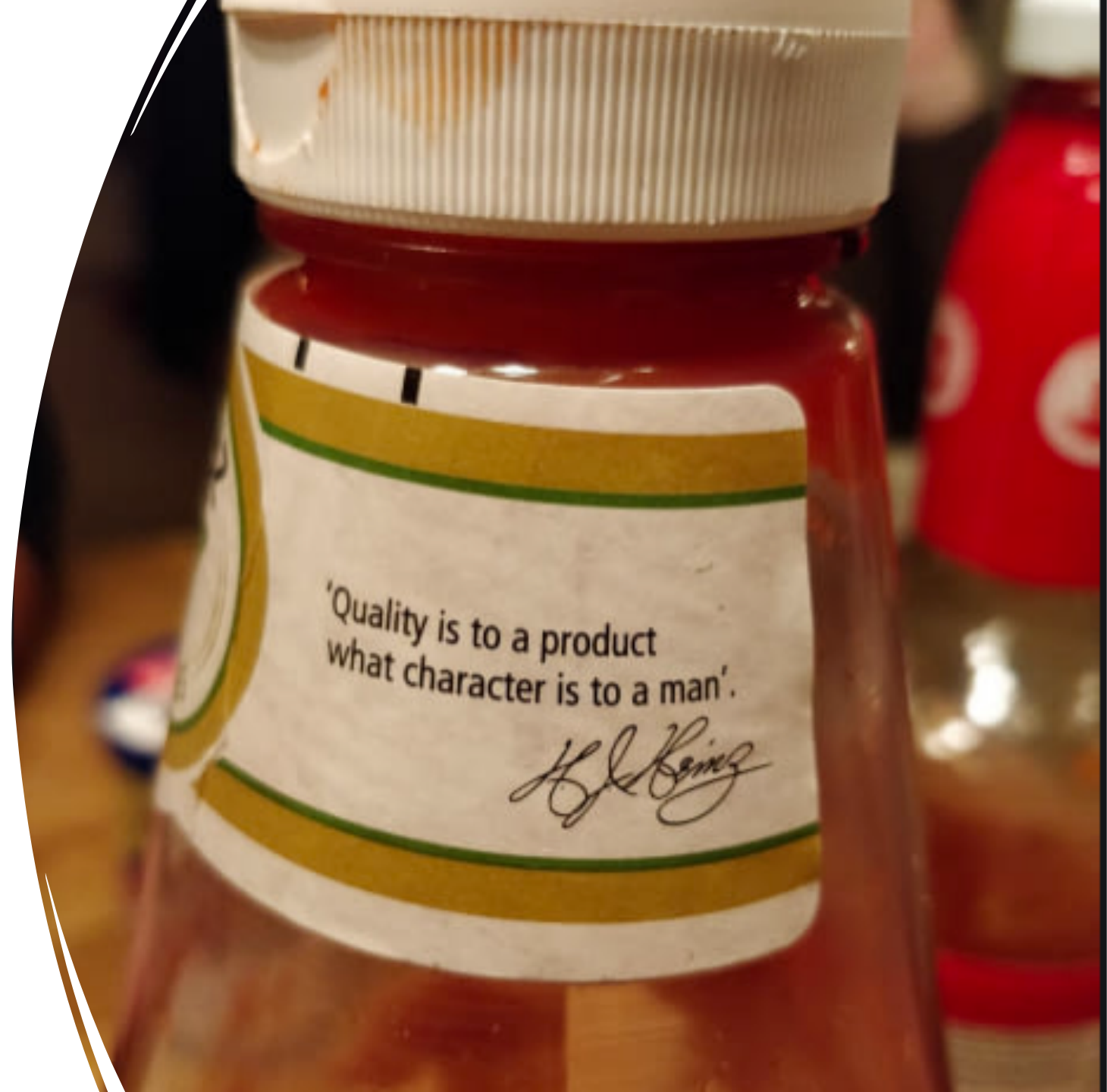# Software Quality Planning

TDDE46

Azeem Ahmad

Linköping University, Sweden

Objectives

- Introduction and use of the GQM -> Set-up a measurement program
- ISO 730:2014
- Pointers to coaching and reviews

Good Quality Software

- What is a good quality software?
- How to achieve the good quality software?

'Quality is to a product what character is to a man'.

