Aligning an Organization’s Goals and Strategies through Measurement: GQM+Strategies®

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Top Level Organizational Problems

How does an organization all work in the same strategic direction?
Need alignment and communication of goals and strategies at all levels

How do I manage creative people balancing organizational goals and individual needs?
Need global and local goals, strategies, context, and assumptions

How do I monitor and evaluate the achievement of my goals and strategies?
Need hierarchical measurement and interpretation models
Measuring Success

Success requires both the right strategy and operational effectiveness [Michael E. Porter, Harvard Business School]

• Achieving a goal requires
  • the right course
  • an effective vehicle
  • collaboration among all units involved

• Question: How do we know whether the course is right and the collaborative vehicle is effective?

• Answer: Alignment & Measurement
Achieving Success

Organizations need to be able to
- develop operational business goals
- define strategies for implementing them
- communicate the goals throughout the organization
- translate the goals into lower levels for projects
- assess the effectiveness of their strategies
- recognize the achievement of their business goals
- measure for visibility, control, and improvement

We need to develop and connect goals and strategies at all levels in the organization and make them measurable.
Using Measurement to Translate Business Vision into Operational Strategies

- Measurement with GQM
  - Understanding fundamentals of measurement
  - Identifying information needs and defining measurement goals
  - Defining measures and interpretation models
- Alignment with GQM+Strategies
  - Articulating business and organizational goals
  - Selecting appropriate operational strategies
  - Documenting context, assumptions, and linkages
- Tying it all together
  - Linking goals and strategies to measures
  - Collecting data and interpreting
Why do Most Organizations Measure?

Understand the Business and Create Visibility
- Build baselines, show relationships
- Identify critical factors

Manage and Control Based on Quantitative Evidence
- Plan and estimate
- Track- actuals versus estimates
- Decision-making

Guide Improvement and Optimize the Activities
- Prioritize and Assess
- Feedback Experience to Improve Process
- Package what you have learned
Example Questions Measurement Should Answer

- What should happen, is it happening?
  - Plan, track and control projects and processes

- Are certain types of problems commonplace?
  - Determine strengths and weaknesses of the current processes

- What technologies will minimize the problems, change the baselines?
  - Develop a rationale for adopting/refining supporting technologies

- Are we making progress in achieving our goals?
  - Assess the effectiveness of operational activities and the achievement of goals
Measurement is the fundamental underlying framework for achieving success

Measurement is a means to an end, not an end in itself
What is measurement?

- **Entities**
- **Attributes**
- **Rules**
- **Numbers/Symbols**

- Process: effort → person-days → 53 pds
- Service: satisfaction → number of Customers → 6000
- Resource: experience → >10 projects → “high”

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Problems with Measurement

Measurement is not just the collection of data
it cannot simply be aggregated… and requires interpretation

Problems
  Identifying the **right information**
  Too much **unnecessary data** collected
  Data is **not analyzed** (in the right environment/context)
  Important aspects cannot be analyzed because of **missing data**

General Consequences
  Drawing wrong conclusions
  Unnecessary effort
  Insufficient pay-off to cost
  Discouraging people

Goal-oriented Measurement
Internal and External Stakeholders have Goals

Stakeholder Stakeholder Stakeholder
Goal Goal Goal Goal Goal
Conflict? Conflict? Conflict?
Goal Oriented Measurement
The Goal Question Metric (GQM) Structure

- Measurement Goal
  - Question
  - Metric
- Measurement Goal
  - Question
  - Metric
- Measurement Goal
  - Question
  - Metric
- Measurement Goal
  - Question
  - Metric

What should be measured?

How should it be interpreted?
# Levels of measurement ability

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Ability</th>
</tr>
</thead>
<tbody>
<tr>
<td>5: Motivate / Improve</td>
<td>Describe what needs to be done to control and manage</td>
<td>Build prescriptive models</td>
</tr>
<tr>
<td>4: Predict</td>
<td>Estimate expected product quality and process resource consumption</td>
<td>Build predictive models</td>
</tr>
<tr>
<td>3: Evaluate</td>
<td>Assess achievement of quality goals, impact of technology on products</td>
<td>Compare models</td>
</tr>
<tr>
<td>2: Understand</td>
<td>Explain associations / dependencies between processes and products</td>
<td>Analyze models</td>
</tr>
<tr>
<td>1: Characterize</td>
<td>Describe and differentiate software processes and products</td>
<td>Build descriptive models and baselines</td>
</tr>
</tbody>
</table>

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Lessons Learned Goal-oriented Measurement

Measurement should not be an end in itself, but a key factor to reach business goals.

Measurement needs to be deeply integrated into organizational processes.

Measurement programs help to make decision making more transparent.

