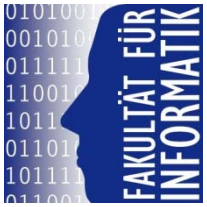

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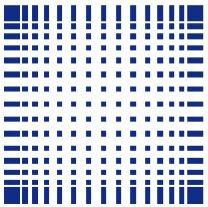

Fraunhofer IESE

Software-Qualitätsmanagement

SWQ – SS2019 – 2IM

Kapitel 4.1: Geschäftsausrichtung (Teil 1)

Dr. Adam Trendowicz
Fraunhofer Institut für Experimentelles Software Engineering

Inhalt

1. Motivation
2. GQM⁺Strategies Method
3. GQM⁺Strategies Process

Antonio Fiol
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Inhalt

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 between all involved units
- Question: How do we know whether the course is right and the collaborative vehicle is effective?
- Answer: Alignment & Measurement

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 Organizations Measure?

- Understand the Business and Create Visibility
  - Build baselines, show relationships
  - Identify critical factors
- Manage and Control Projects Based on Quantitative Evidence
  - Plan and estimate
  - Track- actuals versus estimates
  - Decision-making
- Guide Improvement and Optimize the Activities
  - Prioritize and assess
  - Package experiences

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

Conclusions

You cannot control what you cannot measure *[Tom DeMarco]*

- Measurement is a mean to an end, not an end in itself
  - 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

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GQM⁺Strategies is registered trademark at the German Patent and Trade Mark Office No. 302008021763; international registration number IR992843

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Importance of IT Business Alignment
(IT = Classical IT Services + Software Development)

- Software-intensive systems/services are taking over ever more tasks today
- IT and software becomes a central driver for innovation and growth
- Business success becomes dependent on IT/software-related strategies
- It is important to align IT/software-related strategies with business goals across the whole organization
  - Derivation of IT/software-related strategies from business goals
  - Illustrate contribution of IT/software-related strategies to business goals

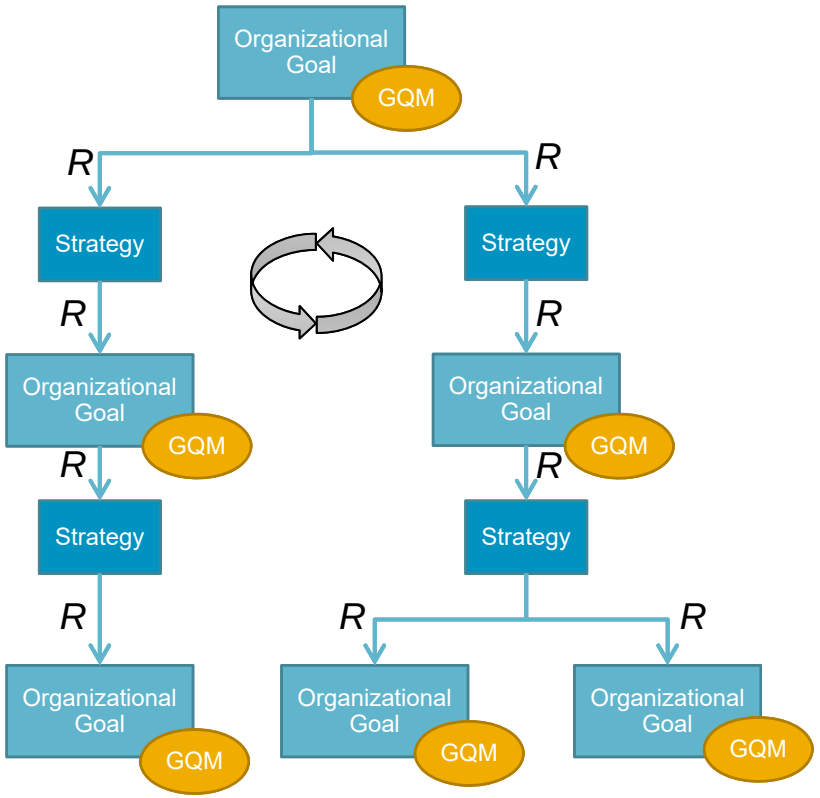
- **Otherwise, …**
  - IT/software is seen as a pure cost driver that is easy to substitute
  - Core competences for business success are outsourced

Do you need IT Business Alignment?

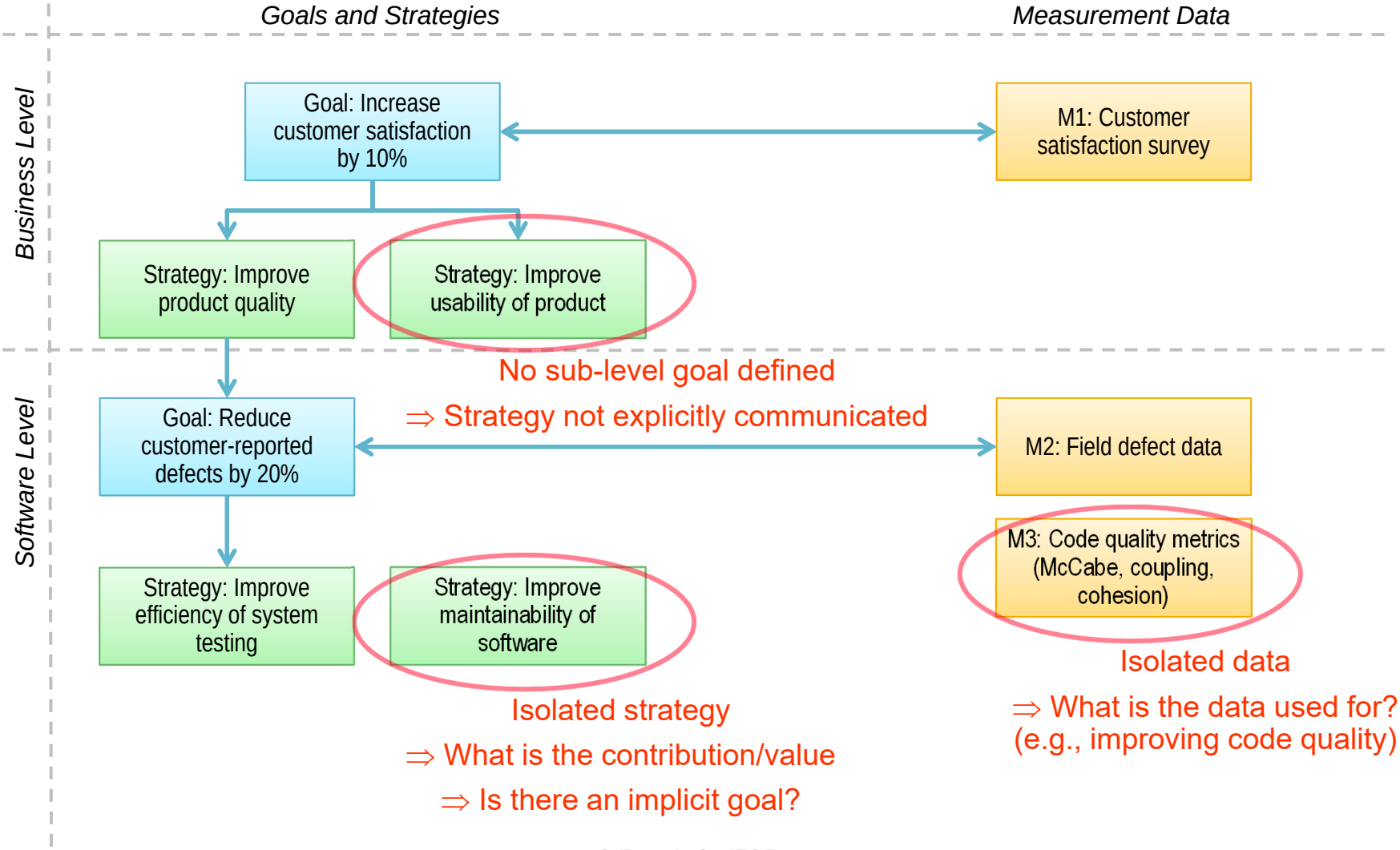
- Symptoms
  - Strategies on different levels of an organization are not linked to each other
  - It is often hard to demonstrate how improvement strategies generate business value
  - It is not clear, how development activities contribute to business goals
  - Software and system engineers are frequently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

