

# 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**

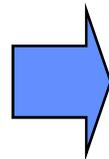
### General Consequences

Drawing wrong conclusions

Unnecessary effort

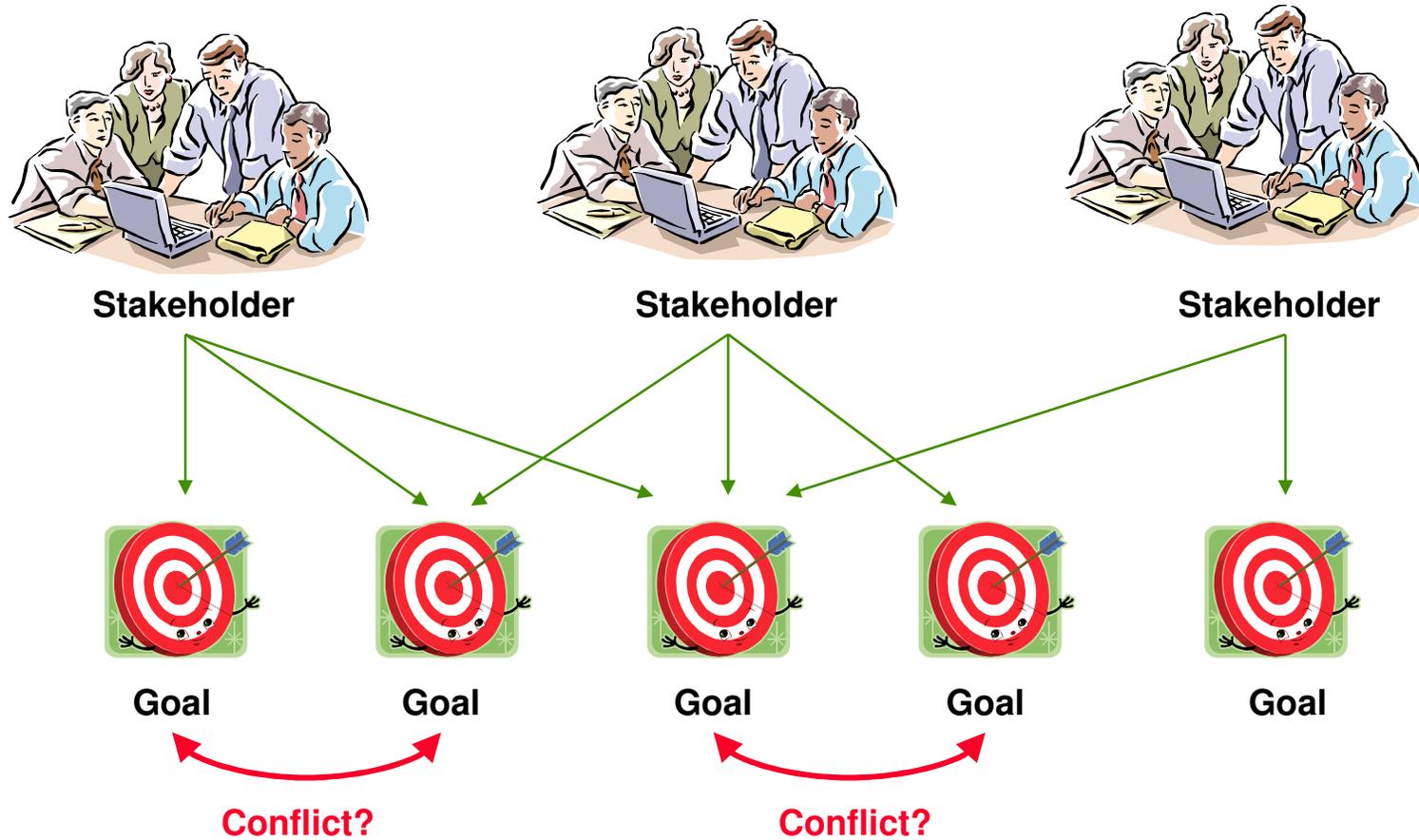
Insufficient pay-off to cost

Discouraging people



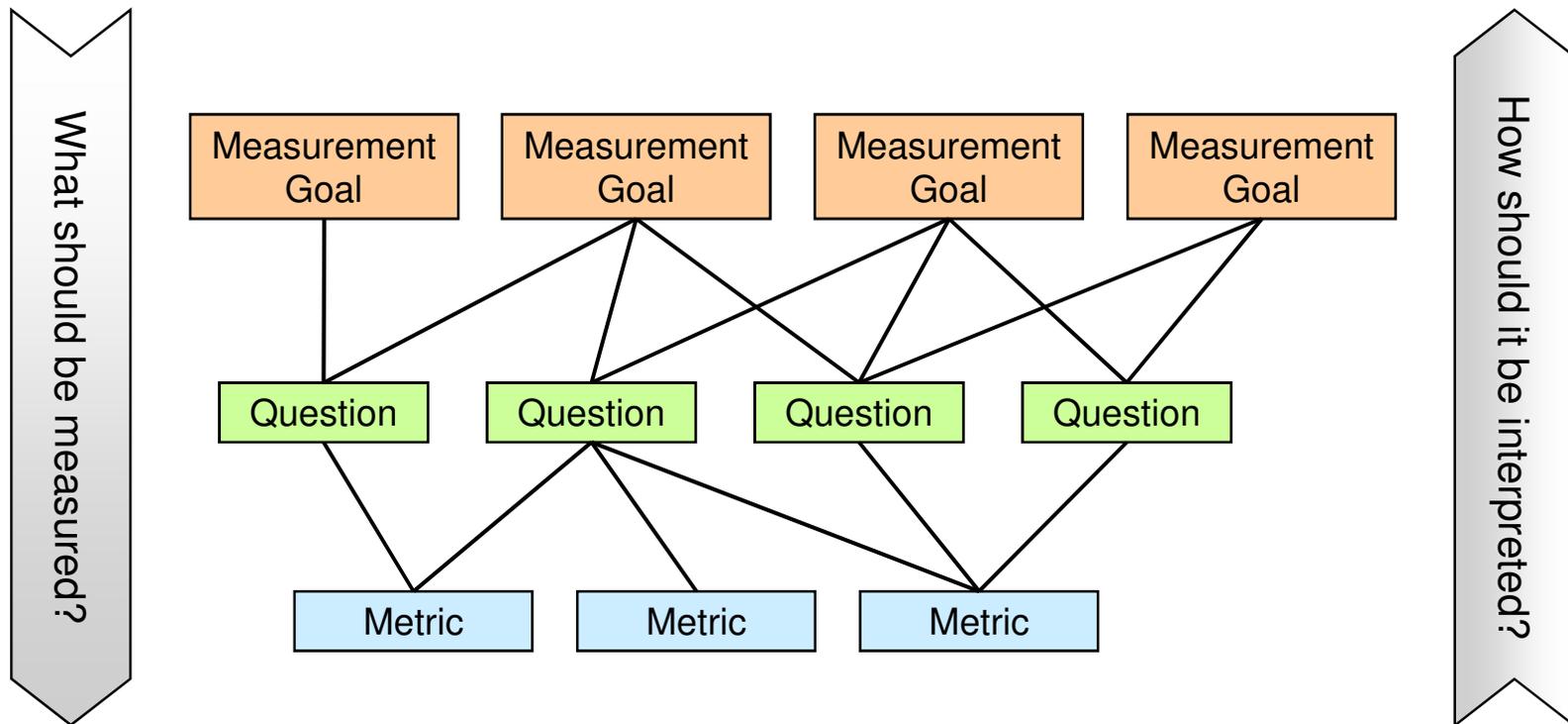
**Goal-oriented Measurement**

# Internal and External Stakeholders have Goals



# Goal Oriented Measurement

## The Goal Question Metric (GQM) Structure



## Levels of measurement ability

Level of Sophistication

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

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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

