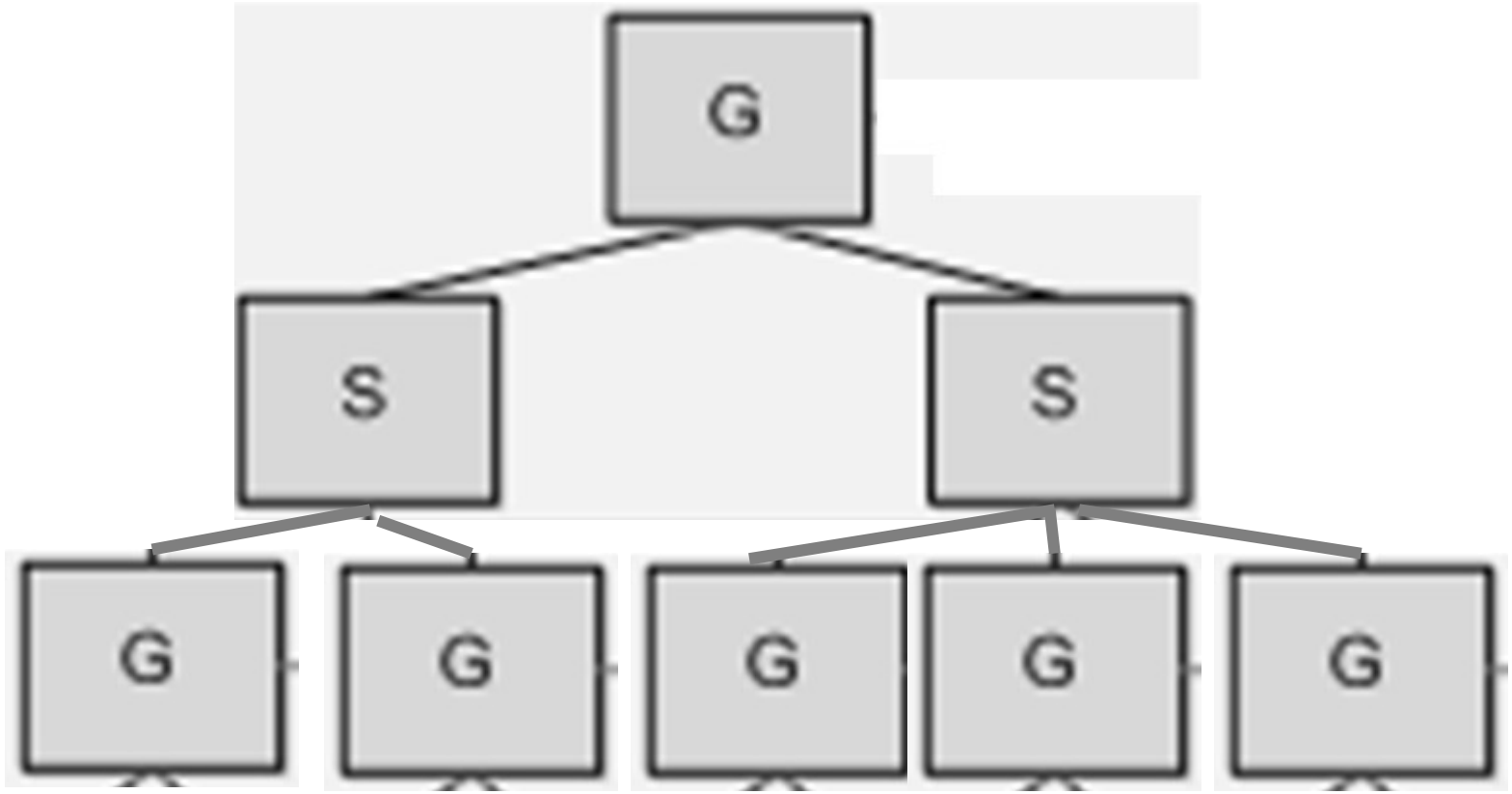


Figure 2.1.L GQM⁺Strategies: Organizational Planning perspective

ORGANIZATION PLANNING

STOP CRITERIA

The process of defining goals, selecting strategies to accomplish those goals, and generating new goals to embody those strategies continues as long as new lower-level goals and strategies are required to adequately address the defined organizational scope.

The breakdown process stops when all reached strategies are executable as they are defined without placing, or however without tracing at GQM+S level the realization of, further detailed goals.

ORGANIZATION PLANNING

Applying the approach delivers a **hierarchical model** of goals and strategies, which often resembles the ***structure of the organization*** [or part of it].

THE BASIC IDEA. TWO MAJOR PERSPECTIVES.

