

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

– Unknown author

This chapter introduces the GQM⁺Strategies approach for aligning organizational goals and strategies through measurement. We first explain the basic idea of combining alignment and measurement within GQM⁺Strategies, which provides an integrated method for explicitly defining organizational goals and controls for the execution of those plans. Next, we describe in detail the core components of GQM⁺Strategies. This includes a specification of the GQM⁺Strategies model as well as the description of the GQM⁺Strategies process for defining, controlling, and continuously improving organizational goals and strategies.

2.1 The Basic Idea

GQM⁺Strategies is an approach for aligning the 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. The major outcome of the approach is a strategic measurement program allowing for data-based decisions to be made in an organization. Goals and strategies across all units are linked to each other, and measurement data is collected in order to systematically evaluate goal attainment and the success/failure of the strategies.

Consistent with common practices in organizational management, the approach considers two major perspectives: Organizational Planning and Control. The *Organizational Planning* perspective specifies the goals (*G*) of an organization and thus what the organization strives to achieve. Additionally, this perspective also defines 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. Applying GQM⁺Strategies supports an iterative definition and alignment of goals and

strategies across all organizational units within the application scope (see left side of Fig. 2.1).

Organizational goals should be defined to be measurable and achievable. Example goals might be to improve customer satisfaction, increase the market share, or reduce production costs. *Strategies* are defined and selected with the purpose of achieving the defined goals. Goals and strategies are typically defined in the context of a specific organization, where the number of potential options is limited by organization-specific capabilities or constraints. In order to account for those 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.

Based on an initial set of goals and strategies, further lower-level goals are defined. 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. Applying the approach delivers a hierarchical model of goals and strategies, which often resembles the structure of the organization. Note that the scope is not limited to a single organization, but may encompass a network of organizations that share common top-level goals and want to achieve alignment with respect to lower-level goals and strategies.

Although a top-down process of defining goals and strategies might be obvious, the GQM⁺Strategies process does not require any top-down refinement. In some cases, it might be more suitable to start with lower-level goals or strategies and integrate those bottom-level organizational goals and strategies with the higher-level context of the organization. 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 using the GQM approach. In this context, each organizational goal is associated with a measurement goal (*MG*), with questions (*Q*) and metrics (*M*) that help to obtain objective information about the success of goal attainment (see right side of Fig. 2.1).

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.

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. Through this well-designed integration of both perspectives, GQM⁺Strategies (1) improves organizational effectiveness by getting the entire organization to work in the same strategic direction (means for *alignment*), while (2) optimizing efficiency through continuous monitoring of the attainment of goals and strategies, which allows for immediately initiating countermeasures when attainment of a goal is threatened (means for *decision-making*). Furthermore,

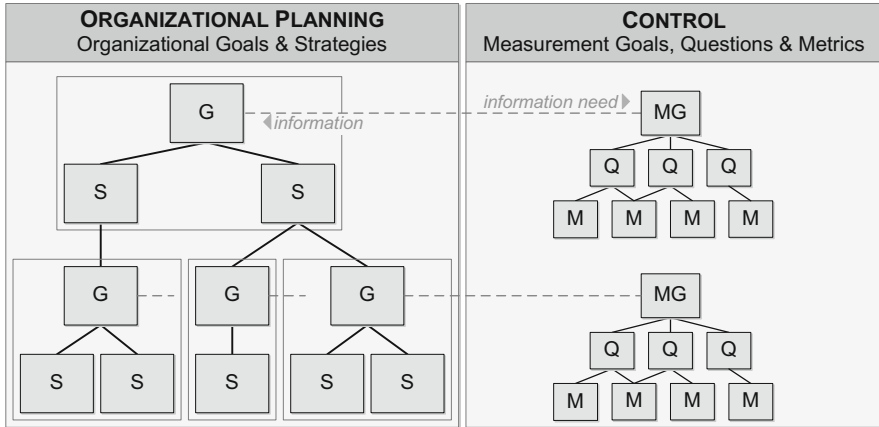


Fig. 2.1 GQM+Strategies: organizational planning and control perspectives

(3) the whole structure provides a means for transparently communicating goals, strategies, and the required data to the organization (means for *communication*).

2.2 GQM+Strategies Model

The first outcome of GQM+Strategies is a model of organizational goals, strategies, and associated measurement models. Figure 2.2 specifies the basic elements of a GQM+Strategies grid, which are grouped into two submodels: GQM+Strategies Element and GQM Graph.