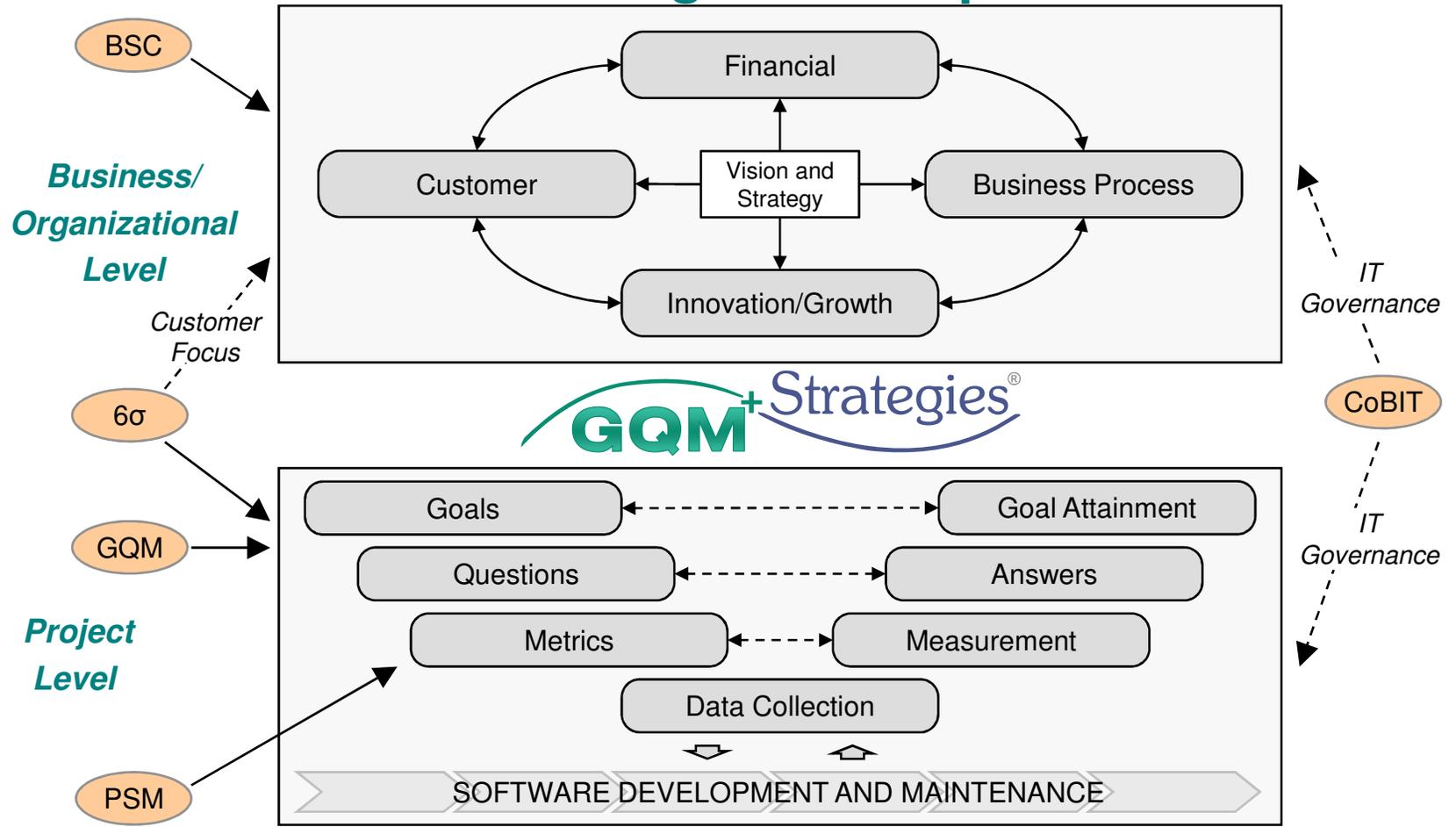


# Do you need Organizational Alignment?

## 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

# Management Gap



# Overview of GQM+Strategies<sup>®</sup>

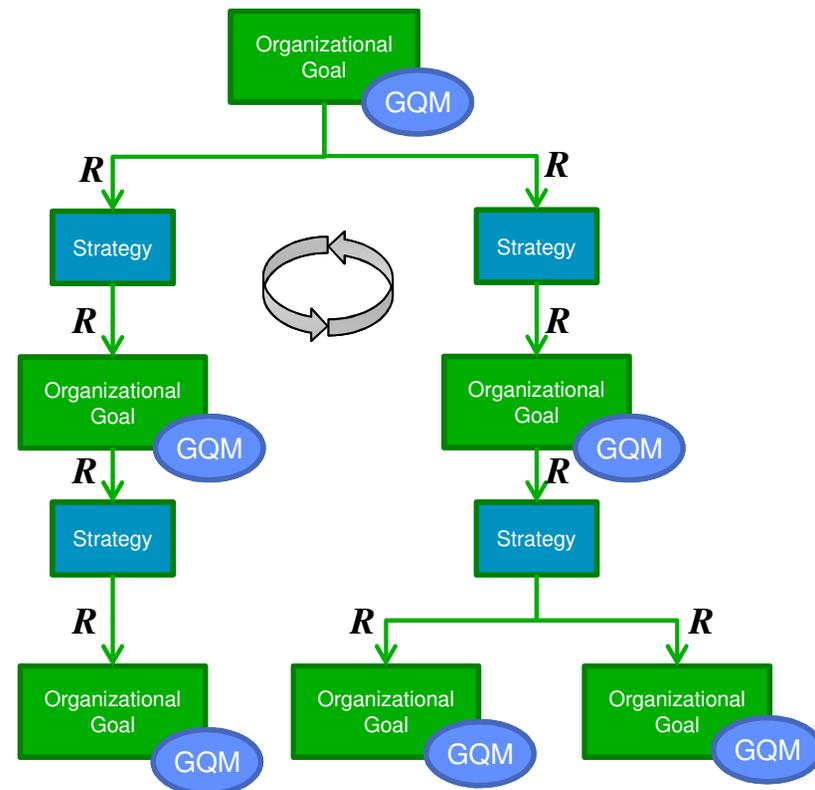
Align the business at all levels of the organization