Organizational Planning Perspective

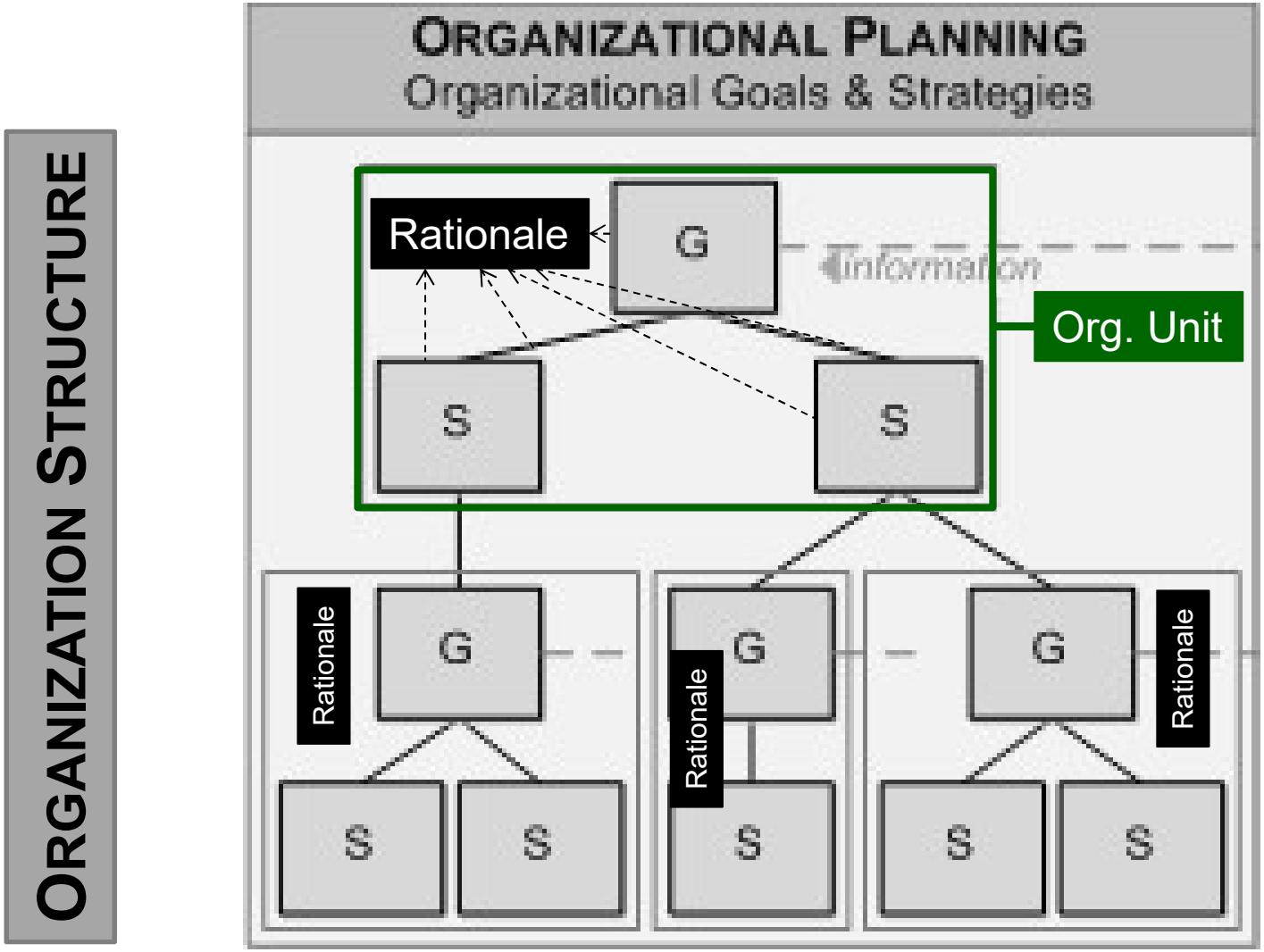


Figure 2.1.L GQM+Strategies: Organizational Planning perspective

ORGANIZATION PLANNING

Note, that the scope is not limited to a single organization, but may encompass a ***network of organizations***, which share common top-level goals and want to achieve alignment with respect to lower-level goals and strategies.

THE CONTROL PERSPECTIVE

The *Control* perspective specifies suitable controls for **evaluating the success of the organizational goals** from the Organizational Planning perspective.

This is achieved by defining **measurement models**.

Definition of *control*

transitive verb

1 *a* : to check, test, or verify by evidence or experiments (*archaic*)

b : to incorporate suitable controls in *a controlled experiment*

2 *a* : to exercise restraining or directing influence over: REGULATE *control one's anger*

b : to have power over : RULE *A single company controls the industry.*

c : to reduce the incidence or severity of especially to innocuous levels: *control an insect population; control a disease*

intransitive verb

To incorporate controls in an experiment or study —used with *for* - *control for socioeconomic differences*

https://www.merriam-webster.com/dictionary/control

THE CONTROL PERSPECTIVE

MEASUREMENT MODELS

The specification of suitable controls is achieved by defining **measurement models** using the **GQM approach**.

- In this context, each organizational goal is associated with a **measurement goal** (*MG*), **questions** (*Q*) and **metrics** (*M*) that help gain *objective information* on the success of goal attainment.