Goal-oriented measurement is the basis for the success of measurement programs.

Higher-level goals require more understanding, but have a bigger payback.

There is no universal measurement program solving all problems related to measurement.

A comprehensive approach is needed for defining and setting up a KPI system that creates return on investment.

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Conclusions about Measurement

You cannot control what you cannot measure [Tom DeMarco]

- Measurement is a mean to an end, not an end in itself
  - Just collecting any data generates costs and bring no value
- Measurement should be driven by specific information needs
  - In order to make informative decision we need proper information
- Measures should be interpreted in particular context
  - Interpreting data without context is meaningless
- Measurement should be aligned to organizational goals and strategies
Do you need Organizational Alignment?

Symptoms

– Strategies on different levels of an organization are not linked to each other
– It is often hard to demonstrate how improvement strategies generate business value
– It is not clear, how development activities contribute to business goals
– Software and system engineers are frequently faced with apparently unrealistic goals
– IT and software are seen as a pure cost driver that is easy to substitute for
– Core competences for business success are outsourced
Overview of GQM Strategies

Align the business at all levels of the organization
- Link organizational goals and strategies from the management level to the project level
- Control success/failure through measurement and KPI definition (based on the GQM Paradigm)
- Document the rationale for linking organizational goals and strategies
- Make measurement-based improvement decisions

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**Basic concepts**

**Business Goals:** Goals the organization wishes to accomplish in general in order to achieve its objectives

**Context Factors:** Environmental factors representing the organizational environment

**Assumptions:** Estimated unknowns affecting the interpretation of the data

**Strategy:** A possible approach for achieving a goal that may be refined by a set of concrete activities (i.e., business or development processes)

**Level i Goals:** A set of lower-level goals inherited from level i-1 goals as part of the level i-1 goal strategy

**GQM Goals:** Measureable goals associated with each business goal

**Interpretation Models:** Models that help interpret data to determine whether goals at each level is achieved
Tying Strategies to GQM: A Complete Goal+Strategies® Element

Goal+Strategies Element

- Goal
  - Context/Assumption
  - Strategy

Goal+Strategies Element

GQM Graph

- Goal
- Metric
- Question
- Metric
- Question

GQM Graph

Interpretation Model

leads to a set of

made measurable through

> made measurable through
< measures achievement of

is part of
Linking Goals at Multiple Levels: A Sample GQM*Strategies® Grid
GQM+Strategies® Features Help Address Common Issues

- Align the business at all levels of the organization in a seamless way
- Link goals and strategies from the top management level down to the project level
- Control success/failure of goals and strategies through measurement
- Document the rationale for linking goals and strategies (context and assumptions)
- Close gaps and let all goals and measurement data contribute to a consistent and meaningful story
- Provide a means of assessing the value of different approaches, such as agile and Lean
**Standard Problems**

**Goals and Strategies**

- **Goal:** Increase customer satisfaction by 10%
  - **Strategy:** Improve product quality
  - **Strategy:** Improve usability of product

- **Goal:** Reduce customer-reported defects by 20%
  - **Strategy:** Improve efficiency of system testing
  - **Strategy:** Improve maintainability of software

**Measurement Data**

- **M1:** Customer satisfaction index
- **M2:** Field defect data
- **M3:** Code quality metrics (McCabe, coupling, cohesion)

Isolated data

⇒ What is the contribution/value?
⇒ Is there an implicit goal?

No sub-level goal defined
⇒ Strategy not explicitly communicated

Isolated strategy
Real Example

Separated branches
⇒ Are there hidden relationships?

Different level of detail
⇒ Is model balanced?
Example Business Goal: Level 1

**Context:** Organization, ABC, provides information services to customers through the Web. Customers pay for access to information via software that searches, analyzes, and presents information, not for software

**Context:** The amount of revenue generated at ABC is determined by the number of times customers access the ABC software products, not the number of customers

**ABC business goal:** Increase profit through increased customer usage of the Web-based software services

**Assumption:** There are enough CMMI projects with a maturity level > 1 to provide a 15% improvement, so the organization can manage a 10% improvement if the level 1 projects remain the same
## Business Goal: Level 1

<table>
<thead>
<tr>
<th>Goal Aspect</th>
<th>Aspect Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus</td>
<td>Net Income</td>
</tr>
<tr>
<td>Object</td>
<td>ABC Web Services</td>
</tr>
<tr>
<td>Magnitude (degree)</td>
<td>10% increase per year</td>
</tr>
<tr>
<td>Timeframe</td>
<td>Annually, beginning in 2 years</td>
</tr>
<tr>
<td>Organizational Scope</td>
<td>Development Groups: 15%/year for all CMMI projects with maturity level &gt; 1</td>
</tr>
<tr>
<td>Constraints (limitations)</td>
<td>Available resources, ability to sustain CMMI levels, …</td>
</tr>
<tr>
<td>Relations to other goals</td>
<td>CMMI Goals</td>
</tr>
</tbody>
</table>
Business Goal: Level 1

**Strategies:** deliver added functionality at regular and frequent intervals to encourage more usage, increase the rates charged to customers, reduce development costs, ...