Strategic Measurement Systems with GQM+Strategies

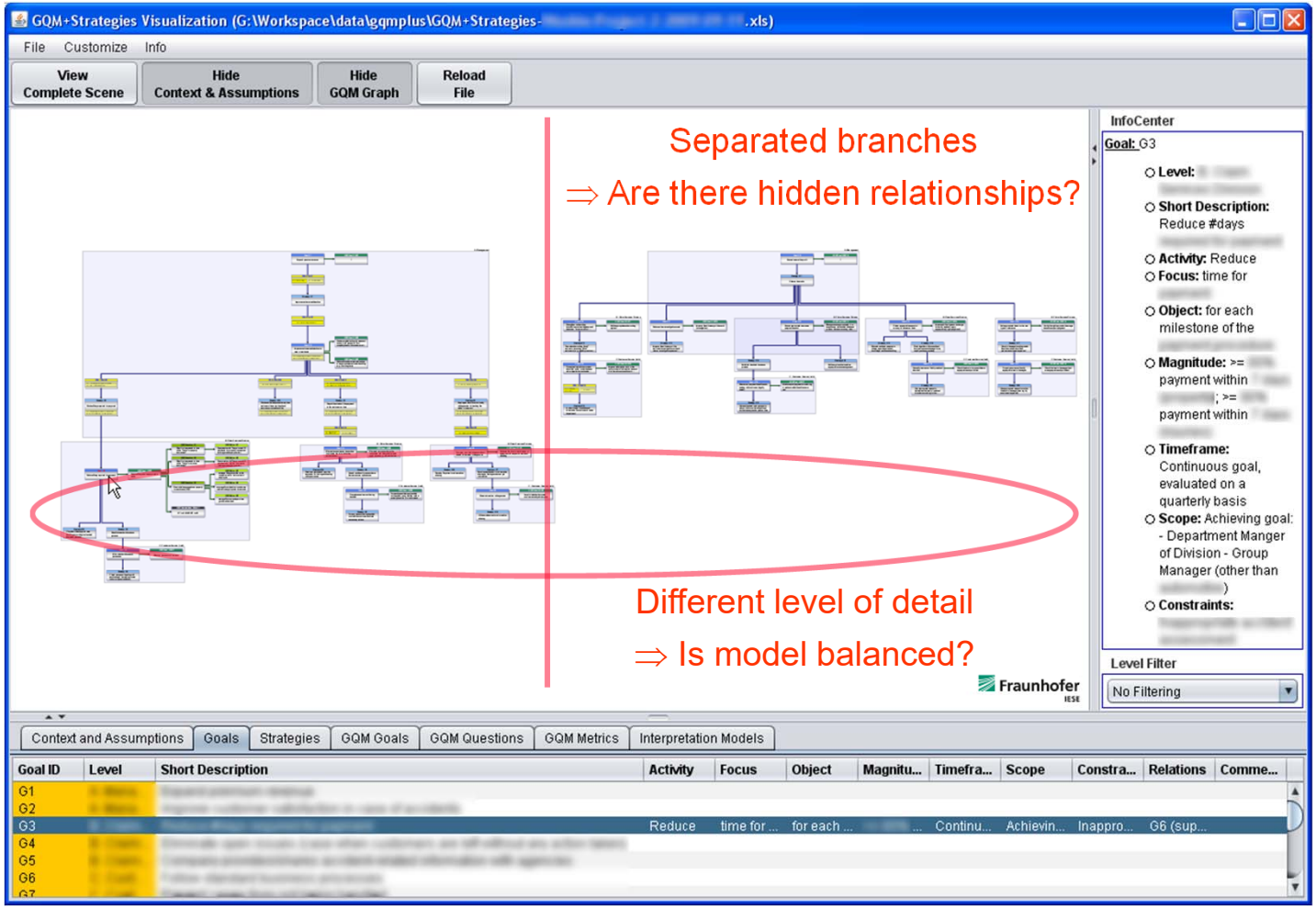
- Align the business at all levels of the organization
  - Link organizational goals and strategies from the management level to the project level
  - Control success/failure through measurement and KPI definition (based on the GQM Paradigm)
  - Document the rationale for linking organizational goals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



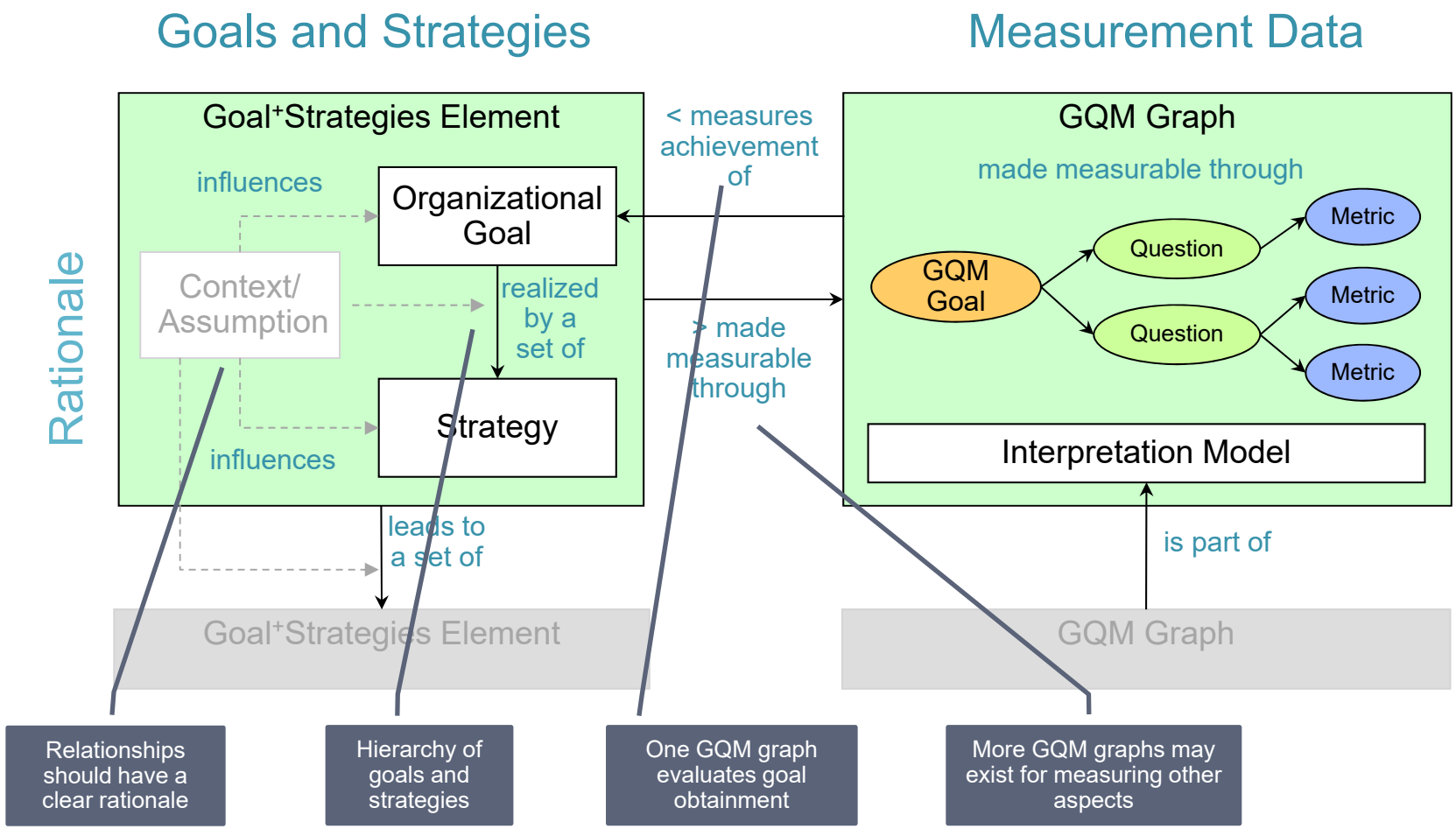
Potential Issues to Face (Example)



Real Life Grid (Example)