Control Perspective. GQM

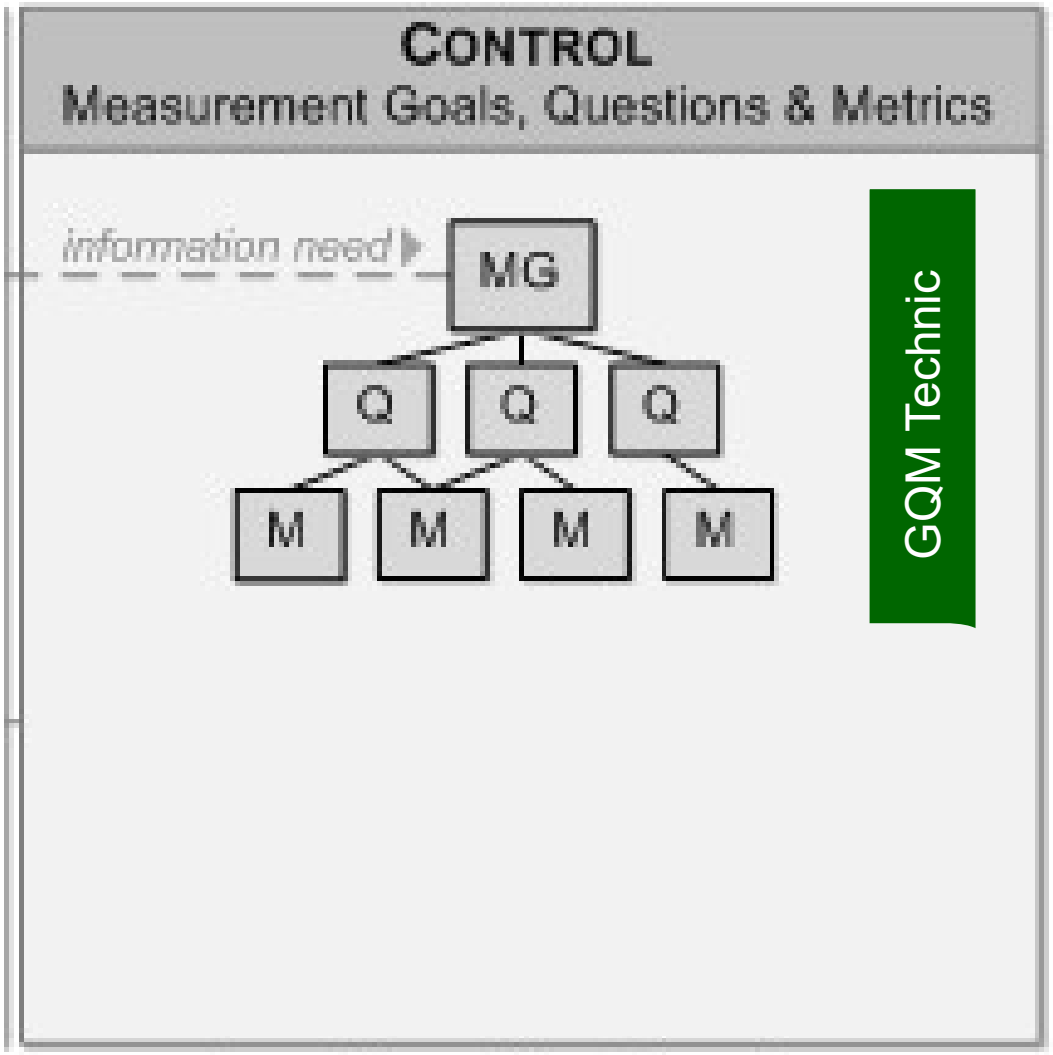


Figure 2.1.R GQM⁺Strategies: Control perspective

THE CONTROL PERSPECTIVE: THE INTERPRETATION MODEL

For each of the defined measurement goals, **interpretation models** are specified, which support the evaluation of the goal attainment and strategy success with respect to the defined set context factors and assumptions.

Control Perspective

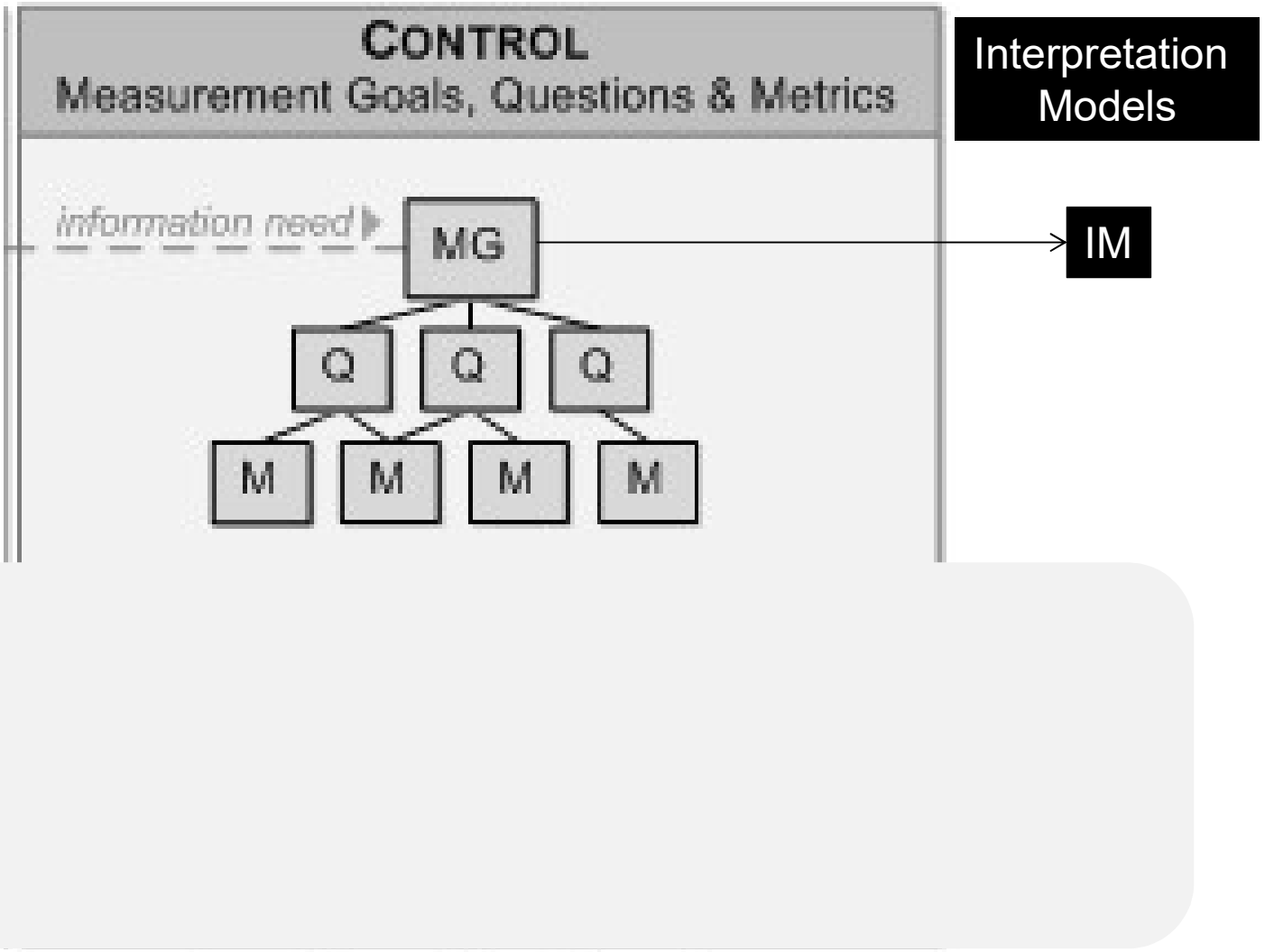


Figure 2.1.R GQM⁺Strategies: Control perspective

A TWO FOLDERS HIERARCHICAL MODEL-BASED MECHANISM: THE GRID

Thus the entire hierarchical model, which we call a **grid**, provides not only a *mechanism for planning* organizational goals and strategies, but also for defining a *measurement model* that is consistent and relevant to the organizational planning perspective.