The **GQM+Strategies Element** specifies organizational goals and strategies, context factors, assumptions, and their mutual relationships. An organizational goal can be linked to one or more strategies that aim at achieving this organizational goal. Conversely, a strategy can be linked to one or more organizational goals. Context factors and assumptions can be associated with organizational goals, strategies, or links between organizational goals and strategies. These associations indicate how context factors and assumptions influence the setting of organizational goals with respect to the selection of strategies or the refinement of organizational goals and strategies. A GQM+Strategies Element can be refined by further GQM+Strategies Elements. This represents the refinement of strategies by new organizational goals on a lower level of an organization. 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. The template includes, for example, such aspects as the *object* and its exact characteristic (*focus*) that are subject to achievement, the desired *magnitude* of the improvement, the *time frame* for achieving the goal, the *organizational scope* of the goal including the individual primarily responsible for achieving the goal, the *constraints* that may limit

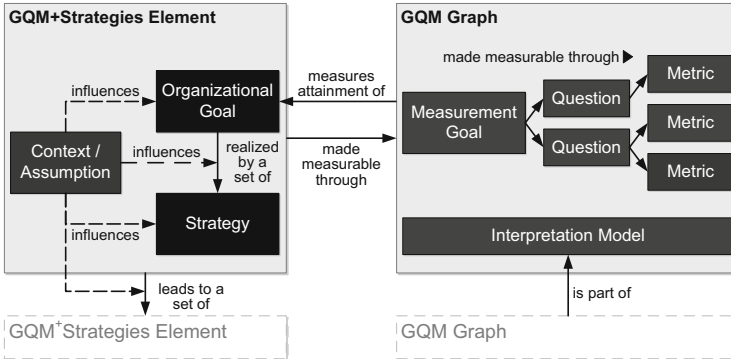


Fig. 2.2 QQM+Strategies grid

Table 2.1 Basic aspects of an organizational goal

Organizational goal	
Object	What is the object under consideration? Object refers to artifacts, processes, or personnel addressed by the goal. <u>Examples</u> : customers, software product, IT infrastructure, etc.
Focus	What characteristic of the object is considered? Focus refers to the object’s attribute for which a certain state is going to be achieved. <u>Examples</u> : satisfaction, quality, performance, effectiveness, etc.
Magnitude	What is the quantity (measure) of the goal to be achieved? <u>Examples</u> : percentage of change relative to current state (50 %), absolute value (20), etc.
Time Frame	When should the goal be achieved? <u>Examples</u> : 6 months, next fiscal year, etc.
Organizational Scope	Who or what organizations are responsible for goal attainment? <u>Examples</u> : project manager, a particular set of projects, company, business unit, division, department, etc.
Constraints	What are relevant constraints that may prevent attainment of the goal? <u>Examples</u> : 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 a negative impact on the other goal. <u>Example</u> : Introducing a new testing approach in order to achieve a higher software quality goal will require additional investments and thus contradict a cost reduction goal

attainment of the goal, and *relationships* to other goals (in particular, conflicting goals). Table 2.1 specifies the aspects of an organizational goal in more detail.

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 the question of “How is the goal to be achieved?” and defines rather general “means” for achieving the “end” (i.e., attaining the goal). Before implementing a QQM+Strategies grid in an organization,

strategies are operationalized through operative activities and procedures (i.e., business or development processes). Strategies may further be linked to subgoals on lower levels that must be achieved for that strategy to be considered successful.

GQM⁺Strategies enforces the explicit documentation of the rationale for specific goals, strategies, and their mutual relationships. Rationale refers to information about the actual or presumed characteristics of the organization's environment that affected a decision about particular goals and strategies. In practice, the rationale encompasses the strengths and opportunities we want to utilize as well as weaknesses and risks we want to avoid when defining particular goals and strategies. In GQM⁺Strategies, we distinguish between two types of rationale: context and assumption. **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 that needs to be evaluated through measurement. For example, we may base an organizational improvement goal on assumed, yet not quantitatively measured baselines. In the course of an application of GQM⁺Strategies, we should employ measurement to develop actual baselines and to re-evaluate our goals (i.e., attainment of the defined organizational improvement goal).

The **GQM Graph** specifies a measurement and evaluation framework. It uses the classical GQM approach 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 the attainment of the organizational goals defined in the GQM⁺Strategies element. Each GQM graph consists of a measurement goal, questions, metrics, and an interpretation model.

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. For example, 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. In order to make an informed decision on the attainment of the organizational goal, we would need knowledge about two aspects: the current (baseline) productivity and the productivity following the implementation of the strategies associated with the goal. Consequently, we would need to define two measurement goals, that is, objectives of measurement: characterize the development productivity of the software team to date, and evaluate the improvement in the team's productivity after implementation of the appropriate improvement strategies.

The measurement goal is systematically documented using the GQM goal template. The template specifies the measured *object* and its *attributes*, the *purpose* of measurement, the *viewpoint* that the measurement represents, and the *context* in which the measurement takes place. For example, the measurement goal regarding the characterization of baseline development productivity would be documented as follows: Analyze past software projects with respect to development productivity for the purpose of characterizing them to create a baseline from the viewpoint of the

organization in the context of the software organization. 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.