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Software Measurement Goals

- Software Measurement Goals provides a valuable tool for understanding the effects of actions that are implemented to improve a software development process.
  - Increased understanding of the software development process
  - Increased control of the software development process

'Projects without clear goals will not achieve their goal clearly'

Tom Gilb

Goal Oriented Software Measurement (GQM)

- Performed towards an explicitly stated purpose such as Goal Question Metrics (GQM), proposed by Basili and Weiss
  - Goals (Conceptual Level): what organization wants to improve
    - i.e. increase code readability
    - i.e. fault free software
  - Questions (Operational Level): refine each goal to more quantifiable way
    - How to write readable code?
    - What are the bottle necks?
  - Metric (Quantitative Level): indicate the metrics required to answer each question
    - Cyclomatic complexity
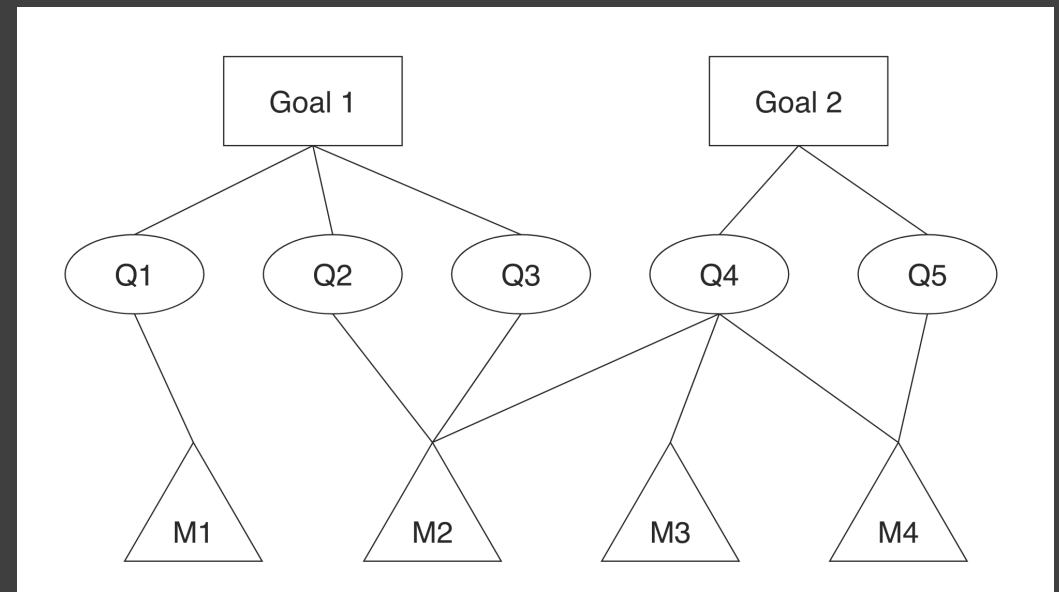
- An example from the paper named "Goal Question Metric Paradigm by Basili and Rombach"

Goal	Purpose Issue Object (process) Viewpoint	Improve the timeliness of change request processing from the project manager's viewpoint
Question	Q1	What is the current change request processing speed?
Metrics	M1 M2 M3	Average cycle time Standard deviation % cases outside of the upper limit
Question	Q2	Is the (documented) change request process actually performed?
Metrics	M4 M5	Subjective rating by the project manager % of exceptions identified during reviews
Question	Q3	What is the deviation of the actual change request processing time from the estimated one?
Metrics	M6 M7	$\dfrac{\text{Current average cycle time - Estimated average cycle time}}{\text{Current average cycle time}} * 100$ Subjective evaluation by the project manager
Question	Q4	Is the performance of the process improving?
Metrics	M8	$\dfrac{\text{Current average cycle time}}{\text{Baseline average cycle time}} * 100$
Question	Q5	Is the current performance satisfactory from the viewpoint of the project manager?
Metrics	M7	Subjective evaluation by the project manager
Question	Q6	Is the performance visibly improving?
Metrics	M8	$\dfrac{\text{Current average cycle time}}{\text{Baseline average cycle time}} * 100$

Let's assume that you own a product that provides budget management to students who have limited budget for a month. Students add all their financial activities (i.e. shopping, gym, beer etc) and the system predicts whether to buy new stuff or not in coming week. All students in Sweden are using your products. You are also expecting some other companies to develop the same software. What would be your **one measurement goal**.
Explain:
- The purpose
- Issues
- Object
- View point.

| Goal		
	Purpose	Improve
	Issue	the timeliness of
	Object (process)	change request processing
	Viewpoint	from the project manager's viewpoint

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Four Phases of GQM – Setting up a Measurement Program

- **The Planning phase**, during which a project for measurement application is selected, defined, characterised, and planned, resulting in a project plan.