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 *R* 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)

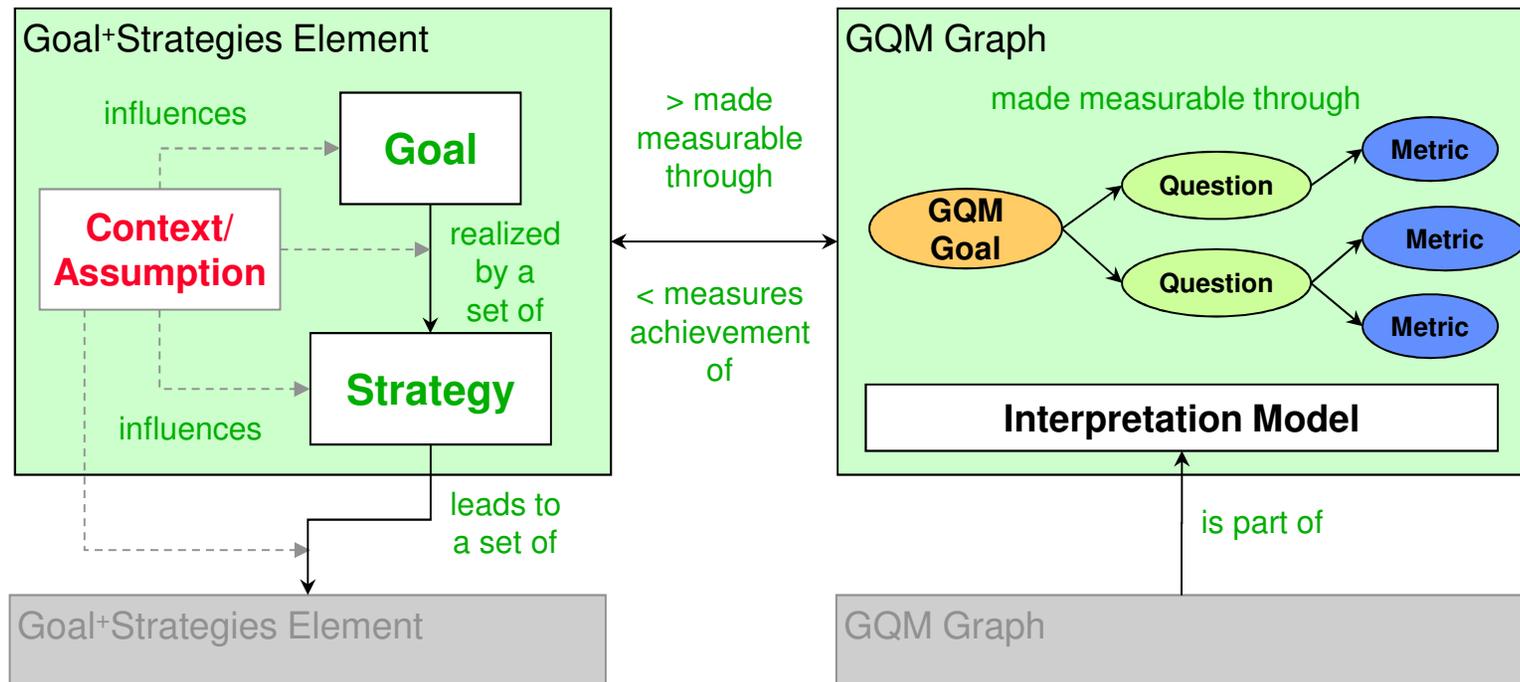
**Level i Goals:** A set of lower-level goals inherited from level i-1 goals as part of the level i-1 goal strategy