Organizational Planning and Control Perspectives

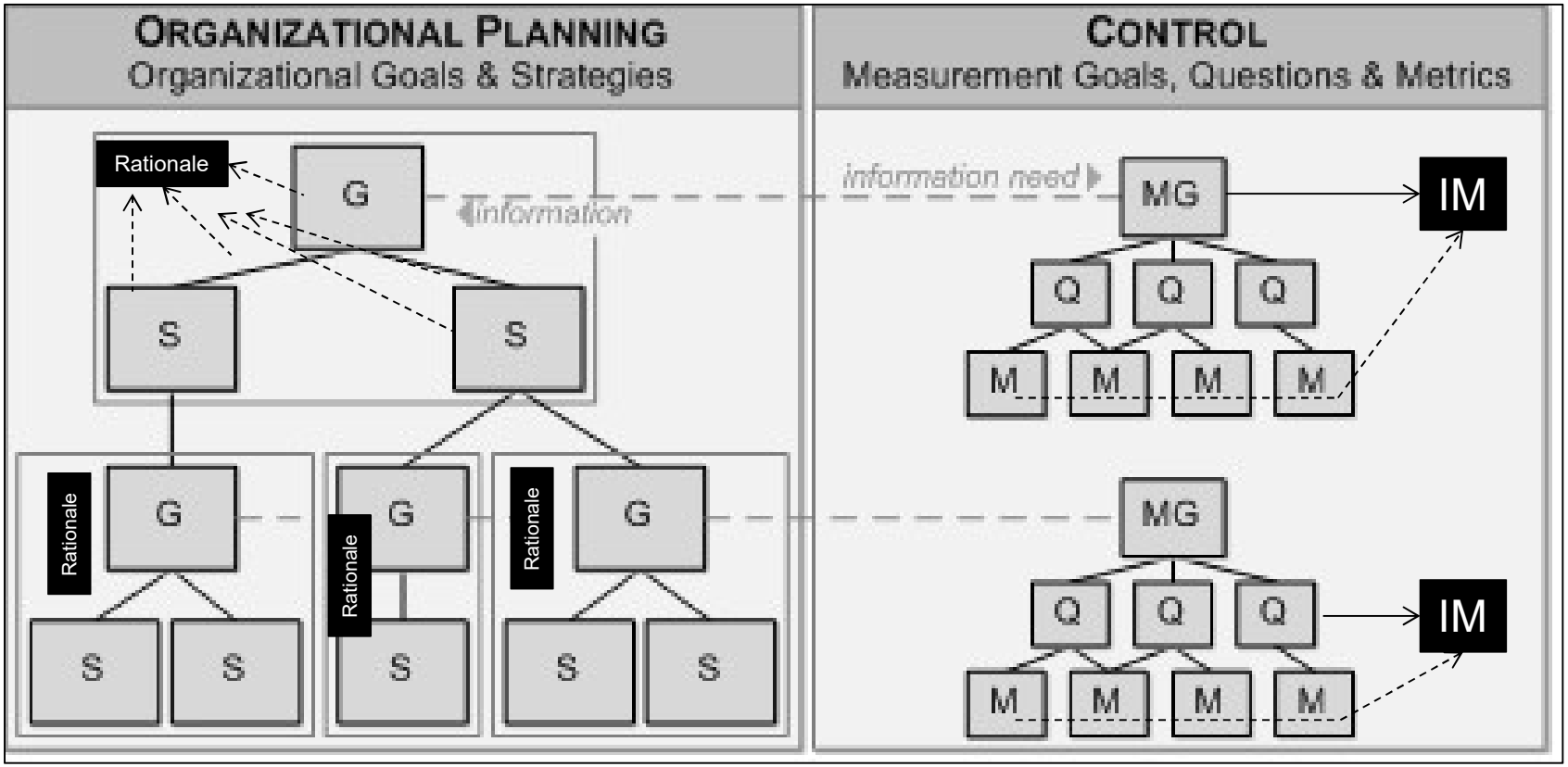
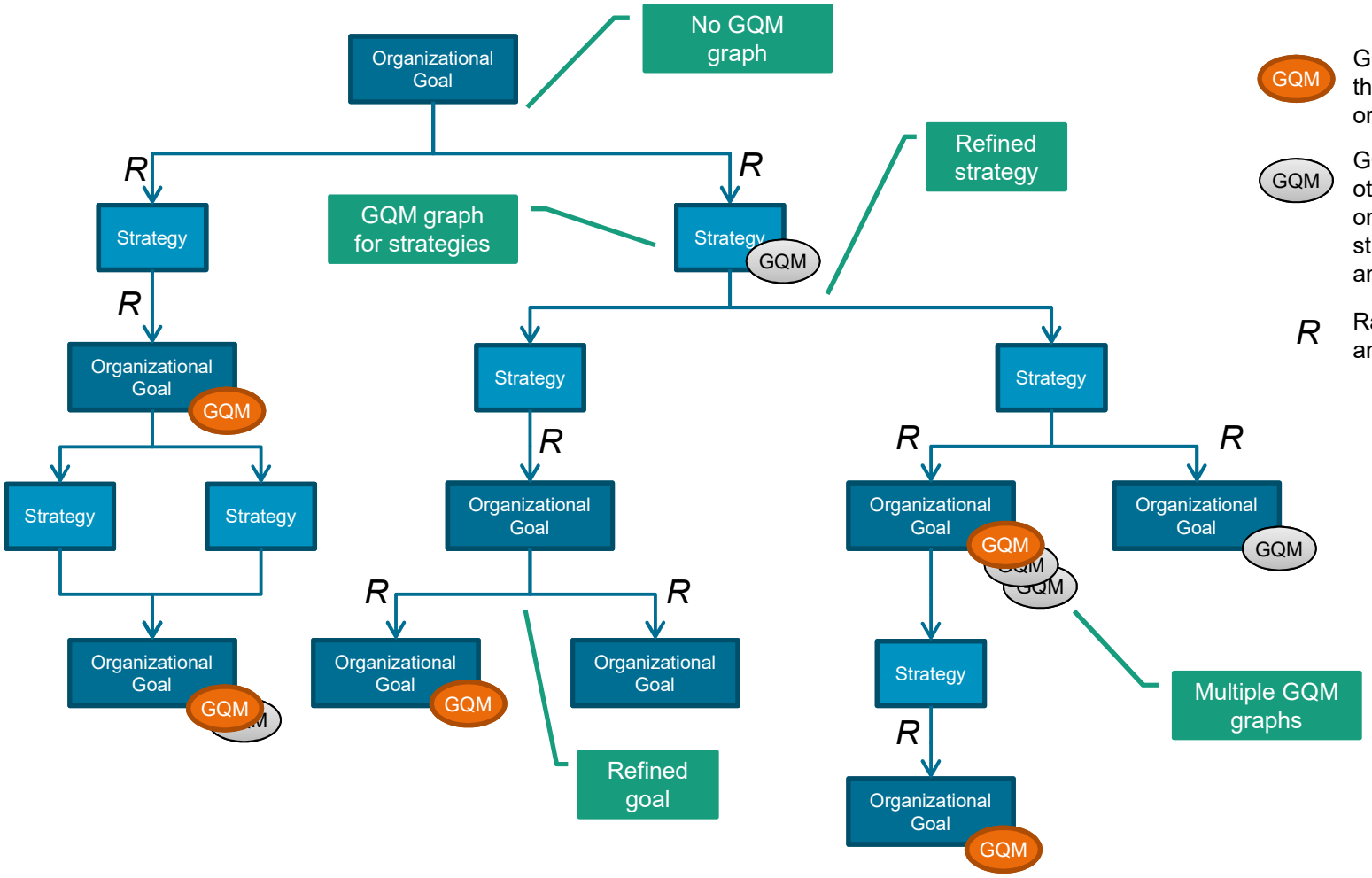