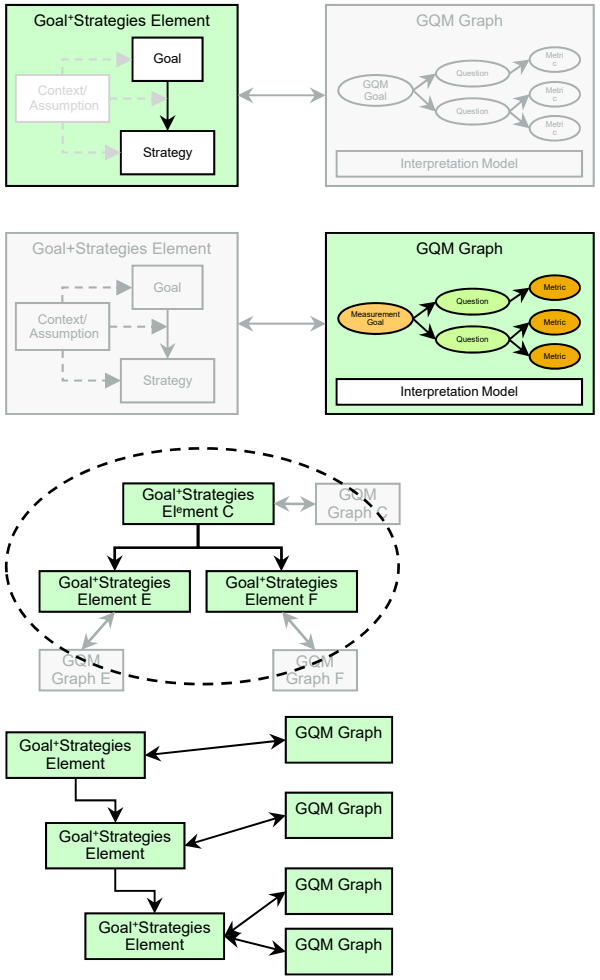
The GQM+Strategies® Grid Meta-Model



Basic Concepts

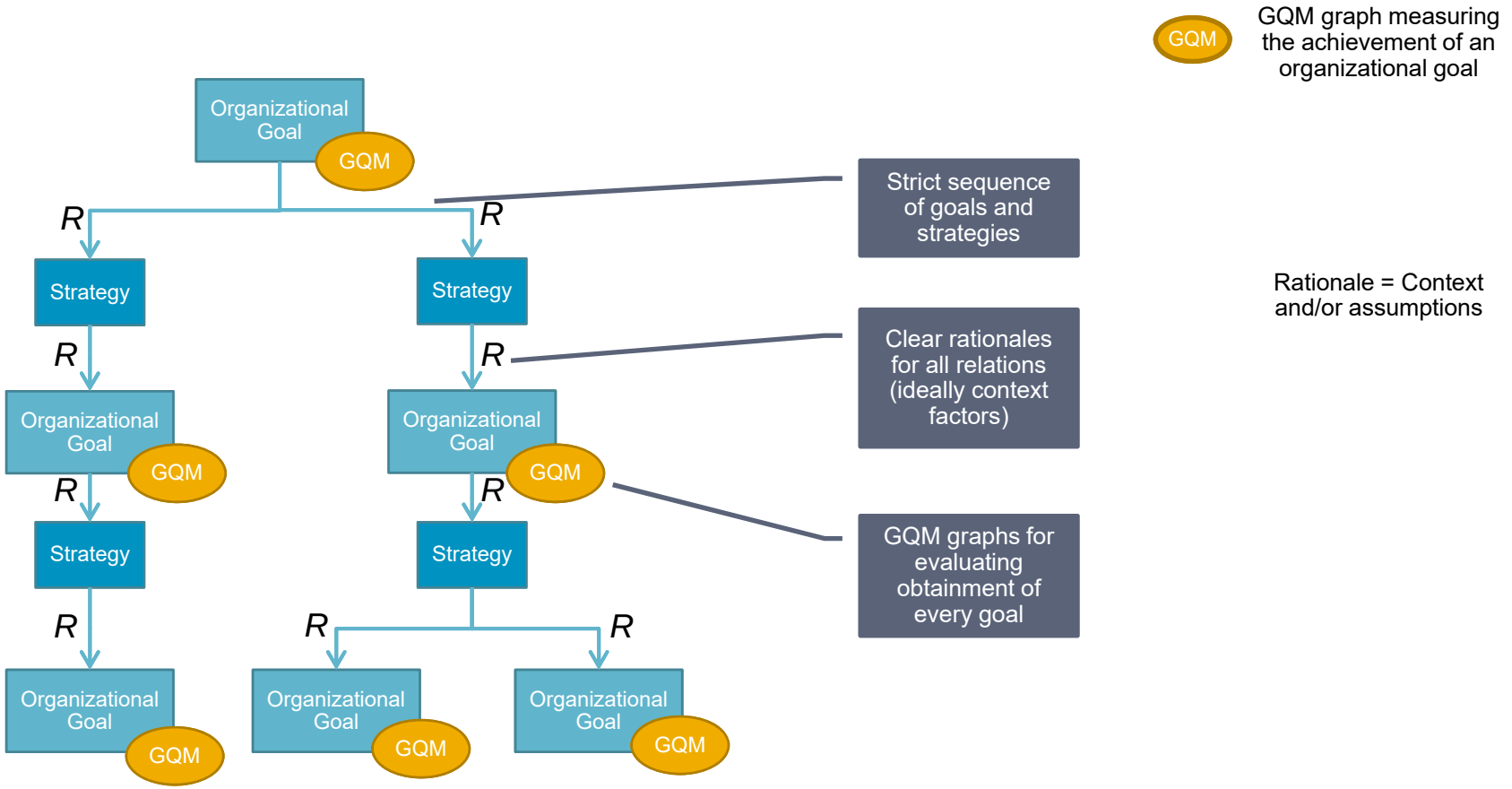
- Organizational Goals that the organization wishes to accomplish in order to achieve its objectives are de-fined at different levels of the organization (e.g., an improved customer satisfaction or reduced rework cost). They define a target state the organization wants to accomplish within a given time frame.
- Strategies are possible approaches for achieving a goal within the environment of the organization. The number of goal/strategy levels depends on the (internal) structure of an organization.
- Context Factors represent the external and internal organizational environment, e.g., the business environment, the company's position in the market, or the available resources for innovation.
- Assumptions are estimated unknowns, i.e., what is believed to be true but needs to be re-evaluated over time. The relevant context factors and assumptions define the rationale for choosing specific goals and strategies.
- GQM Graphs define how to measure whether a goal was accomplished and whether a strategy was successful. Following the classical GQM approach, goals are broken down into concrete metrics. Interpretation models are used for objectively evaluating goals and strategies.

Goal Derivation Concepts

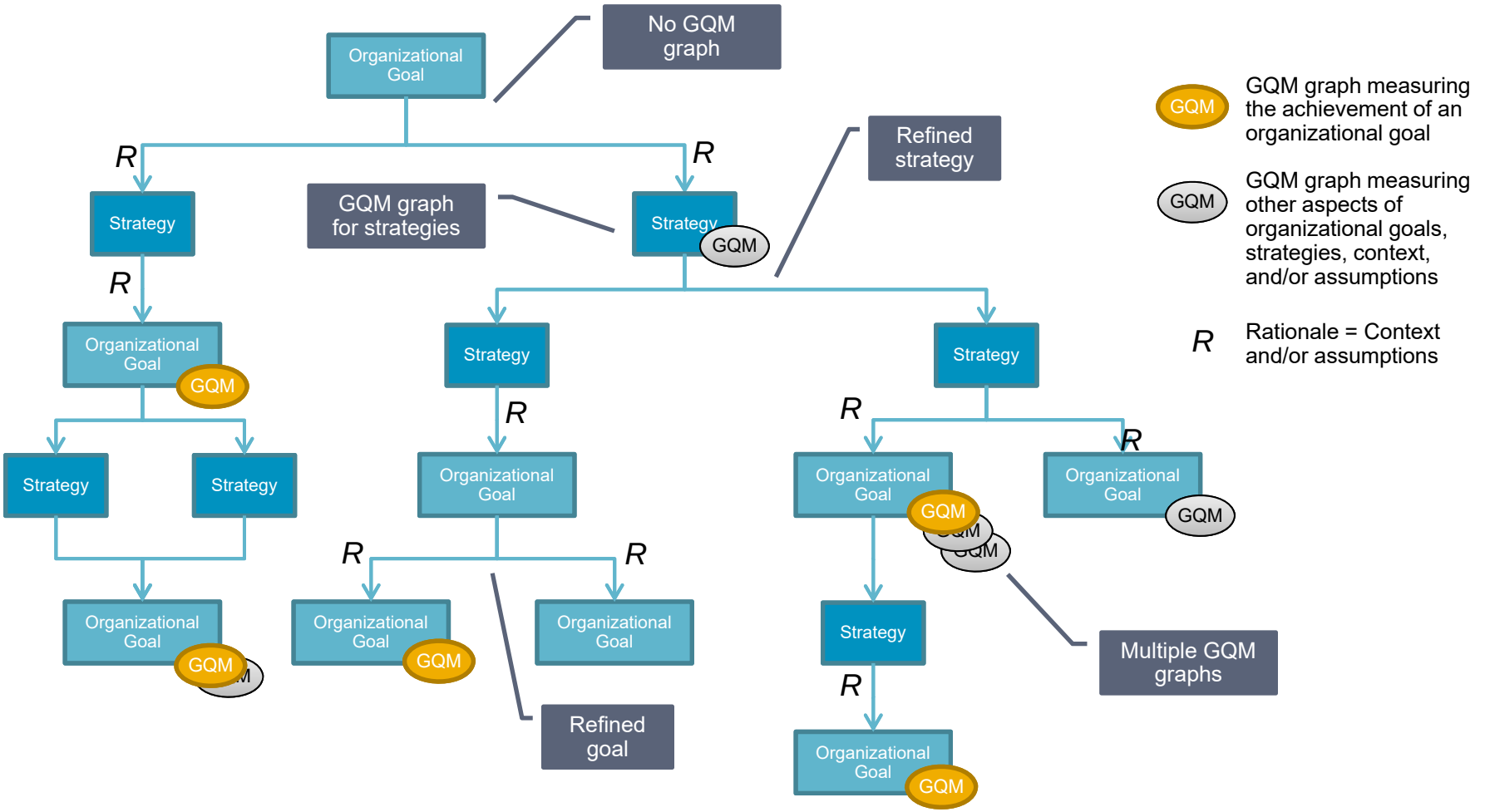


- Goal⁺Strategies Element: A single goal and derived strategies, as well as all context information and assumptions that explain the linkage between the goal and corresponding strategies
- GQM Graph: A single Measurement goal (that measures a Goal⁺Strategies Element), corresponding questions, metrics and interpretation models
- Goal Tree: The tree of all Goal⁺Strategies elements generated by a single Goal⁺Strategies element including the element itself and links to lower level goals and upper level strategies
- GQM⁺Strategies Grid: Integrated collection of all Goal⁺Strategies elements, GQM graphs, and all links; a Goal⁺Strategies Element may have multiple measurement goals associated to it