**Assumption:** Added functionality will lead to increased customer satisfaction, which will in turn lead to higher usage

**GQM Goal:** Analyze the trend in profit for the purpose of evaluation with respect to a 10% increase in annual income per year from the point of view of ABC’s management in the context of ABC

**GQM Questions:** What is the profit figure for this year (P0)? What is the profit figure for each succeeding year (P(x))?
Interpretation model:

Starting in year 2, i.e., for \( x = 2, 3, \ldots \)

\[
\text{if } P(x) \geq 1.1 \times P(x-1) \\
\text{then the goal has been satisfied,}
\]

\[
\text{else if added functionality was increased appropriately} \\
\text{then some assumption or level 1 strategy is wrong}
\]

The full interpretation is dependent on the lower level goals, e.g.

\[
\text{else if added functionality was not increased by 5\% then the level 2 strategy was not effective, ...}
\]
Level 2 Goal

Based upon the chosen level 1 strategy we define our next level goal

• **Level 2 Goal:** Deliver the right kind/amount of added capability (5% more) every 6 months (requires accurate estimates of cost and schedule (10% variance) (for CMMI level 2 or better projects)

• **Strategy:** Use MoSCoW to determine what capabilities to deliver and COCOMO to check that the selected capabilities can be delivered on schedule and within cost

• **Definition: MoSCoW** is a method for negotiating with the customer on the importance of delivery of each functional requirement. MoSCoW stands for: M - MUST have this, S - SHOULD have this if at all possible, C - COULD have this if it does not affect anything else, W - WON'T have this time but WOULD like in the future.

• **Definition: COCOMO** is a cost and schedule estimation model based upon a number of project specific variables, including size.
Level 2 Goal

- **Context:** there are experts available who can tailor, teach, and apply the MoSCoW and COCOMO approaches

- **Assumption:** can estimate percent of function delivered, e.g., can use a proxy like additional lines of code delivered, number of function points delivered, or a formula based upon a count of actual requirements weighted in some way (hard, medium, easy).

- **Assumption:** the backlog of customer-requested requirements continues to grow and requirements are characterized by M, S, C, W and complexity of implementation
## Level 2 Goal Template

<table>
<thead>
<tr>
<th>Goal Aspect</th>
<th>Aspect Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus</td>
<td>More usable functionality, e.g., M type requirements</td>
</tr>
<tr>
<td>Object</td>
<td>Backlog of customer-requested requirements</td>
</tr>
<tr>
<td>Magnitude (degree)</td>
<td>Deliver 5% more than the prior release</td>
</tr>
<tr>
<td>Timeframe</td>
<td>Every 6 months, beginning in 2 years</td>
</tr>
<tr>
<td>Scope</td>
<td>Development Groups: 15%/year for all CMMI projects &gt; 1</td>
</tr>
<tr>
<td>Constraints (limitations)</td>
<td>Available resources, ability to sustain CMMI levels, ability to estimate cost and schedule for a release,…</td>
</tr>
<tr>
<td>Relations to other goals</td>
<td>Achievement of cost and schedule estimate accuracy, Ability to improve CMMI levels of development groups, …</td>
</tr>
</tbody>
</table>
Level 2 Goal

• **GQM Goal**: Analyze each 6 month release for the purpose of evaluation with respect to a 5% new function growth as compared to prior function growth from the point of view of the services project manager in the context of ABC services.

• **GQM Questions**: What was the amount of function delivered at each release? What was the % of new M, S, C, and W requirements released? What is the % growth from the prior release?