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

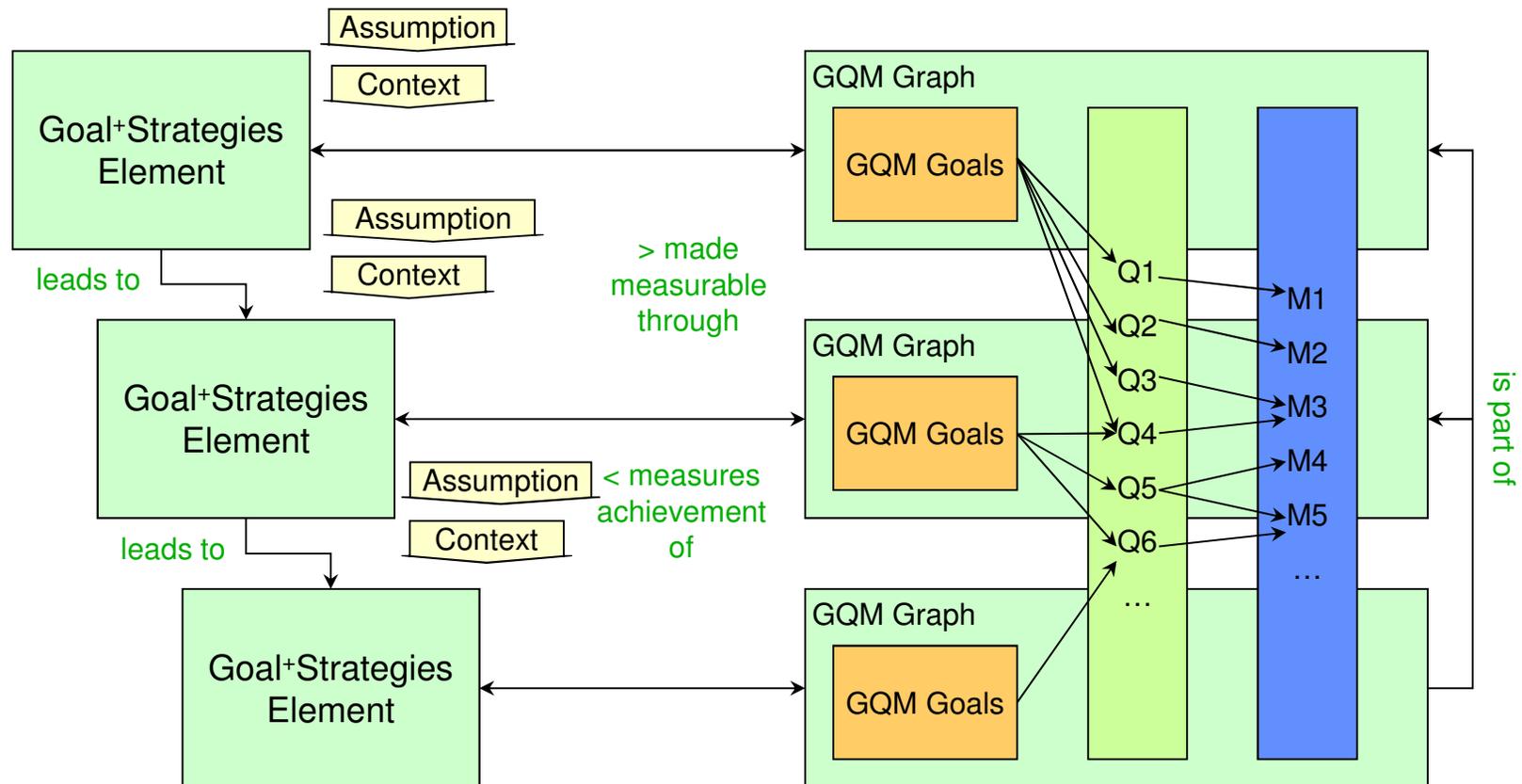
**Interpretation Models:** Models that help interpret data to determine whether goals at each level is achieved