Ideal Structure of a GQM+Strategies® Grid



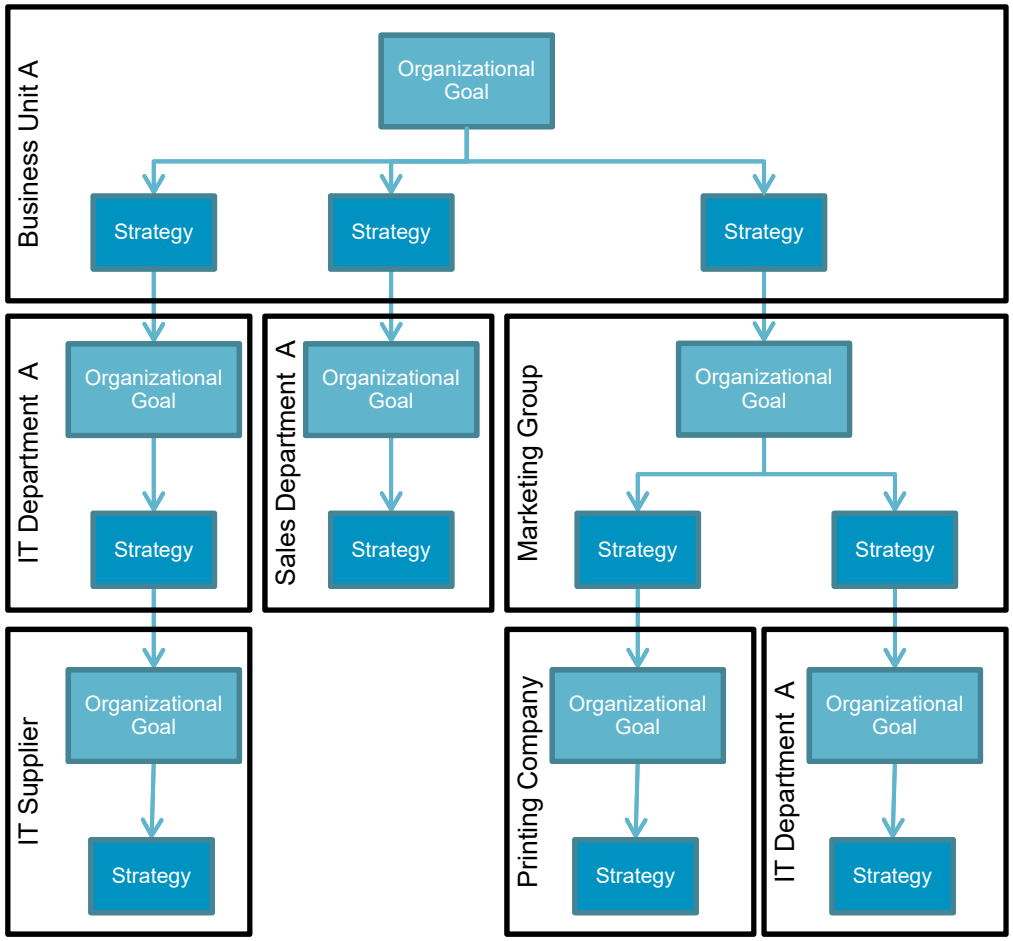
Possible Structures of a GQM+Strategies® Grid



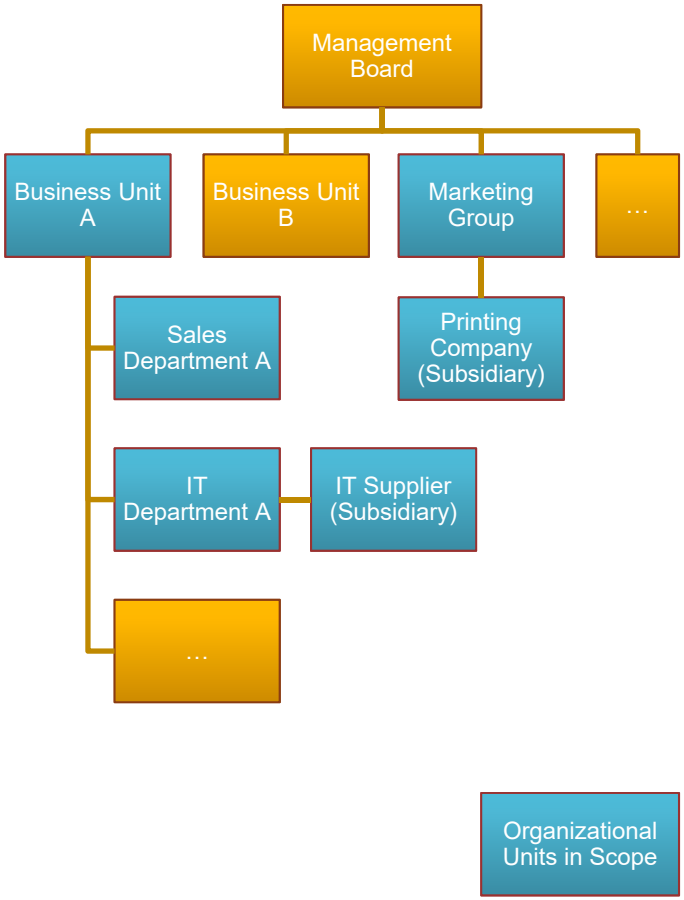
The meta model is quite flexible, but does not guarantee a good model!

Relationship to Organizational Structure

Grid (Example)



Organizational Structure (Example)



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GQM+Strategies®

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Antonio Fiol
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GQM+Strategies® Process

0 Initialize
Commitment
Staffing & Responsibilities

1 Characterize
Define application scope
Characterize environment/context

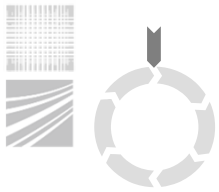
2 Set Goals
Determine organizational structures
Perform status quo analysis
Prioritize goals
Build up grid

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

4 Execute Model
4.1 Execute strategies
4.2 Collect and analyze data
4.3 Provide feedback

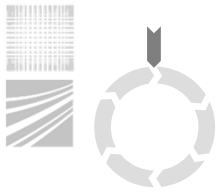
5 Analyze Results
Analyze data and revise strategies
Review and communicate results
Analyze cost/benefit

6 Package and Improve
Adapt and improve goals and strategies
Revise context and assumptions
Record lessons learned



0 Initialize: Initialize Application of GQM+Strategies

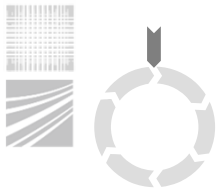
- Get Commitment
  - Define baseline problems
  - Determine scope of GQM+Strategies application
  - Agree on necessary resources
- Plan GQM+Strategies Application Process
  - Assign resources and responsibilities, prepare infrastructure, determine schedule and cost
  - Prepare the method for tracking plans
- Train Internal Company Expert and People
  - Provide training for key persons who will be involved in the process



EXAMPLE

0 Initialize: Get Commitment

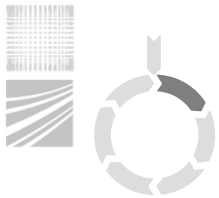
- Company X directly provides IT-based banking and insurance services to their customers on the European Market (without local sales agents)
- Company X wants to build up a measurement program for quantitatively evaluating the success and failure of their organizational strategies
- Therefore, the top level management decided to apply GQM⁺Strategies®
- X has a lot of customers in the banking area, but only few in the insurance area; so the initial scope for evaluating the success and failure of their organizational strategies has been set to the insurance area
- The current activities have not led to more customers in the insurance area



EXAMPLE

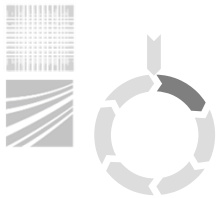
0 Initialize: Plan GQM+Strategies Application Process

- Responsibilities in company X have been clarified
  - Müller (CEO): Main stakeholder of measurement initiative
  - Meyer (Division Manager of Insurance Business Unit): Responsible for insurance-related strategies of company X
  - Schmidt (Department Head of Software Group): Responsible for in-house software development and IT support of business units
  - Schiller (Company Expert on GQM+Strategies®)
- A rough schedule for the application has been set up
  - Milestone M0 (November 2019): Training of people and definition of grid (end of phase “3 Set Goals”)
  - Milestone M1 (January 2020): Rollout of measurement program and start tracking of goals and strategies (end of phase “4 Choose Process”)
  - Milestone M2 (September 2020): Analyzing the performance of goals and strategies and initiating counter measures (end of phase “6 Package”)
  - After that the grid will be updated and analyzed every 6 months as part of organization-wide improvement workshops of the top level management of company X



1 Characterize: Define Scope and Environment

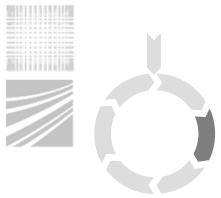
- Identify the scope
  - What part of the organization is mainly involved (based on baseline problems identified in Step 0)
- Characterize the environment
  - Characterize the product or service
  - Characterize existing processes, tools, and technologies
  - Characterize size of the organization (e.g., # people, #projects, revenue, staff/project, duration/project)
  - Characterize customers
  - Characterize income sources and business model (e.g., factors that influence profitability, contracting vehicles, etc.)
  - Characterize organizational interfaces (internal and external)
  - Characterize the existing measurement programs (e.g., goals, models, measures, and measurement data)



EXAMPLE

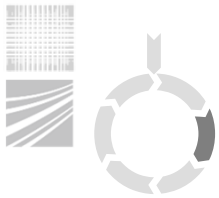
1 Characterize: Define Scope and Environment