Figure 2.1.LGQM^{+}Strategies: Organizational Planning and Control perspectives

Possible Structures of a GQM+Strategies® Grid



ADVANTAGES FROM TWO INTEGRATED PERSPECTIVES: THE GRID

Through this well-designed integration of both perspectives, Organizational planning and Control, GQM⁺Strategies:

- improves organizational effectiveness by getting the entire organization to **work in the same strategic direction** (means for **alignment**), while
- optimizing efficiency through **continuous monitoring** of the attainment of goals and strategies, which allows for immediately initiating countermeasures when a goal attainment is threatened (means for **decision-making**). Furthermore,
- the whole structure provides a means for **transparently communicating** goals, strategies, and the required data to the organization (means for **communication**).

GQM+STRATEGIES APPROACH. GOING A BIT MORE IN DEEP WITH THE MODEL. THE PROCESS

.2 GQM+STRATEGIES MODEL

As already mentioned, the first outcome of GQM+Strategies is a **model** of organizational goals, strategies, and associated measurement models.

The next figure specifies the basic elements of a GQM+Strategies grid, which are grouped into two sub-models:

- GQM+Strategies Element
- GQM Graph.

Organizational Planning and Control Perspectives

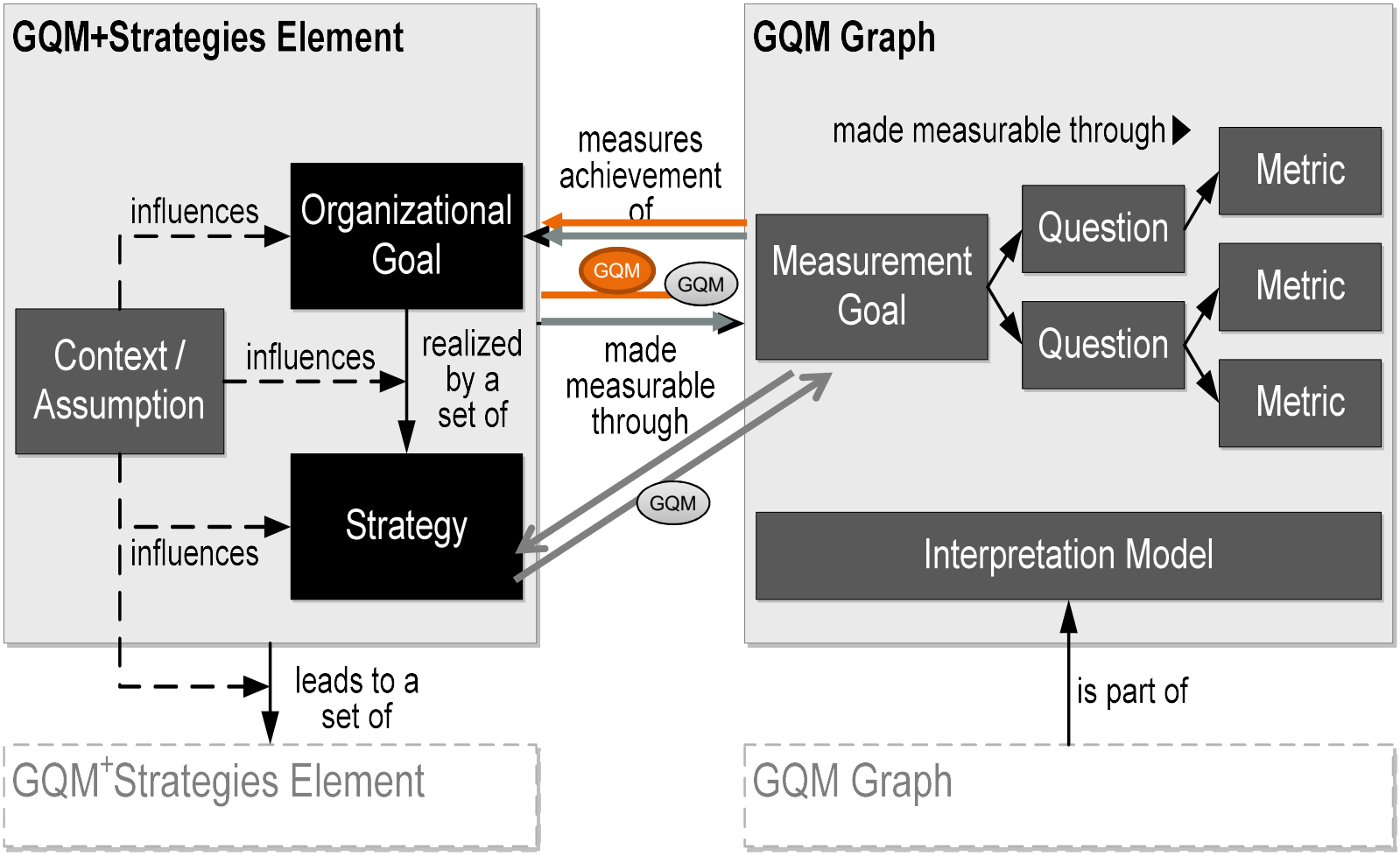


Figure 2.2 GQM+Strategies Grid

The GQM+Strategies® Grid Meta-Model

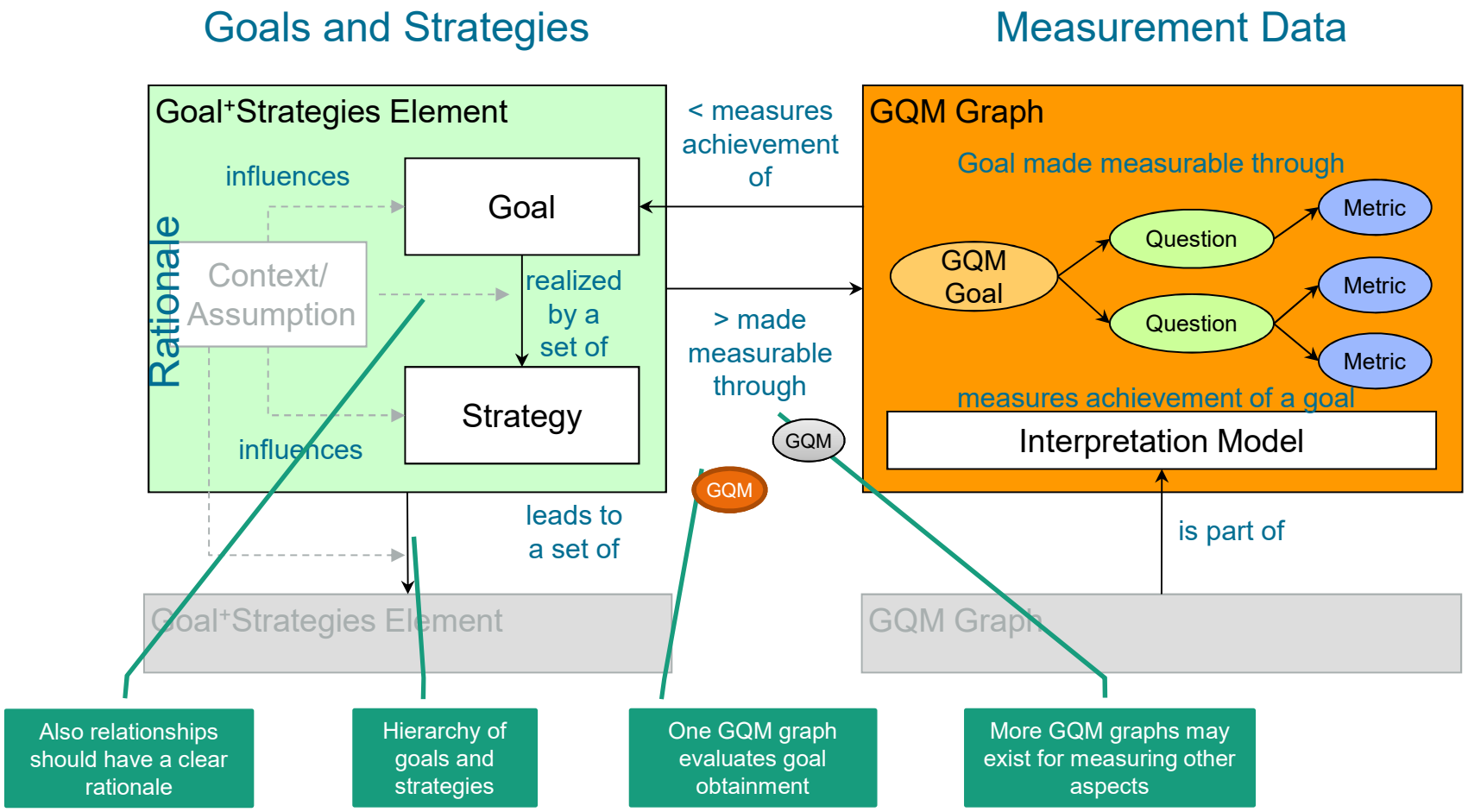


Figure 2.2 GQM+Strategies Grid

The GQM+Strategies Grid Ontology

Vedere trasparenze spedite a parte

GQM+STRATEGIES ELEMENTS

The **GQM+Strategies Element** specifies goals and strategies, and their mutual relationships.

Ideally the starting point in a GQM+Strategies element is a **business goal** defined at the highest level of the organization.

The goal is then refined into a hierarchy of associated strategies and goals defined across the organization, creating a hierarchy of GQM+Strategies elements.

GQM+STRATEGIES ELEMENTS: HIERARCHICAL STRUCTURE OF GOALS AND STRATEGIES

The grid structure allows for the modeling of sub-goals or sub-strategies hierarchies.