# Tying Strategies to GQM: A Complete Goal+Strategies® Element

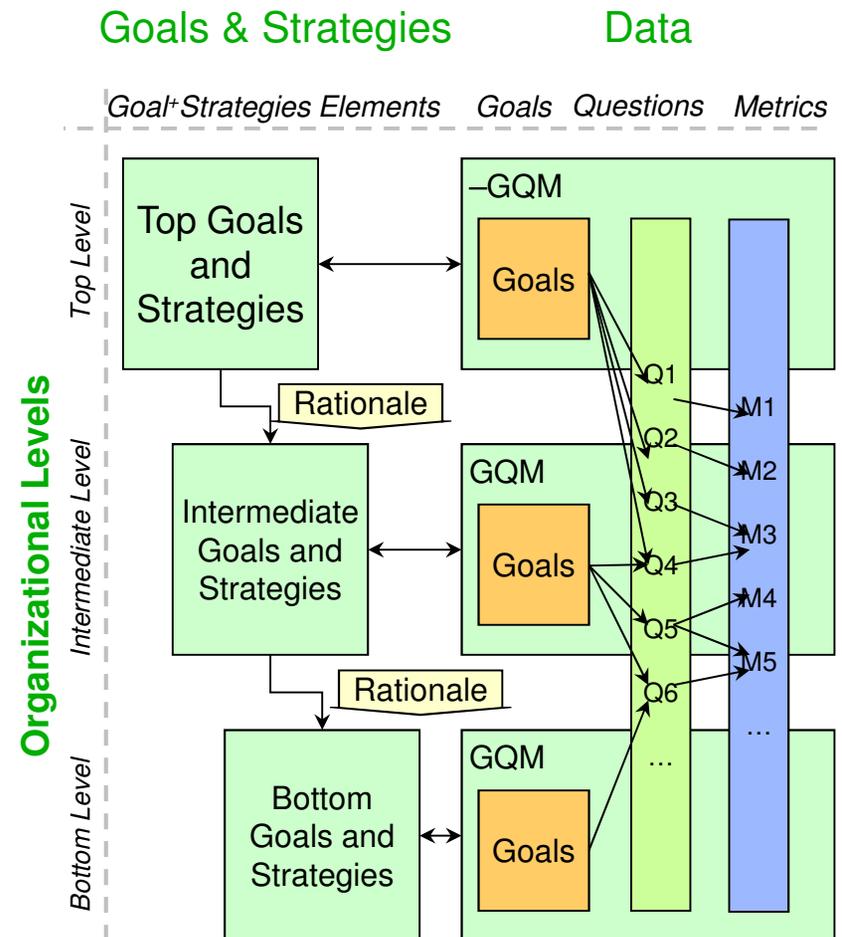


# Linking Goals at Multiple Levels: A Sample GQM+Strategies® Grid

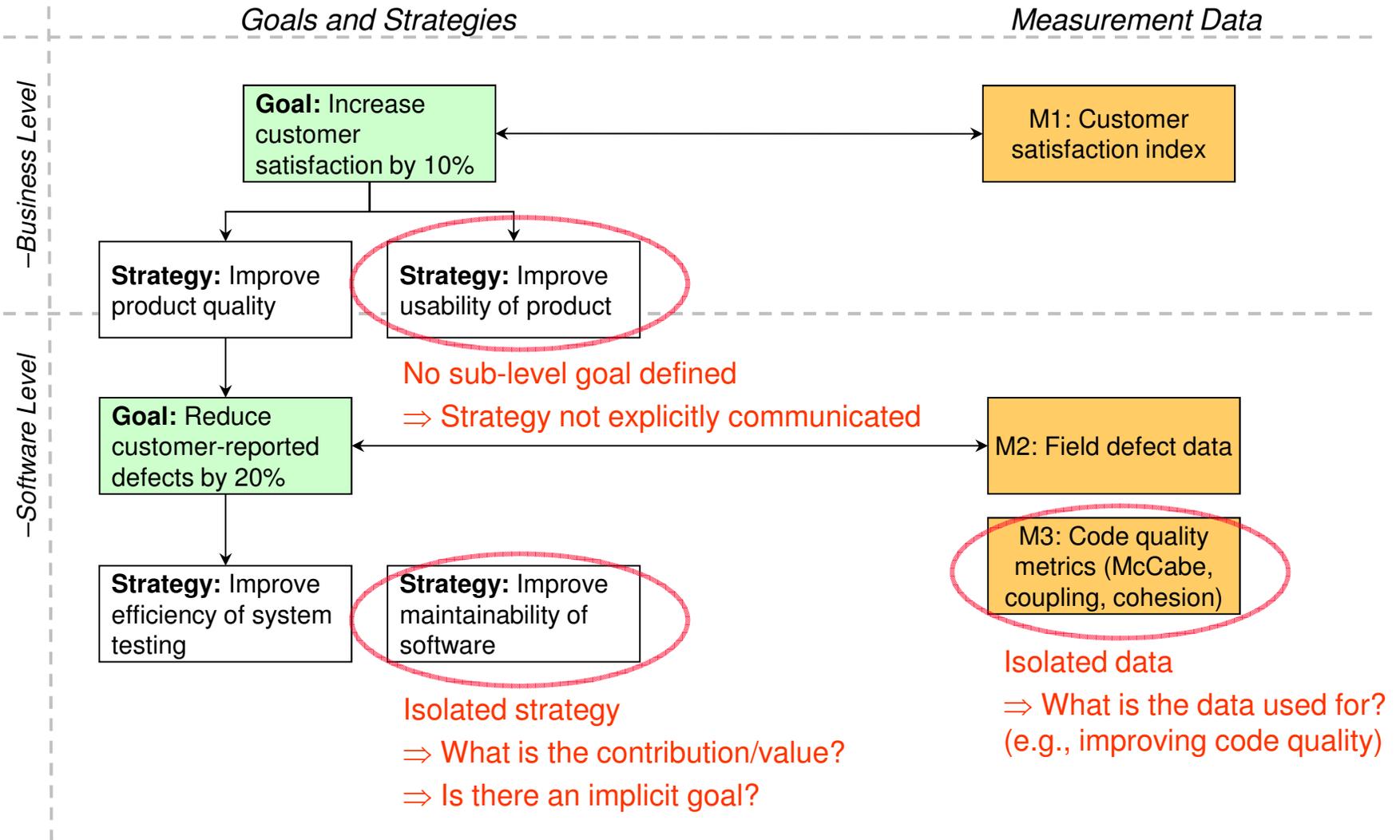


# GQM+Strategies® Features Help Address Common Issues

- 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



# Real Example

Separated branches  
=> Are there hidden relationships?

Different level of detail  
=> Is model balanced?