- Company X conducts a workshop clarifying scope and environment
  - Scope
    - IT/software support for the insurance business area of company X
  - Environment
    - Application domain: Insurance software
    - Project organization: Maintenance projects
    - Processes
      - Mainly: Rational Unified Process (RUP)
      - Partly: Scrum (agile development)



2 Set Goals: Determine Structures, Analyze Status Quo, Prioritize Goals, and Build Up Grid

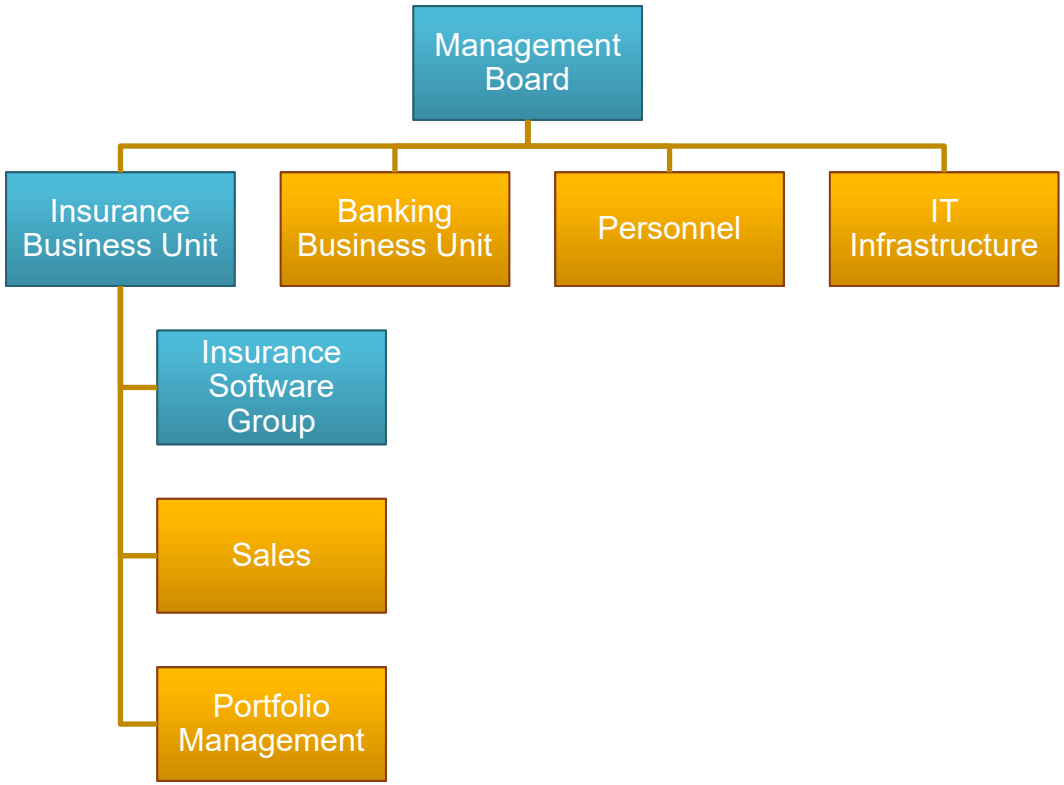
- Define Organizational Units Involved
  - Determine organizational structures
  - Describe relationships among them
- Perform status quo analysis
  - Collect existing goals, strategies, and measurement data
  - Analyze potential issues to focus on (e.g., related to incompleteness, inconsistency of information)
- Build Up a GQM⁺Strategies® Grid



EXAMPLE

2 Set Goals: Define Organizational Units Involved

- Company X defines the following organizational chart (initial scope on blue ones):



EXAMPLE

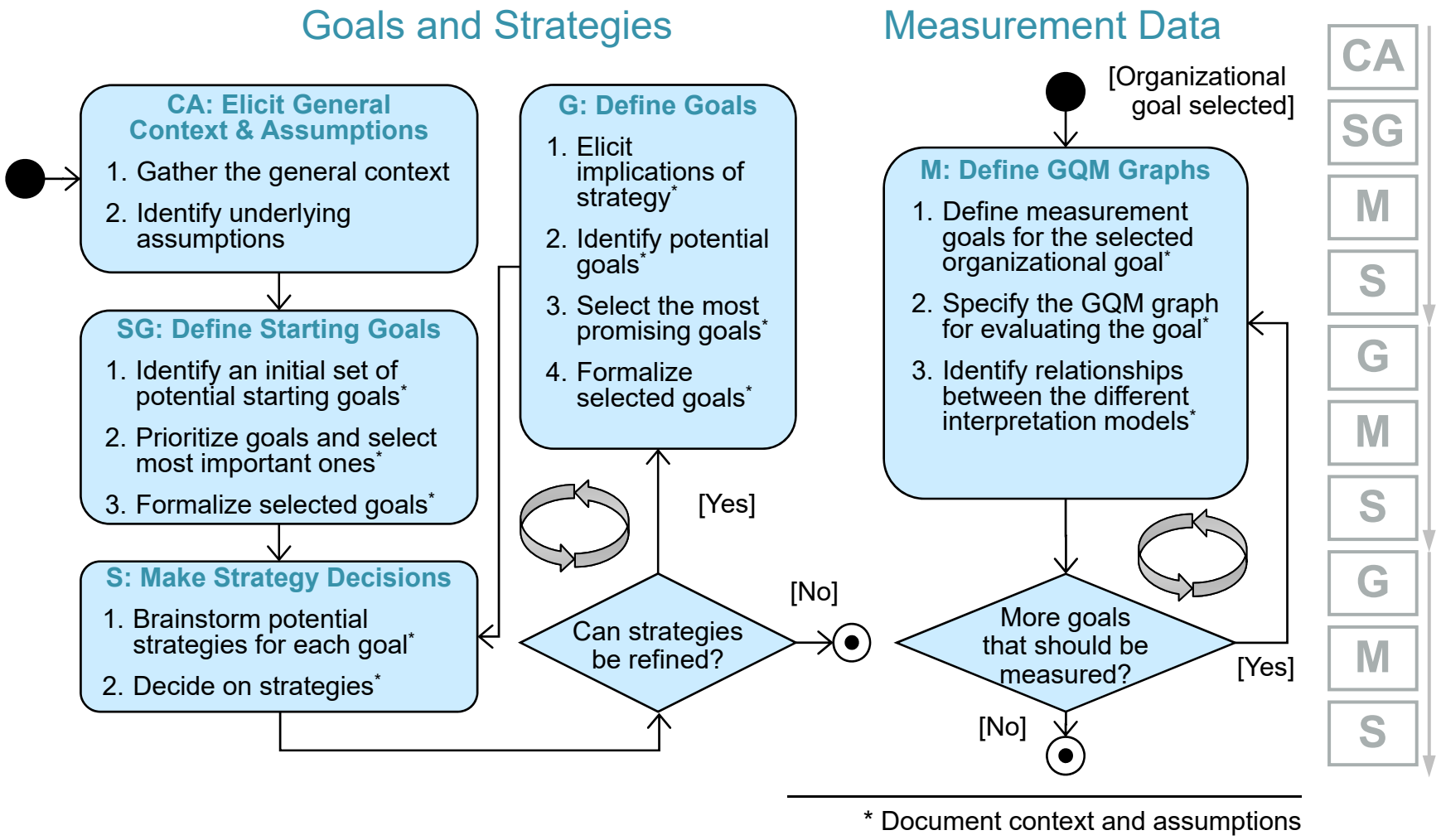
2 Set Goals: Perform Status Quo Analysis

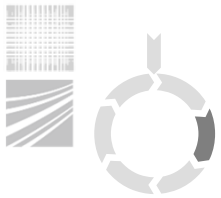
- Company X collects existing assets for the defined scope (organizational units) based on existing documentation and a workshop
- X performs an analysis of potential issues (which will need to be addressed when building the grid later on)
  - Issue 1: In one strategy sufficient?
  - Issue 2: What data is available for evaluating the reliability on customer's side
  - Issue 3: What strategies can be performed for decreasing the amount of defects slipped?