The possibility of *thinking in terms of goal or strategy refinement* is especially ***useful*** in the *initial stages* of grid development when it might be *easier to brainstorm about goals or strategies only* and then later to complement the structure of goals and strategies into a complete and consistent grid.

GQM+STRATEGIES ELEMENTS: **REFINEMENT OF GOALS AND STRATEGIES**

In practical situations, *complex or abstract goals can optionally be refined into simpler and more specific* **sub-goals** before they will be associated with appropriate lower-level strategies.

Analogously, *complex or abstract strategies can optimally be refined into simpler and more specific* **sub-strategies** before they will be associated to low-level goals.

GQM+STRATEGIES ELEMENTS:
ORGANIZATIONAL GOAL

In GQM+Strategies, an **organizational goal** refers to an anticipated state in the future that an organization wants to achieve.

The goal specifies "**What is to be achieved?**" and is systematically documented by means of a structured goal template.

GQM+STRATEGIES ELEMENTS: ORGANIZATIONAL GOAL. GOAL TEMPLATE

The **template** includes, for example, such aspects as:

- The **object** ("entity") under consideration
- The **focus**, i.e., the exact characteristic ("attribute", "property") that is subject to achievement
- The desired **magnitude** of the achievement
- The **timeframe** for achieving the goal
- The **organizational scope** of the goal including the individual/organization primarily responsible for achieving the goal
- The **constraints** that may limit the goal attainment, and
- The **relationships** to other goals (including, conflicting goals, if any).

Graphical view & terms definitions follow

GQM+STRATEGIES ELEMENTS: ORGANIZATIONAL GOAL. **GOAL TEMPLATE**

Organizational Goal

Object	Focus	Magnitude	Timeframe	Organizational Scope	Constraints	Relations
Esempio						

GQM+STRATEGIES ELEMENTS: ORGANIZATIONAL GOAL. GOAL TEMPLATE

Organizational Goal

Object	Focus	Magnitude	Timeframe	Organizational Scope	Constraints	Relations
customers in insurance area	amount	10% more	by the end of next fiscal year	management	while maintaining cost	-

Organizational Goal

Organizational Goal	
Object	What is the object under consideration? Object refers to artifacts, processes, or personnel addressed by the goal. Examples: customers, software product, IT infrastructure, etc.
Focus	What characteristic of the object is considered? Focus refers to the object's attribute, for which certain state is going to be achieved. Examples: satisfaction, quality, performance, effectiveness, etc.
Magnitude	What is the quantity (measure) of the goal to be achieved? Examples: percentage of change relative to current state (50%), absolute value (20), etc.
Timeframe	When should the goal be achieved? Examples: 6 months, next fiscal year, etc.
Organizational Scope	Who or what organizations are responsible for the goal attainment? Examples: project manager, a particular set of projects, company, business unit, division, department, etc.
Constraints	What are relevant constraints that may prevent from achieving the goal? Examples: market situation, legal regulations, obligatory standards, available resources, etc.
Relationships	What are other goals the goal is related to? Goals can be related due to a strategy that leads to both goals: Goals are in agreement given a certain strategy if the strategy supports attainment of both goals. Goals are conflicting given a certain strategy if the strategy supports attainment of one goal while having negative impact on the other goal. Example: Introducing new testing approach in order to achieve increased software quality goal will require additional investments and thus contradict a cost reduction goal.

Table 2.1 Basic aspects of an organizational goal

GQM+STRATEGIES ELEMENTS: **STRATEGY**

For each goal:

- the planned procedure for achieving the goal is specified through one or more associated strategies.

Hence, a **strategy** refers to a ***planned approach*** for achieving an organizational goal.

It answers "**How is the goal to be achieved?**" and defines rather general "***means***" of getting to the "***end***" (i.e., the goal).

GQM+STRATEGIES ELEMENTS: FROM A STRATEGY TO ITS SUB-GOALS

// Implementation of strategies: Precondition

Before implementing a GQM+Strategies grid in an organization:

> Strategies are *operationalized* through **operative activities** and **procedures** (i.e., business or development processes).

/*Whether not terminal, i.e., not immediately implementable – in GQMpS terms – as they are defined,*/

These strategies will specify **sub-goals** that must be achieved for that strategy to be considered successful.

GQM+STRATEGIES ELEMENTS: **RATIONALE**

GQM+Strategies enforces the explicit documentation of the rationale for specific goals, strategies, and their mutual relationships.

The rationale refers to information about *actual characteristics* (**context factors**) or *presumed characteristics* (**assumption**) of the organization's environment that affected our decision on particular goals and strategies.

In practice, the rationale encompasses *strengths* and *opportunities* we want to utilize as well as *weaknesses* and *risks* we want to avoid when defining particular goals and strategies.

GQM+STRATEGIES ELEMENTS: CONTEXT AND ASSUMPTIONS

Context refers to an actual environmental characteristic.

An **assumption** refers to a presumed, yet uncertain, aspect of the environment. It is a placeholder for something which needs to be evaluated through measurement.

For example, we may base an organizational improvement goal on assumed, yet not measured quantitatively e.g., baselines. In the course of a GQM+Strategies application we should employ measurement to develop actual baselines and to re-evaluate our goals (i.e., attainment of the defined organizational improvement goal).

GQM+STRATEGIES ELEMENTS: GQM GRAPH

The **GQM Graph** specifies a measurement and evaluation framework.

It uses a classical approach, the GQM paradigm or technique, to specify:

- **What** data needs to be collected and
- **How** that data should be interpreted

in order to make **informed decisions** about the success of strategies and attainment of the organizational goals defined in the GQM+Strategies element.

GQM+STRATEGIES ELEMENTS:
GQM GRAPH COMPOSITION

Each GQM graph consists of:

- Measurement goal
- Questions
- Metrics, and
- Interpretation model.

GQM+STRATEGIES ELEMENTS: GQM GRAPH: **MEASUREMENT GOAL**

A Measurement goal describes **what** knowledge needs to be gained from the measurement activity in order to make a **decision** about the **success** or **failure** of an associated goal and/or strategy.