InfoCenter  
Goal: G3

- Level: [blurred]
- Short Description: Reduce #days
- Activity: Reduce
- Focus: time for [blurred]
- Object: for each milestone of the [blurred]
- Magnitude: >= payment within [blurred]; >= payment within [blurred]
- Timeframe: Continuous goal, evaluated on a quarterly basis
- Scope: Achieving goal: - Department Manger of Division - Group Manager (other than [blurred])
- Constraints: [blurred]

Level Filter  
No Filtering

Goal ID	Level	Short Description	Activity	Focus	Object	Magnitu...	Timefra...	Scope	Constra...	Relations	Comme...
G1	[blurred]	[blurred]									
G2	[blurred]	[blurred]									
G3	[blurred]	[blurred]	Reduce	time for ...	for each ...	[blurred]	Continu...	Achievin...	Inappro...	G6 (sup...	
G4	[blurred]	[blurred]									
G5	[blurred]	[blurred]									
G6	[blurred]	[blurred]									
G7	[blurred]	[blurred]									



## 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

Goal Aspect	Aspect Value
Focus	Net Income
Object	ABC Web Services
Magnitude (degree)	10% increase per year
Timeframe	Annually, beginning in 2 years
Organizational Scope	Development Groups: 15%/year for all CMMI projects with maturity level > 1
Constraints (limitations)	Available resources, ability to sustain CMMI levels, ...
Relations to other goals	CMMI Goals

# 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 ( $P_0$ )? What is the profit figure for each succeeding year ( $P(x)$ )?