Unit	Goals	Strategies	Data Source
Management Board	Increased number of customers in insurance area	Improve products Issue 1	Customer Relationship Management (CRM)
Insurance Business Unit	Improved reliability of IT-based products	Improve QA activities	- Issue 2
Insurance Software Group	Decreased defects slipped through QA	- Issue 3	Bug Tracking

EXAMPLE

Standard Workflow for Building Up a GQM+Strategies Grid

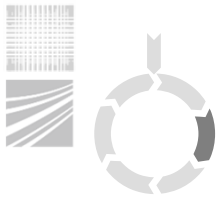




EXAMPLE

2 Set Goals: Elicit General Context & Assumptions

- Company X conducts a workshop for defining the grid
- Gather the general context
  - Context CA1
    - Company X provides banking and insurance services to their customers.
    - X directly sells services via the internet without local sales agents.
    - X has a lot of customers in the banking area, but only few in the insurance area.
- Identify underlying assumptions
  - *None*



EXAMPLE

2 Set Goals: Define Starting Goals

- Identify an initial set of potential goals
  - NC-G: Increased number of customers in the insurance business area
- Prioritize goals
  - Only one goal was selected for company X
- Formalize selected goals

EXAMPLE

2 Set Goals: The Organizational Goal Template

Focus	Describes the quality we want to focus on (e.g., productivity)
Object	Describes the object that is addressed by the goal (e.g., software development projects)
Magnitude	Describes the amount that should be obtained (e.g., 10% more)
Timeframe	Describes the timeframe until when to obtain the goal (e.g., by the end of 2013)
Organizational Scope	Describes who in the organization is responsible for obtaining the goal (e.g., department XYZ)
Constraints	Documents constraints for obtaining the goal (e.g., economical environment)
Relations	Documents relationships to other goals and strategies (e.g., conflicting or supporting)

EXAMPLE

2 Set Goals: Formalize Goal: “NC-G: Increased number of customers”

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

EXAMPLE

Evaluating Organizational Goals: Heuristic

Organizational Goal

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

Heuristic

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

EXAMPLE

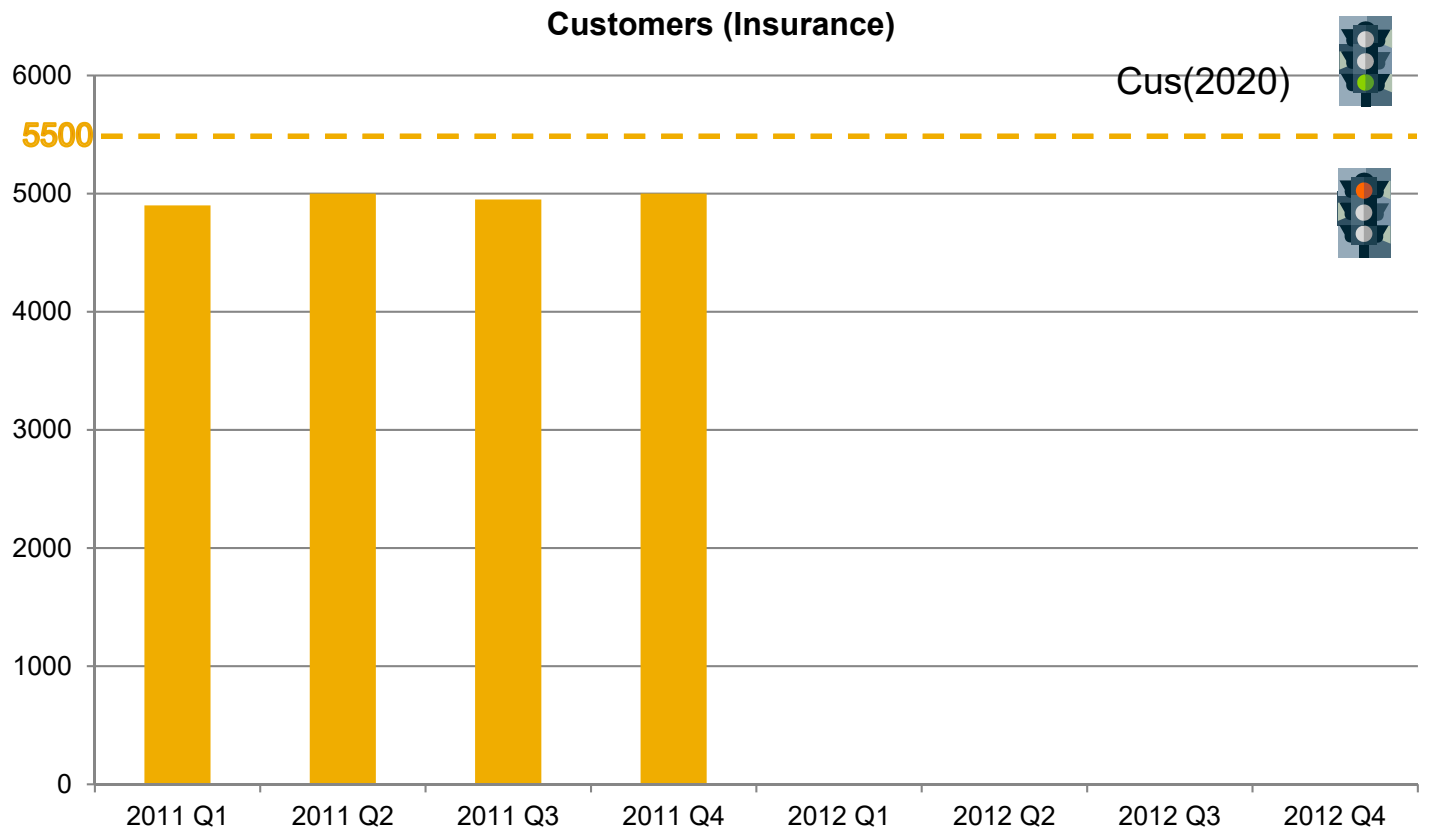
2 Set Goals: Define GQM Graph: “GQM-NC-G: Evaluate increase of number of customers”

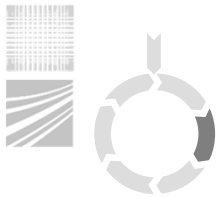
Object	Purpose	Quality Focus	Viewpoint	Context
Customers in insurance area	Evaluate	Amount	Management	See C&A
Quality Focus			**Variation Factors**	
■ NC-G-Q1: How many customers have been gained in the fiscal year? ■ **Cus(Y): Average number of customers in year Y (e.g., in the next fiscal year 2020)**			-	
Baseline Hypotheses			**Impact of Variation Factors**	
Cus(2019)=5000			-	
Interpretation Model				
NC-G-I: **Cus(2020)/Cus(2019) >= 1.1**				

CA
SG
M
S
G
M
S
G
M
S

EXAMPLE

2 Set Goals: Visualization: “GQM-NC-G: Evaluate increase of number of customers”





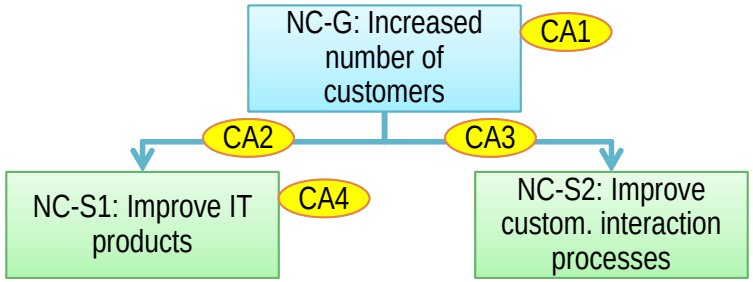
EXAMPLE

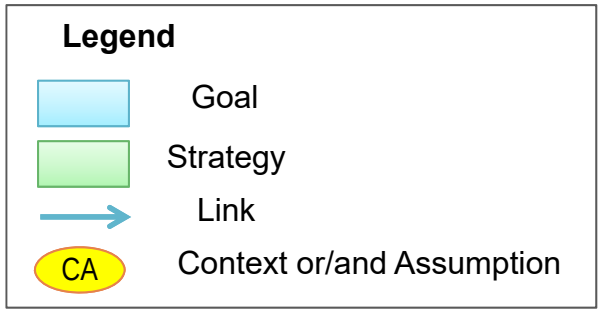
2 Set Goals: Make Strategy Decisions

- Document context and assumptions
  - Context CA4: The services of X are build upon an Enterprise information system (IS) that is composed out of different software components (from which 60% were developed in-house by the IT department).
- Brainstorm potential strategies
  - Strategy NC-S1: Improve IT products
  - Strategy NC-S2: Improve customer interaction processes
  - Strategy NC-S3: Intensify marketing
- Document context and assumptions
  - Assumption CA2: For getting more customers in the insurance area, the quality of the IT products has to be improved.
  - Assumption CA3: For getting more customers in the insurance area, the quality of the customer interaction processes has to be improved.
- Decide on a strategy
  - Strategy NC-S1 and Strategy NC-S2

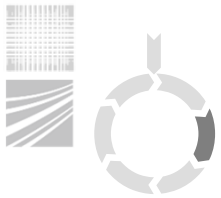
EXAMPLE

2 Set Goals: GQM+Strategies Grid





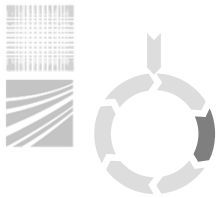
- CA1: Company X provides banking and insurance services to their customers. X directly sells services via the internet without local sales agents. X has a lot of customers in the banking area, but only few in the insurance area.
- CA2: For getting more customers in the insurance area, the quality of the IT products has to be improved.
- CA3: For getting more customers in the insurance area, the quality of the customer interaction processes has to be improved.
- CA4: The services of X are build upon an Enterprise information system (IS) that is composed out of different software components (from which 60% were developed in-house by the IT department).



EXAMPLE

2 Set Goals: Define Goals (1/2)

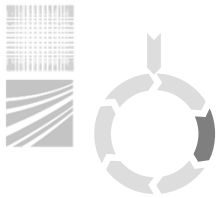
- Elicit the implications of the chosen strategy (e.g. to other organizational units)
  - Company X takes a look to their service desk data for checking improvement potential
- Document context and assumptions
  - Context CA5: 30% of customers complain that it takes too long to deliver new features (react to the market) and to fix existing bugs.
  - Context CA6: 20% of customers complain that the IT products they have to deal with are not reliable.
  - Context CA7: 15% of customers complain about many issues related to the customer interaction process.