GQM+STRATEGIES ELEMENTS: GQM GRAPH: MEASUREMENT GOAL. **Example (1/3)**

Let us consider an

- **organizational goal** of **improving development productivity** by ***10%***. (…)

We base this goal on

- the **observation (context)** that **too much effort is being spent on software development activities**, and on
- the **presumption** (**assumption**) that this large effort is caused by **low productivity of the software team**.

GQM+STRATEGIES ELEMENTS: GQM GRAPH: MEASUREMENT GOAL. **Example (2/3)**

In order to make an informed decision on the attainment of the organizational goal we would need knowledge on the following two aspects:

- the **current productivity** (“**baseline**”), and
- **productivity after** the strategies associated to the goal have been implemented.

GQM+STRATEGIES ELEMENTS: GQM GRAPH: MEASUREMENT GOAL. **Example (3/3)**

Consequently, we would need to define **two measurement goals**, that is, **objectives** of measurement:

1. **characterize development productivity of software team so far**, and
2. **evaluate improvement in the team's productivity after the appropriate improvement strategies have been implemented**.

GQM+STRATEGIES ELEMENTS: GQM GRAPH: MEASUREMENT GOAL TEMPLATE

The measurement goal is systematically documented using the GQM goal template.

The template specifies;

- the measured **object** ("entity")
- the **purpose** of measurement
- the **attribute** (or **quality focus**)
- the **viewpoint** that measurement represents, and
- the **context** in which measurement takes place.

Measurement Goal (GQM) Template

Object	Purpose	Quality Focus	Viewpoint	Context
Customers in insurance area	"Evaluate"	Amount	Management	C&A

GQM+STRATEGIES ELEMENTS: GQM GRAPH: MEASUREMENT GOAL TEMPLATE. **Example**

For example, the measurement goal regarding **characterization of baseline development productivity** would be documented as follows:

Analyze past software projects for the **purpose** of ***characterizing* them *to create a* baseline** with respect to (*focus*/**attribute**) **development productivity** from the **viewpoint** of the **organization** in the **context** of the **software organization XY**.

If such historical data does not exist, we might start with a *presumed baseline*, based upon expert opinion. This presumed baseline value is an *assumption* that must be checked as a real baseline value is established over time.

GQM+STRATEGIES ELEMENTS: GQM GRAPH: QUESTIONS, METRICS, INTERPRETATION MODEL

Measurement Goal (GQM)

Object	Purpose	Quality Focus	Viewpoint	Context
Customers in insurance area	"Evaluate"	Amount	Management	C&A

Interpretation Model
If 10% more by the end of next fiscal year then goal obtained

GQM+STRATEGIES ELEMENTS: GQM GRAPH: QUESTIONS, METRICS, INTERPRETATION MODEL

Measurement goals are defined in an operational, traceable way by refining them into a set of quantifiable questions.

Questions are used as guidelines for extracting the appropriate information to fulfill the information need defined by the measurement goal.

Questions specify **metrics** that define what quantitative data needs to be collected in order to answer the questions.

Finally, **interpretation models** describe how the data items associated with different metrics are related and combined (interpreted) to answer the questions and satisfy the measurement goal (i.e., fulfill information need).

GQM+STRATEGIES ELEMENTS: GQM GRAPH: QUESTIONS, METRICS, INTERPRETATION MODEL. **Example (1/3)**

Continuing the example of **measuring baseline productivity**, let the organization be interested about:

- *basic development productivity* (i.e., how much effort has been spent on delivering product of certain size), and
- *potential factors that may influence productivity* (e.g., experience and skills of development team).

GQM+STRATEGIES ELEMENTS: GQM GRAPH: QUESTIONS, METRICS, INTERPRETATION MODEL. **Example (2/3)**

Again about the example of **measuring baseline productivity** example questions may be:

- What is the **size** of delivered software products?
- How much **effort** has team spent for delivering these products?
- What was the **experience** of team members in the application domain?
- How **large** was the **team**?

GQM+STRATEGIES ELEMENTS: GQM GRAPH: QUESTIONS, METRICS, INTERPRETATION MODEL. Example (3/3)

Example metrics derived from these questions may be:

- **Development effort** in person-days,
- **Functional size** of delivered software product,
- **Experience in the application domain** in years,
- **Team size** in terms of number of team members.

GQM+STRATEGIES ELEMENTS: HOW MANY GQM GRAPHS PER ORGANIZATIONAL GOAL?

Typically, one GQM graph should be defined for each organizational goal in order to quantitatively evaluate its attainment.

Each organizational goal in the GQM+Strategies element may have several associated measurement goals, each of which is the basis for an entire GQM graph.

However, it is expected that different GQM structures will **share several questions and metrics**.

Interpretation models may combine data from different GQM structures, thus optimizing the metrics collection process.

Synthesis on Key elements of a GQM+Strategies Grid

Organizational Goal	An anticipated state in the future that an organization wants to achieve. It answers the question: "What is to be achieved?" The goal is formalized by using a goal template and quantified by using GQM.
Strategy	A planned procedure for achieving an organizational goal. It answers the question: "How is the goal to be attained?" Strategy refers to the "means" of getting to the "end" (i.e., goal) and it can be refined by a set of concrete activities (i.e., business or development processes).
Context Factor	A factual characteristic of an organization or its environment that affects the models and data used.
Assumption	A presumed (expected, yet uncertain) characteristic of an organization, its environment, or the availability of data that affects the kind of models and data used.
Measurement Goal	An objective of measurement derived from a particular information need. Information need refers to the information that the organization needs in order to make a certain decision (e.g., if an organizational goal is achieved). The measurement goal is formalized using the GQM goal template.
GQM Graph	A hierarchy of measurement goals, questions, metrics, and interpretation models provided as the result of applying the GQM method. Questions are derived from measurement goals and lead to metrics.

Table 2.2 Key elements of a GQM+Strategies Grid