- **The Definition phase**, during which the measurement programme is defined (goal, questions, metrics, and hypotheses are defined) and documented

- **The Data Collection phase**, during which actual data collection takes place, resulting in collected data.

- **The Interpretation phase**, during which collected data is processed with respect to the defined metrics into measurement results, that provide answers to the defined questions, after which goal attainment can be evaluated
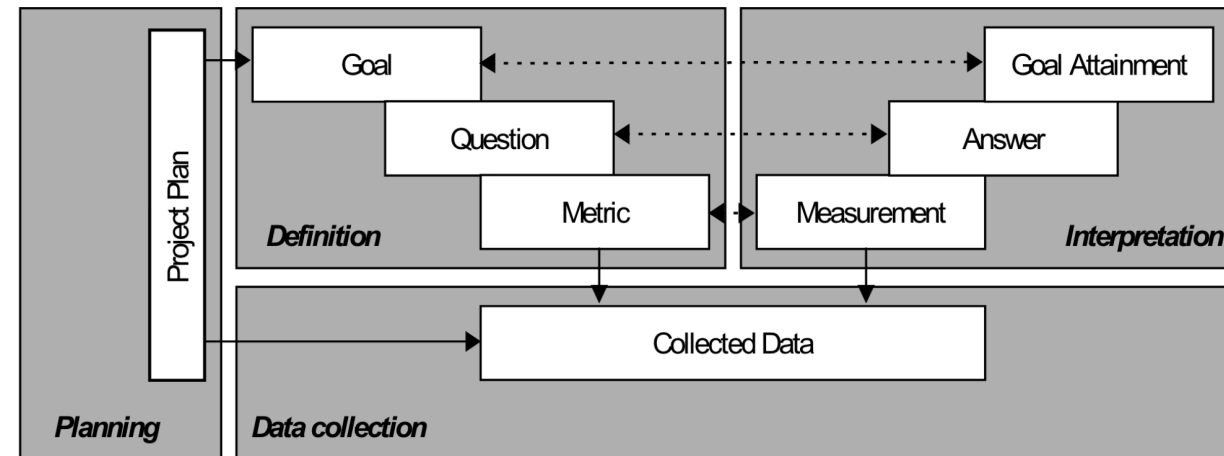
The Planning Phase