EXAMPLE

2 Set Goals: Define Goals (2/2)

- Identify potential goals
  - (Strategy NC-S1: Improve IT products)
    - Goal FF-G: Delivered new features and fixes faster
    - Goal PR-G: Improved reliability of products
  - (Strategy NC-S2: Improve processes)
    - Goal CI-G: Improved custom. interaction processes
- Select the most promising goal considering feasibility, cost, and benefit
  - Company X decides to take all three goals
- Formalize selected goals



EXAMPLE

2 Set Goals: Formalize Goal: "FF-G: Delivered new features and fixes faster"

Focus	time of delivering new features and bug fixes of
Object	Enterprise IS
Magnitude	regular feature releases every 6 months and monthly bug fix releases (or more frequently)
Timeframe	by the middle of next fiscal year
Organizational Scope	management of insurance business unit
Constraints	while maintaining cost
Relations	-

EXAMPLE

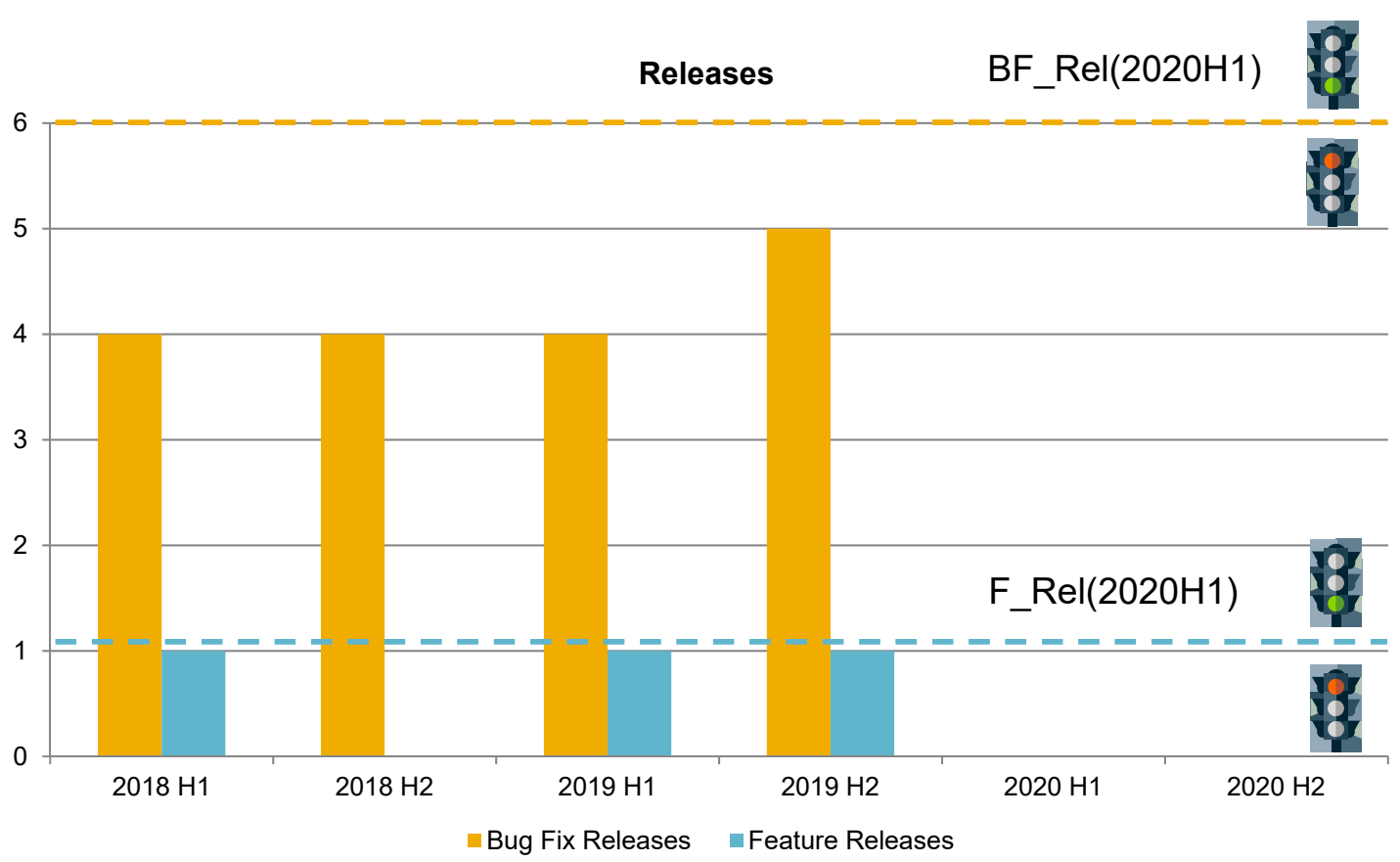
2 Set Goals: Define GQM Graph: "GQM-FF-G: Evaluate faster delivery of new features and fixes"

Object	Purpose	Quality Focus	Viewpoint	Context
Enterprise IS	Evaluate	Time of delivering new features and bug fixes	Management of insurance business unit	See C&A

Quality Focus	Variation Factors
■ FF-G-Q1: How many feature releases have been created in the first half of the fiscal year? ■ **F_Rel(T): Number of feature releases in time span T (e.g., half a year)** ■ FF-G-Q2: How many bug fix releases have been created in the first half of the fiscal year? ■ **BF_Rel(T): Number of bug fix releases in time span T (e.g., half a year)**	-
Baseline Hypotheses	**Impact of Variation Factors**
F_Rel(2019H2) = 1 **BF_Rel(2019H2) = 5**	-
Interpretation Model	
FF-G-I: **F_Rel(2020H1) >= 1** AND **BF_Rel(2020H1) >= 6**, whereas 2020H1 is the first half of fiscal year 2020	

EXAMPLE

2 Set Goals: Visualization: “GQM-FF-G: Evaluate faster delivery of new features and fixes”



EXAMPLE

2 Set Goals: Formalize Goal: "PR-G: Improved reliability of products"

Focus	reliability of
Object	IT products
Magnitude	having 20% less customer complaints
Timeframe	by the middle of next fiscal year
Organizational Scope	management of insurance business unit
Constraints	while maintaining cost
Relations	-

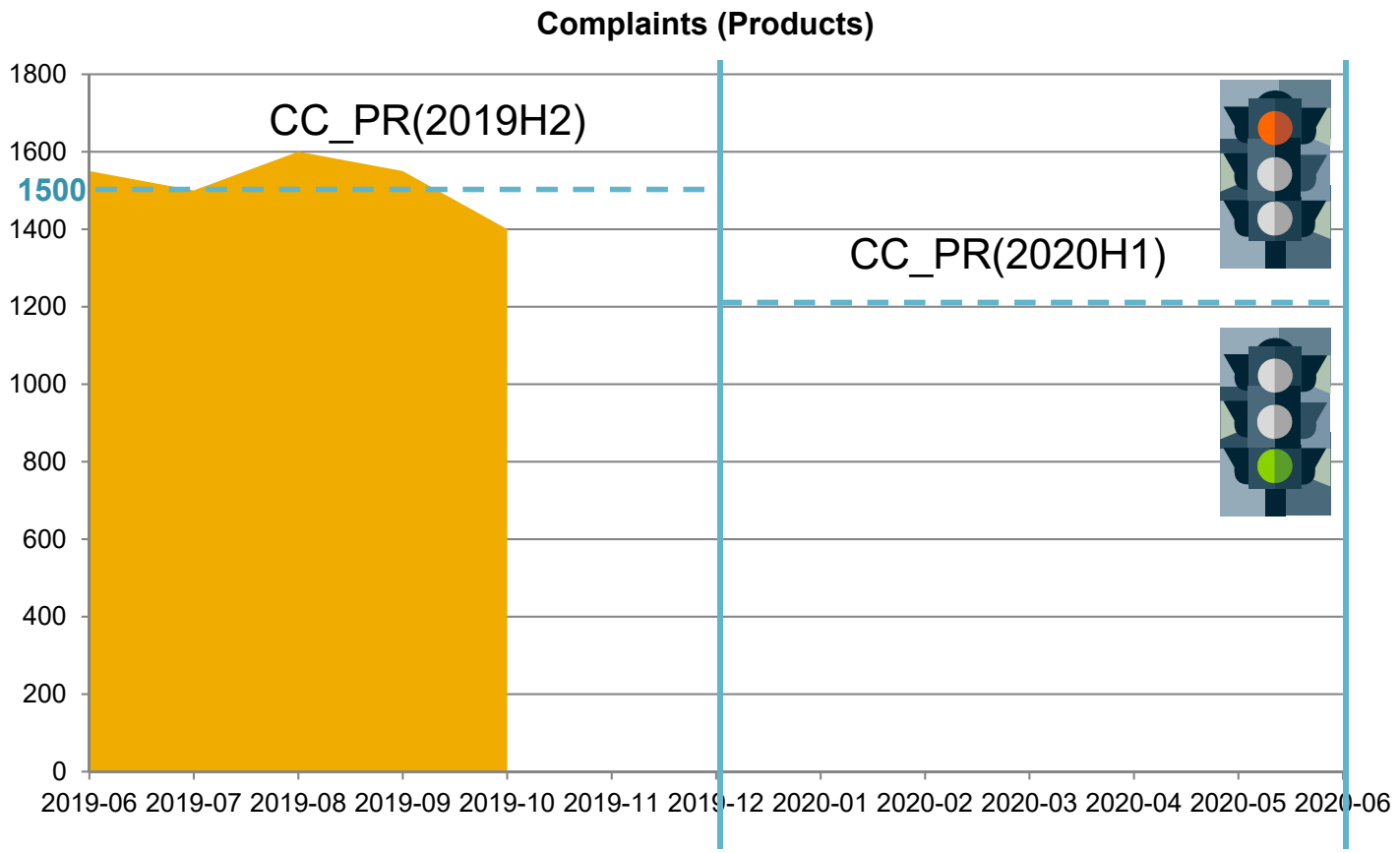
EXAMPLE

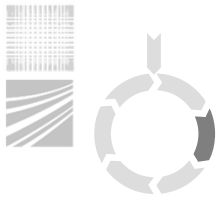
2 Set Goals: Define GQM Graph: "GQM-PR-G: Evaluate improvement of reliability of products"