# Business Goal: Level 1

## Interpretation model:

Starting in year 2, i.e., for  $x = 2, 3, \dots$

**if**  $P(x) \geq 1.1 * P(x-1)$

**then** the goal has been satisfied,

**else if** added functionality was increased appropriately

**then** some assumption or level 1 strategy, is wrong

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

**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

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

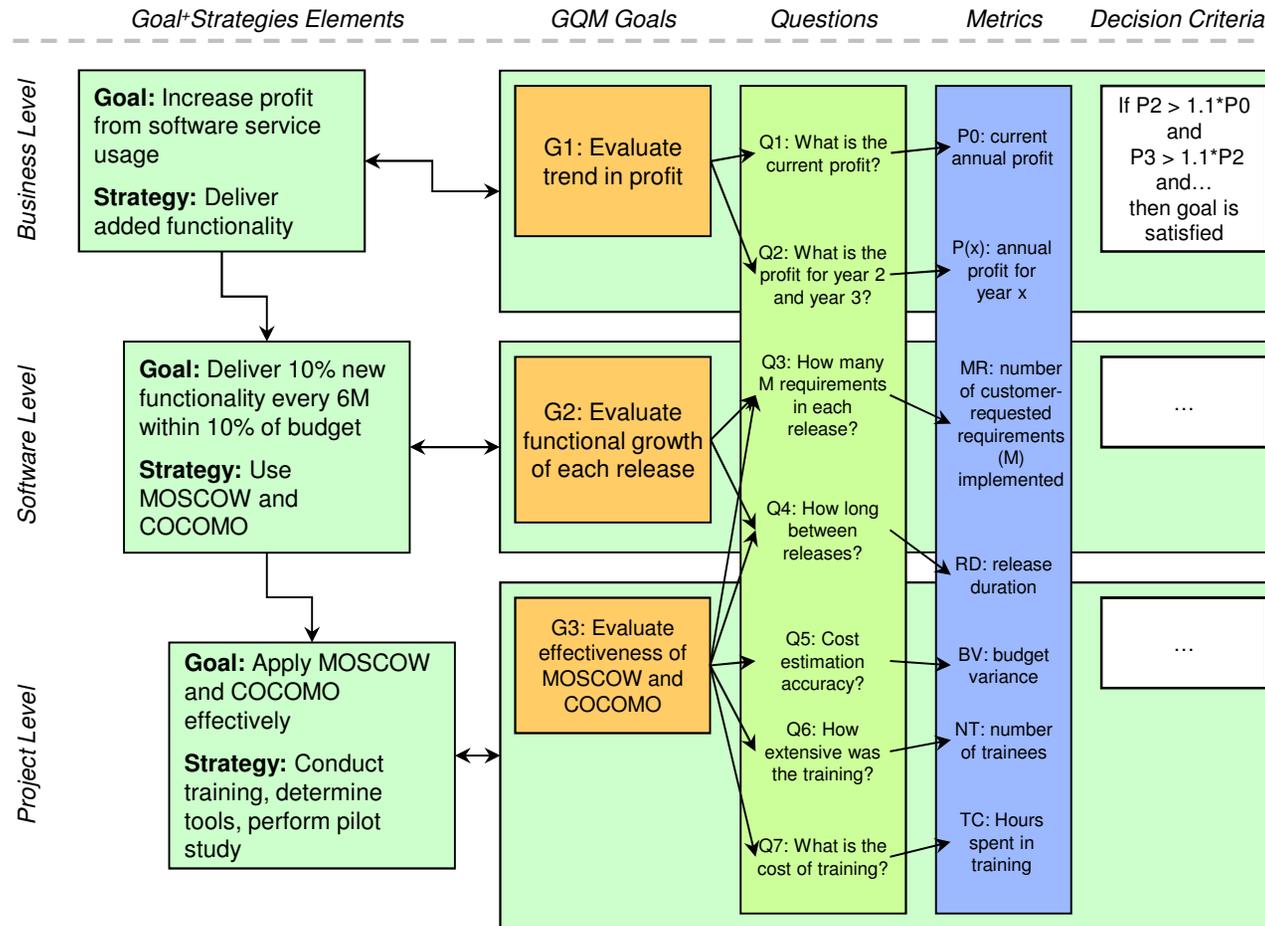


## Level 2 Goal

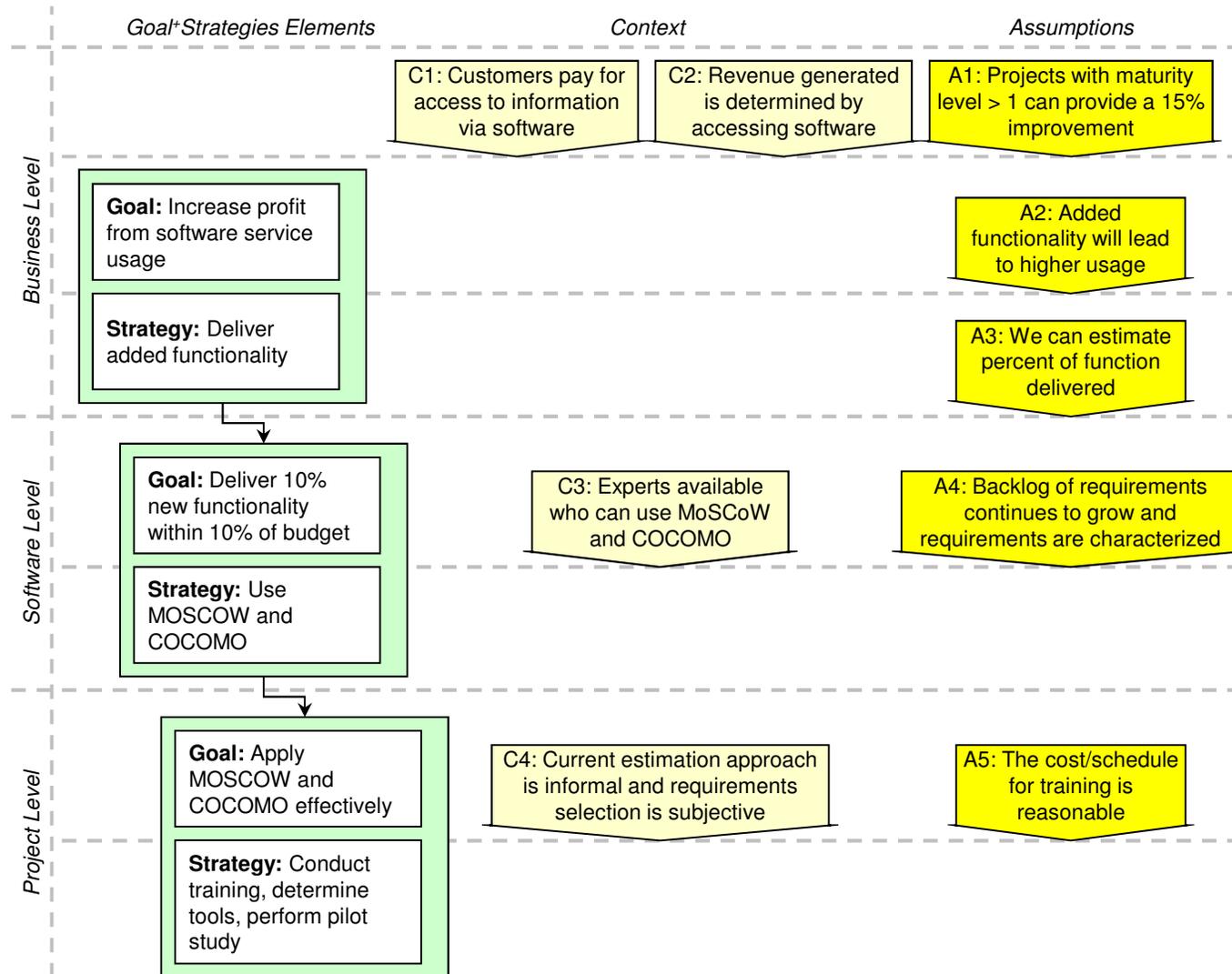
- **GQM Goal:** Analyze each 6 month release for the purpose of evaluation with respect to a 5% new function growth as compared to prior function growth from the point of view of the services project manager in the context of ABC services.
- **GQM Questions:** What was the **amount of function** delivered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