- The planning phase is performed to fulfil all basic requirements to make a GQM measurement programme a success, including training, management involvement and project planning
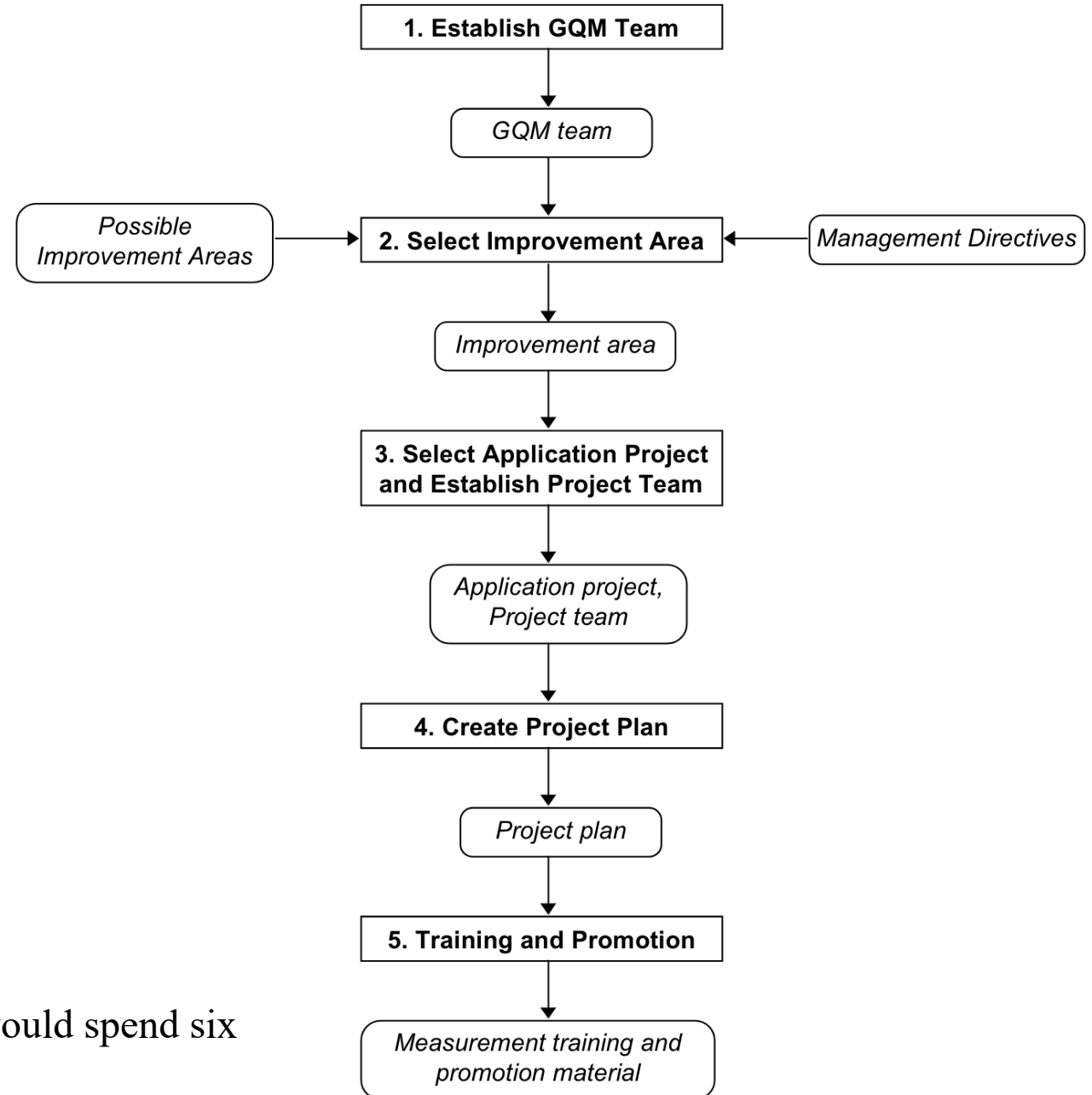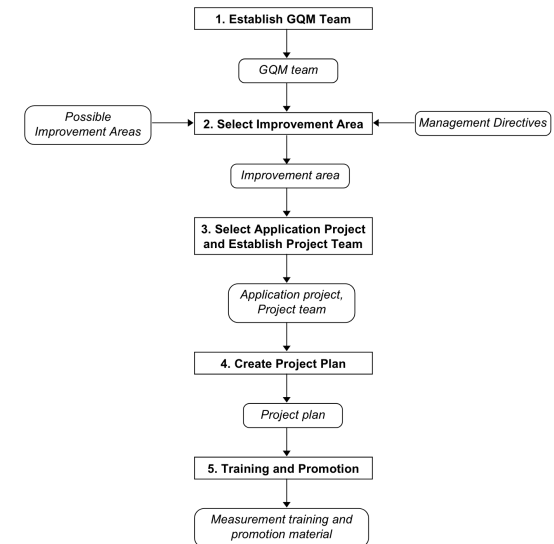
'If I had eight hours to chop down a tree, I would spend six sharpening my axe'