Object	Purpose	Quality Focus	Viewpoint	Context
IT products	Evaluate	Reliability	Management of insurance business unit	See C&A
Quality Focus			**Variation Factors**	
■ PR-G-Q1: How many customer complaints exist regarding product reliability? ■ **CC_PR(T): Average number of complaints about product reliability in time span T (e.g., half a year)**			-	
Baseline Hypotheses			**Impact of Variation Factors**	
CC_PR(2019H2) = 1500, whereas 2019H2 is the second half of fiscal year 2019			-	
Interpretation Model				
PR-G-I: **CC_RP(2020H1)/CC_RP(2019H2) <= 0.8**, whereas 2020H1 is the first half of fiscal year 2020 and 2019H2 is the second half of fiscal year 2019				

EXAMPLE

2 Set Goals: Visualization: “GQM-PR-G: Evaluate improvement of reliability of products”





EXAMPLE

2 Set Goals: Formalize Goal: "CI-G: Improved customer interaction processes"

Focus	process quality of
Object	customer interaction processes
Magnitude	having 20% less customer complaints
Timeframe	by the middle of next fiscal year
Organizational Scope	management of insurance business unit
Constraints	while maintaining cost
Relations	-

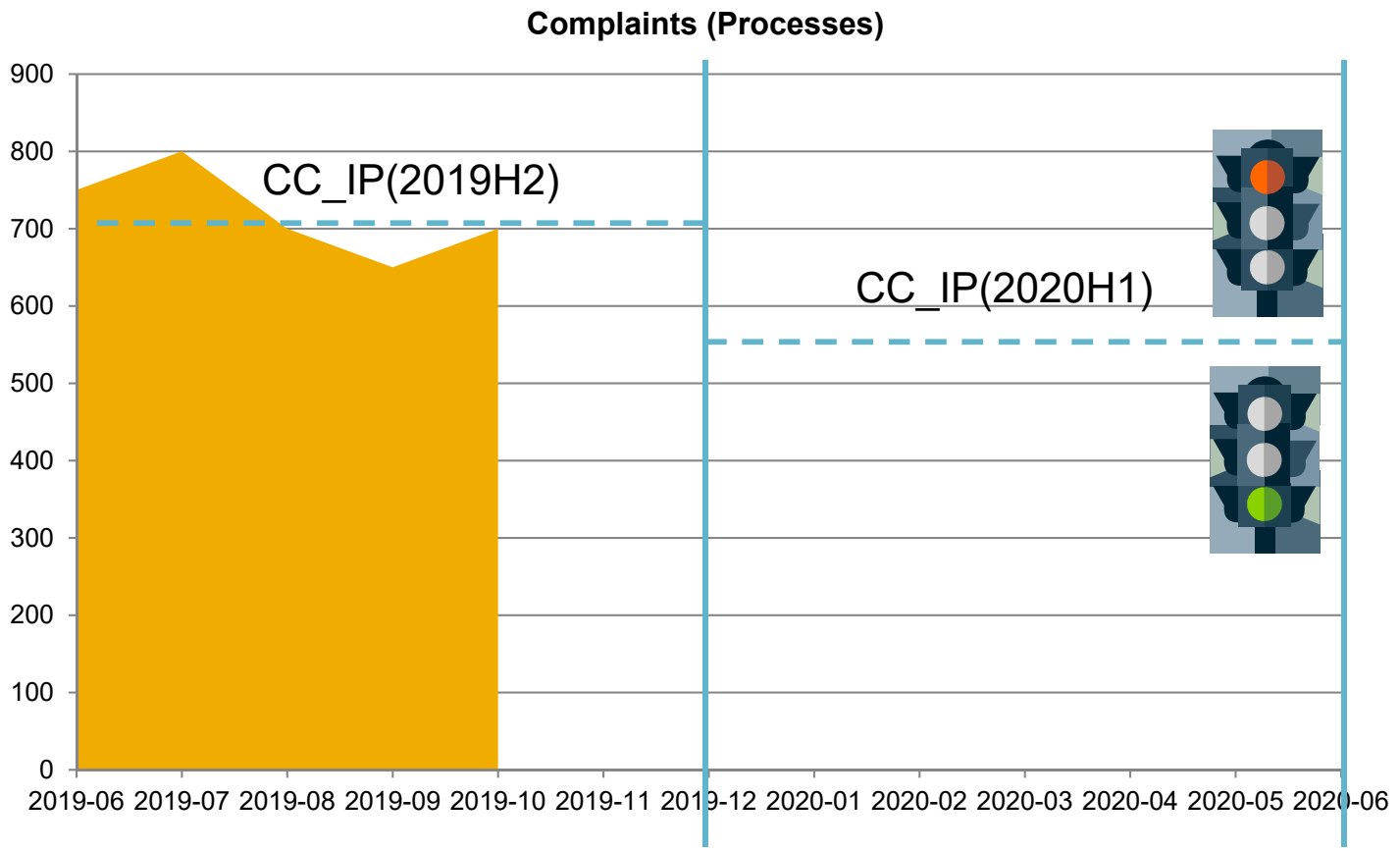
EXAMPLE

2 Set Goals: Define GQM Graph: “GQM-CI-G: Eval. improvement of customer interaction processes”

Object	Purpose	Quality Focus	Viewpoint	Context
Customer interaction processes	Evaluate	Process quality	Management of insurance business unit	See C&A
Quality Focus			**Variation Factors**	
■ CI-G-Q1: How many customer complaints exist regarding the interaction processes? ■ **CC_IP(T): Average number of complaints about the interaction processes in time span T (e.g., half a year)**			-	
Baseline Hypotheses			**Impact of Variation Factors**	
CC_IP(2019H2) = 700, whereas 2019H2 is the second half of fiscal year 2019			-	
Interpretation Model				
CI-G-I: **CC_IP(2020H1)/CC_IP(2019H2) <= 0.8**, whereas 2020H1 is the first half of fiscal year 2020 and 2019H2 is the second half of fiscal year 2019				

EXAMPLE

2 Set Goals: Visualization: “GQM-CI-G: Evaluate improvement of customer interaction processes”




to be continued

Was sollten Sie mitnehmen

- Sie kennen…
  - GQM⁺Strategies Meta-Model
  - GQM⁺Strategies kontinuierliches Verbesserungszyklus
    - Was passiert in jeder Phase (0-6)
  - Organizational goal template
- Sie können erklären…
  - Wieso IT-Business Ausrichtung relevant ist?
  - Wie man eine GQM⁺Strategies Grid (Ziel-Strategie) Graph aufbaut?
  - Bespiele von Probleme/Defizite hinsichtlich IT-Business Ausrichtung in der Praxis

F R A G E N

Exercise & Discussion

- Problem Description
  - The insurance company from the example wants to cut costs
  - Software department should reduce costs of developing the insurance software
- Your tasks
  - Define example strategies for reducing costs of developing the insurance software
  - For a selected strategy:
    - derive and formalize example goals using Organizational Goal Template
    - quantify derived goals using GQM Abstraction Sheet
  - Define example visualization approach for selected goal(s)

- Group work: **30 min**
- Presentation: **15 min** (5 min per group)
- Discussion

References (1)

- Software Measurement
  - J.C. Munson, “Software Engineering Measurement.” AUERBACH, 2003; ISBN 0-84931-503-4.
  - ISO 9126: Software Engineering - Product Quality.
- Experience Factory
  - V.R. Basili, G. Caldiera, and D. Rombach, “The Experience Factory.” in Encyclopedia of Software Engineering (ed. Marciniak). 1994: John Wiley and Sons.
- Corporate Strategy
  - G. Stalk, P. Evans, and L. E. Shulman, “Competing on Capabilities: The New Rules of Corporate Strategy”, Harvard Business Review, March 1992.
- Goal Question Metric Approach
  - L.C. Briand, C. Differding, H.D. Rombach, ”Practical Guidelines for Measurement-Based Process Improvement,” Software Process - Improvement and Practice, vol. 2, no. 4, 1996, John Wiley & Sons.
  - R. van Solingen, E. Berghout, “The Goal/Question/Metric Method” McGraw-Hill Education, 1999; ISBN 0-07709-553-7.