• **Interpretation model**: If at each 6 month milestone the growth in functionality of a release $\geq 5\%$
  
  then the level 2 goal is satisfied for this release

  else, assumptions about MoSCoW are not working or our estimation of cost or schedule is not right, …

  else if goal 1 is satisfied but goal 2 is not
  then investigate why, e.g., delivery of some particular functionality alone caused the gain.
Measuring Increase Net Income

**Goal:** Increase profit from software service usage

**Strategy:** Deliver added functionality

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**Goal:** Deliver 10% new functionality every 6M within 10% of budget

**Strategy:** Use MOSCOW and COCOMO

---

**Goal:** Apply MOSCOW and COCOMO effectively

**Strategy:** Conduct training, determine tools, perform pilot study

---

**GQM Goals**

**Questions**

**Metrics**

**Decision Criteria**

- If P2 > 1.1 * P0 and P3 > 1.1 * P2 and...
  then goal is satisfied
Context and Assumptions for Increase Net Income

**Goal: Increase profit from software service usage**

**Strategy: Deliver added functionality**

**Assumptions**

- **A1:** Projects with maturity level > 1 can provide a 15% improvement
- **A2:** Added functionality will lead to higher usage
- **A3:** We can estimate percent of function delivered
- **A4:** Backlog of requirements continues to grow and requirements are characterized
- **A5:** The cost/schedule for training is reasonable

**Goal: Deliver 10% new functionality within 10% of budget**

**Strategy: Use MOSCOW and COCOMO**

**Assumptions**

- **C1:** Customers pay for access to information via software
- **C2:** Revenue generated is determined by accessing software
- **C3:** Experts available who can use MoSCoW and COCOMO
- **C4:** Current estimation approach is informal and requirements selection is subjective

**Goal: Apply MOSCOW and COCOMO effectively**

**Strategy: Conduct training, determine tools, perform pilot study**
Quality Improvement Paradigm
GQM+Strategies® Life Cycle

**Characterize:** Define scope; characterize context/assumptions

**Set goals:** build grid by selecting goals, strategies and measurements; perform status quo analysis

**Choose process:** Plan implementation of strategies, data collection and analysis, and feedback mechanisms

**Execute processes:** Execute strategies; collect and analyze data, and provide feedback

**Analyze results:** analyze data; review and communicate results; analyze cost/benefit.

**Package experience:** Adapt and improve grid elements and improve all related processes.
GQM+Strategies® Life Cycle

1 Characterize
- Define application scope
- Define responsibilities
- Characterize environment/context

2 Set Goals
- Determine organizational structures
- Perform gap analysis
- Prioritize goals
- Perform grid derivation process

3 Choose Process
- Plan implementation of strategies
- Organize data collection and analysis
- Define feedback mechanisms

4 Execute Model
- Apply strategies
- Collect and analyze data
- Provide feedback

5 Analyze Results
- Analyze data and revise strategies
- Review and communicate results
- Analyze cost/benefit

6 Package and Improve
- Adapt and improve grid
- Correct wrong assumptions
- Adapt strategies
Who is Using GQM+Strategies® and Why?

<table>
<thead>
<tr>
<th>Business</th>
<th>Domain</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>European telecommunications company</td>
<td>Telecommunications</td>
<td>Drive strategic improvement programs, support paradigm shift toward purpose-driven metrics</td>
</tr>
<tr>
<td>European automotive supplier</td>
<td>Automotive</td>
<td>Support CMMI’s Measurement and Analysis process area</td>
</tr>
<tr>
<td>South American Oil company</td>
<td>Oil drilling</td>
<td>Identify the most relevant data to determine when and where to drill</td>
</tr>
<tr>
<td>International software company</td>
<td>Embedded systems used in telecommunications</td>
<td>Increase the visibility at all organizational levels of how strategic decisions impact operations</td>
</tr>
<tr>
<td>Asian insurance company</td>
<td>Information systems</td>
<td>Align strategies and goals for new business domain</td>
</tr>
<tr>
<td>Asian systems engineering organization</td>
<td>Safety-critical software for aerospace domain</td>
<td>Increase visibility of goals and strategies and derived measurement goals to enhance supplier collaboration</td>
</tr>
<tr>
<td>Joint research project to develop a common software platform</td>
<td>Support of complex, dynamic business processes in a variety of domains, including logistics, retail, and customized industrial facilities</td>
<td>Align project objectives and business objectives of involved research and industry partners</td>
</tr>
</tbody>
</table>
Ongoing Activities

A **tool** to support visualization and navigation and zooming through the grid is being used and is evolving based upon feedback.

ROI for goals and strategies has been added to the grid by using the GQM+Strategies notation to represent benefits and cost analysis via Value Based Software Engineering.

A organizational model of **Earned Value Analysis** that does cost/benefit analysis on the grid hierarchy.

A risk analysis approach that uses causal analysis to identify the risks associated with not achieving goals.

A mechanism for prioritizing and evaluating various goal and strategy solutions.
explicit linkages between goals at the strategic and project level

templates to define all types of goals at the level of detail necessary and track their relationships to each other

tracking of context factors and assumptions so the effect of changes in context and the status of the assumptions can be assessed

interpretation models tying together measurement goals, context factors, assumptions, and data

transparency of measurement motivations and goals at different levels of the organization

Support for decision making and tracking of business success
Contributing Team

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References