Abraham Lincoln

```
┌─────────────────────────┐
│  1. Establish GQM Team  │
└─────────────────────────┘
            │
            ▼
      ( GQM team )
            │
            ▼
┌──────────────────┐   ┌──────────────────────────┐   ┌────────────────────────┐
│    Possible      │──▶│ 2. Select Improvement    │◀──│ Management Directives  │
│ Improvement Areas│   │         Area             │   └────────────────────────┘
└──────────────────┘   └──────────────────────────┘
            │
            ▼
    ( Improvement area )
            │
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┌──────────────────────────────┐
│ 3. Select Application Project│
│  and Establish Project Team  │
└──────────────────────────────┘
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  ( Application project,
      Project team )
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│  4. Create Project Plan  │
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     ( Project plan )
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│ 5. Training and Promotion│
└──────────────────────────┘
            │
            ▼
 ( Measurement training and
     promotion material )
```
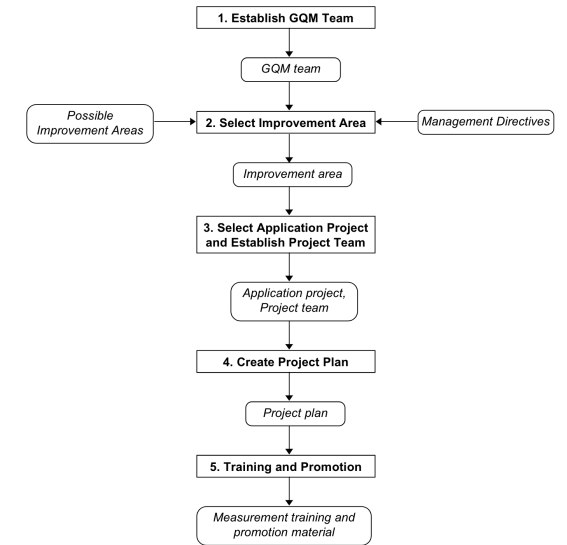
The Planning Phase – Establish GQM Team

- Teams should:
  - Be independent.
  - Possess sufficient background knowledge.
  - Be improvement oriented.
  - Be enthusiastic
- Main activities are:
  - Plan measurement programmes.
  - Carry out measurement definition activities and develop GQM deliverables
  - Feedback session after data interpretation.
  - Report progress

1. Establish GQM Team

GQM team

Possible Improvement Areas → **2. Select Improvement Area** ← *Management Directives*

Improvement area

3. Select Application Project and Establish Project Team

Application project, Project team

4. Create Project Plan

Project plan

5. Training and Promotion

*Measurement training and promotion material*

The Planning Phase – Select Improvement Area

- Areas:
  - Apparent problems that the organisation struggles with.
- More Details After Area Identification
  - problem or improvement area.
  - processes or products involved.
  - environmental, legislative, organisational, and technological influences

1. Establish GQM Team

GQM team

Possible Improvement Areas → 2. Select Improvement Area ← Management Directives

Improvement area

3. Select Application Project and Establish Project Team

Application project, Project team

4. Create Project Plan

Project plan

5. Training and Promotion
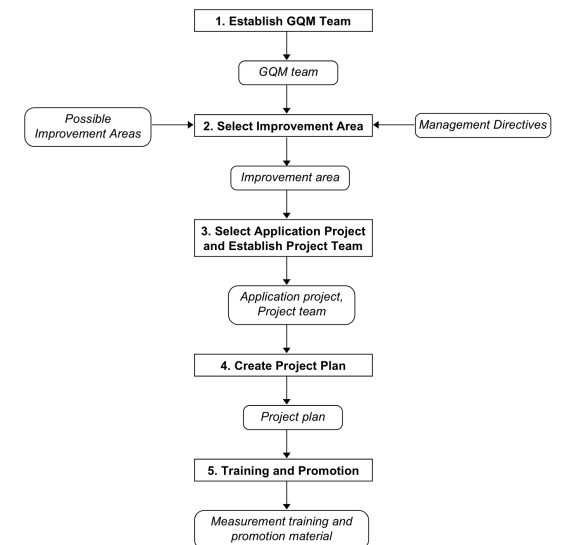
Measurement training and promotion material

The Planning Phase – Select Application Project & Establish a Project Team

- Project team is different than GQM team.

- A project team consists of all the people that work on a particular software development