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 the information need). Continuing the example of measuring baseline productivity, example questions might be: What is the size of the delivered software products? How much effort has the team spent on delivering these products? What was the experience of the team members in the application domain? How large was the team? Note that these questions actually ask about basic development productivity (i.e., how much effort has been spent on delivering a product of a certain size) and potential factors that may influence productivity (e.g., experience and skills of the development team). Example metrics derived from these questions may be development effort in person-days, functional size of the delivered software product, years of experience in the application domain, and team size in terms of number of team members.

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

Table 2.2 briefly explains the meaning of all key elements of QQM⁺Strategies that we have discussed in the paragraphs above.

As already stated, defining the grid is a major contribution in its own right. If an organization stops here, they have provided an alignment of the perspective goals, strategies, and measures that align the organization's approach for achieving its high-level goals. The grid serves as a means of communication to all units in the organization of what is needed and required of them. Even if they never collect a single piece of data, they have laid out a plan for all to see.

2.3 QQM⁺Strategies Process

One may think of different ways for constructing such a model as presented in the previous sections. Depending on how deeply an organization wants to implement the QQM⁺Strategies model into their way of thinking, different activities should be performed. The process presented in this section basically describes a full-featured

Table 2.2 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 the organizational 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 achieved?” Strategy refers to the “means” for getting to the “end” (i.e., goal) and 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

set of activities for constructing the GQM⁺Strategies model and actively using the model for driving continuous improvement programs in an organization. In practice, the process presented here and detailed in the upcoming chapters of this book should be tailored to the specific needs of an organization, which means that dedicated activities are skipped or merged with already existing procedures in place in the organization. However, in order to give the reader a complete picture of how the approach can be fully implemented in an organization, the following reference process is defined.

The reference process consists of six repeatable phases plus one phase for initializing the overall improvement program and the process of creating a strategic measurement program for an organization. The six phases are organized as a continuous improvement cycle (see Fig. 2.3) and are based upon the Quality Improvement Paradigm (QIP) as proposed by Basili and others (Basili 1985; Basili et al. 1994a; Basili and Caldiera 1995; Basili and Green 1994). The cycle will be repeated with a certain frequency. The frequency of running through the whole cycle largely depends on the speed with which the organization wants to evolve and continuously improve. It also depends on the size of the grid that is modeled and on whether this grid captures the entire organization or only different parts thereof.

Phase 0 describes the initialization phase and ensures that the infrastructure and the resources necessary for the application of GQM⁺Strategies are available and that initial planning for the subsequent process phases is performed. The six-phase improvement cycle involves three major stages, each consisting of two phases:

- **Develop:** The first stage is the development of a hierarchical grid/model that aligns the goals, strategies, and required measurement data. The key benefit of



Fig. 2.3 Basic GQM⁺Strategies process

the grid is the ability to reach a consensus between goals and strategies and communicate this consensus to the entire organization. In Phase 1, the current organizational situation for which the grid is to be constructed is characterized. In Phase 2, the grid is defined as a model of organizational goals and strategies, the linkages between them, the rationales (context factors and assumptions), and the required measurement data.

- **Implement:** The second stage involves the execution of the strategies and measurements defined by the grid, which allows checking the attainment of the goals, the effectiveness of the strategies, etc. In Phase 3, the plans for executing the grid strategies and collecting the appropriate data are specified. In Phase 4, those plans are executed and analyzed in terms of whether the strategies are working and the goals are being achieved. If not, the leader of a corresponding improvement project can make the necessary local adjustments to the grid in real time. If a certain milestone is achieved or a defined trigger occurs (e.g., a goal cannot be achieved without serious global adjustments that go beyond the scope and resources of the project), we move to Phase 5.
- **Learn:** The third stage involves learning from what has been done by analyzing the results and improving the process for generating further goals and strategies. In Phase 5, we analyze the attainment of goals and try to investigate root causes for the success/failure of the strategies. In Phase 6, we record what we have learned in the previous phases and request improvement actions if the actual results differ from the planned ones. Example findings may be that our assumptions were wrong or that we did not consider relevant context characteristics—as a consequence of which we selected the wrong strategies

and the associated goals were not achieved. Requested improvements may include revising context characteristics and assumptions, adjusting the structure of goals and strategies, or redefining how measurements are made or interpreted.

Note that the six phases of the GQM⁺Strategies improvement cycle correspond closely to the popular Plan-Do-Check-Act (PDCA) improvement approach proposed by Shewhart (1939) and widely promoted by Deming (1986).

In the following seven chapters (initialization phase plus six QIP phases), we will present the GQM⁺Strategies process in more detail. For each phase of the process, we will describe the activities involved and the results that are delivered. Moreover, we will illustrate the process phases with an example that continues across all process phases; the description of each phase ends with its illustration using the example.



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Aligning Organizations Through Measurement

The GQM+Strategies Approach

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