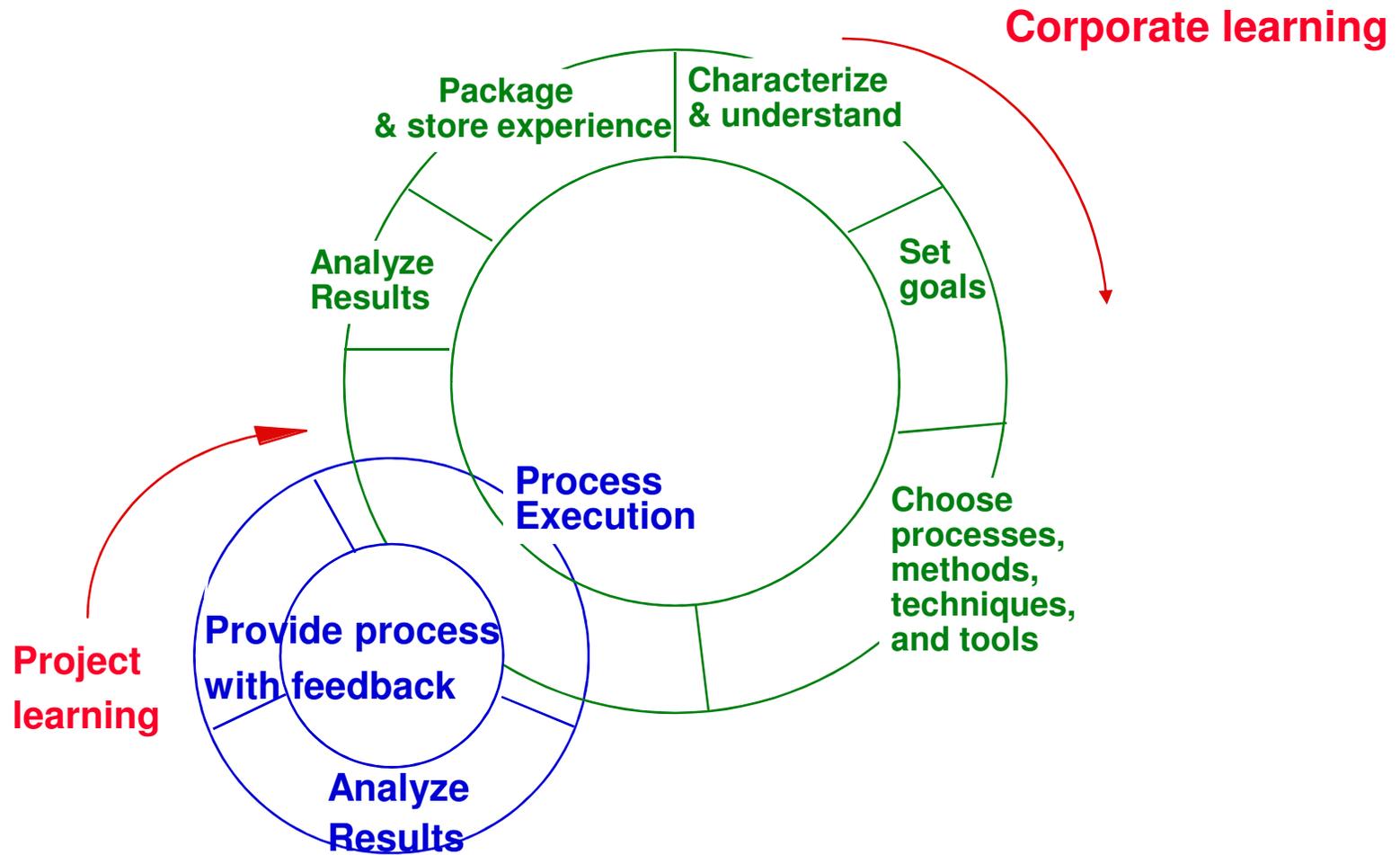
# Measuring Increase Net Income



# Context and Assumptions for Increase Net Income



# 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

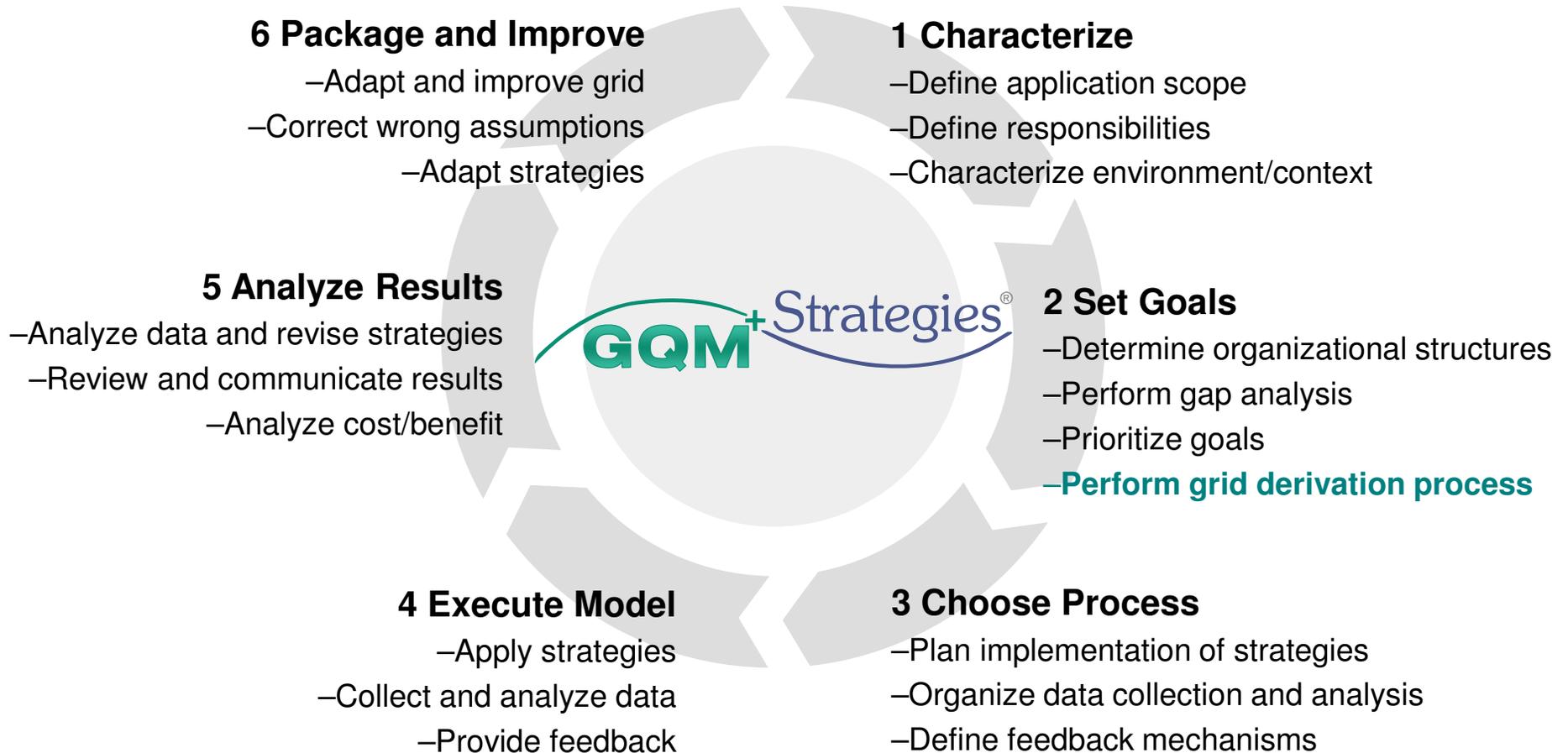
**Choose process:** Plan implementation of strategies, data collection  
and analysis, and feedback mechanisms

**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<sup>®</sup> Life Cycle



## Who is Using GQM+Strategies® and Why?

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

## 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



## Summary

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

UMD: Victor Basili

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Fraunhofer CESE: Carolyn Seaman, Forrest Shull, Madeline Diep, ...

University of Helsinki: Juergen Muench, ...

University of Oulu: Markku Oivo, ...

University of Novo Sad: Vladimir Mandic

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