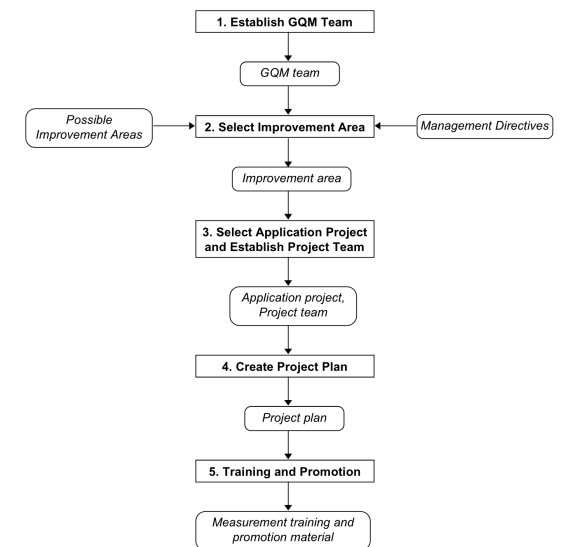- The success of a measurement programme heavily depends on their willingness, motivation, and enthusiasm
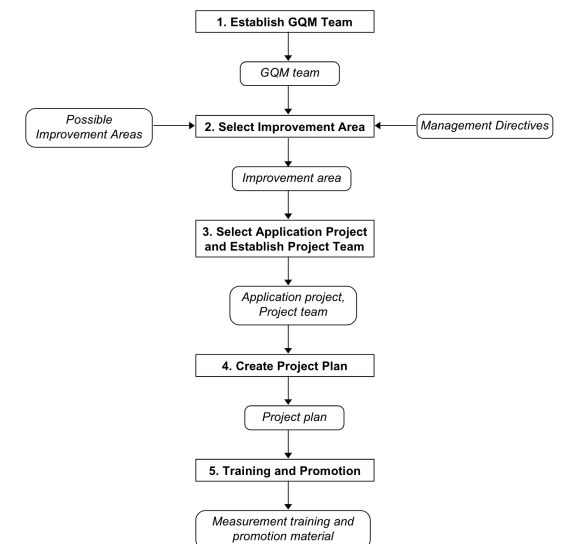
The Planning Phase – Create Project Plan

- Project Plan should have:
  - **<u>Introduction</u>** which presents the scope of the measurement programme, and the relation of the improvement objectives to the software development project goals
  - Schedule
    - Timeline
    - list of deliverables
    - resource allocation
    - cost-benefit analysis
  - Priorities
  - Risk control activities
  - Training and promotion activities
  - many more!

1. Establish GQM Team

GQM team

Possible
Improvement Areas → 2. Select Improvement Area ← Management Directives

Improvement area

3. Select Application Project
and Establish Project Team

Application project,
Project team

4. Create Project Plan

Project plan

5. Training and Promotion

Measurement training and
promotion material

The Planning Phase – Training and Promotion

- During Training & Promotion Session:
  - Clear definition of proposed improvement goals are presented;
  - Benefits of the measurement programmes are explained;
- Answers to Questions:
  - What measurement tasks should I perform?
  - Why should I perform those tasks?
  - How and when should I perform those tasks?
  - How much effort is required by me to perform those tasks?
  - Do the tasks influence my daily activities?
  - What do I get back from this?
  - What will I learn?

1. Establish GQM Team

GQM team

Possible Improvement Areas → 2. Select Improvement Area ← Management Directives

Improvement area

3. Select Application Project and Establish Project Team

Application project, Project team

4. Create Project Plan

Project plan

5. Training and Promotion

Measurement training and promotion material

The Definition Phase

- The Definition phase concerns all activities that should be performed to formally define a measurement programme. During this phase three documents are produced
  - GQM plan
  - Measurement plan
  - Analysis plan
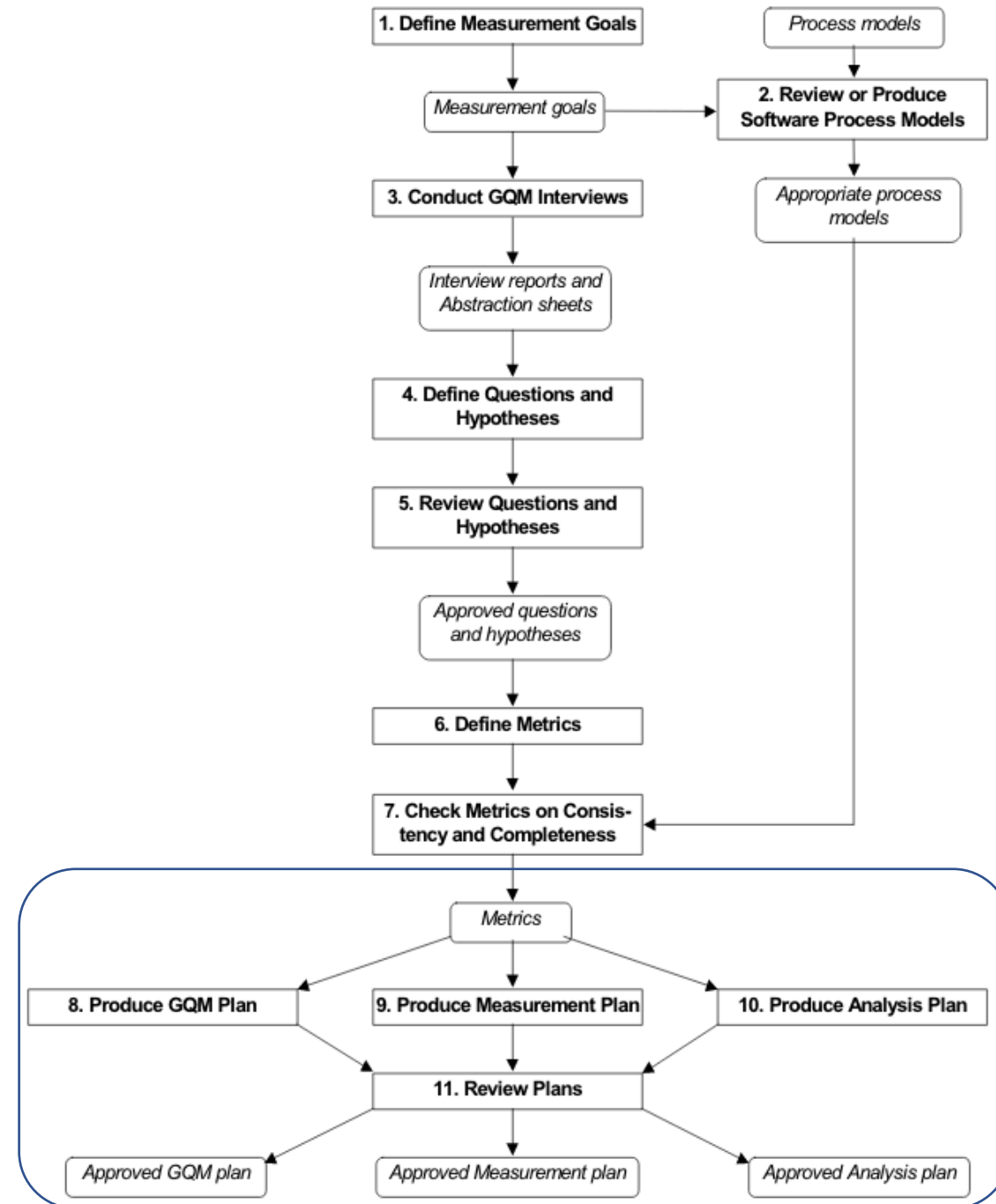
The Definition Phase– Define Measurement Goal

1. What are the strategic goals of your organisation?

3. How can you improve your performance?

4. What are your major concerns (problems)?

5. What are your improvement goals?

Goal		
	Purpose	Improve
	Issue	the timeliness of
	Object (process)	change request processing
	Viewpoint	from the project manager's viewpoint

Deliverable -> List of GQM measurement goal specifications

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The Definition Phase– Conduct GQM Interviews

- Team members are the experts with respect to the object under measurement, so include them
  - make the implicit knowledge of the project members explicit
  - input of the project team is of crucial importance.

Deliverable -> Set of interview reports and abstraction sheets

The Definition Phase– Define Questions and Hypotheses

- Goals are defined on an abstract level, questions are refinements of goals to a more operational level

- By answering the questions, one should be able to conclude whether goal is reached

Deliverable -> List of measurement questions and hypotheses, defined with respect to the measurement goals

The Definition Phase– Review Questions and Hypotheses

- It is important to make sure that these questions are correct
- Possibility of misinterpretaion should be reduced

Deliverable -> List of approved measurement questions and hypotheses

The Definition Phase– Define Metrics

- Metrics should be defined that provide all the quantitative information to answer the questions in a satisfactory way

Deliverable -> List of metrics suitable for supplying information to answer the questions

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The Definition Phase– Check on Metric Consistency and Completeness

- If product metrics are defined these should be checked as to whether they are in fact possible and whether they can actually be measured at a specific moment in the development process

Deliverable -> Consistent and complete definitions of questions and metrics related to the   measurement   goals.

The Definition Phase– Produce a GQM Plan

- Explicit description of goals, questions, metrics and hypotheses
- Basis for definition of data collection procedures
- Guideline for interpretation of collected data

Deliverable -> Preliminary GQM plan.

The Definition Phase– Produce a Measurement Plan

- It provides textual descriptions of direct measurements.

- It identifies a person that collects a particular direct measurement, ie a programmer, engineer, project manager, tester etc.

- It defines the particular moment in time when the person should collect the direct measurement.

- It defines by which medium (tool or form) that person should collect the direct measurement

Deliverable -> Preliminary measurement plan.

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The Definition Phase– Produce Analysis Plan

- Simulates data interpretation according to the GQM plan before actual measuring starts
  - Simulated outcomes of the metrics, graphs and tables
  - indication to the project team which charts they can expect to receive
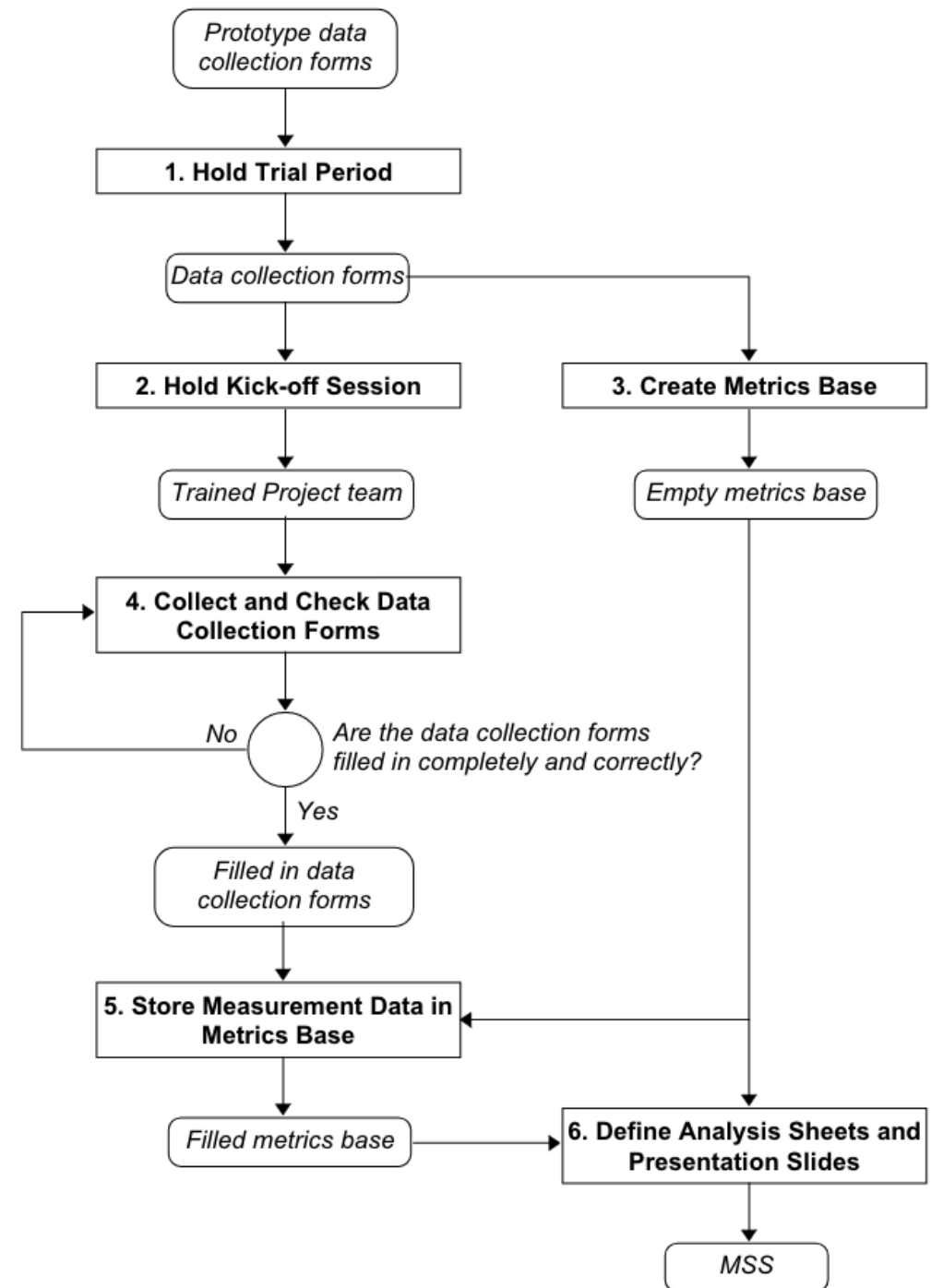
Deliverable -> Preliminary analysis plan.

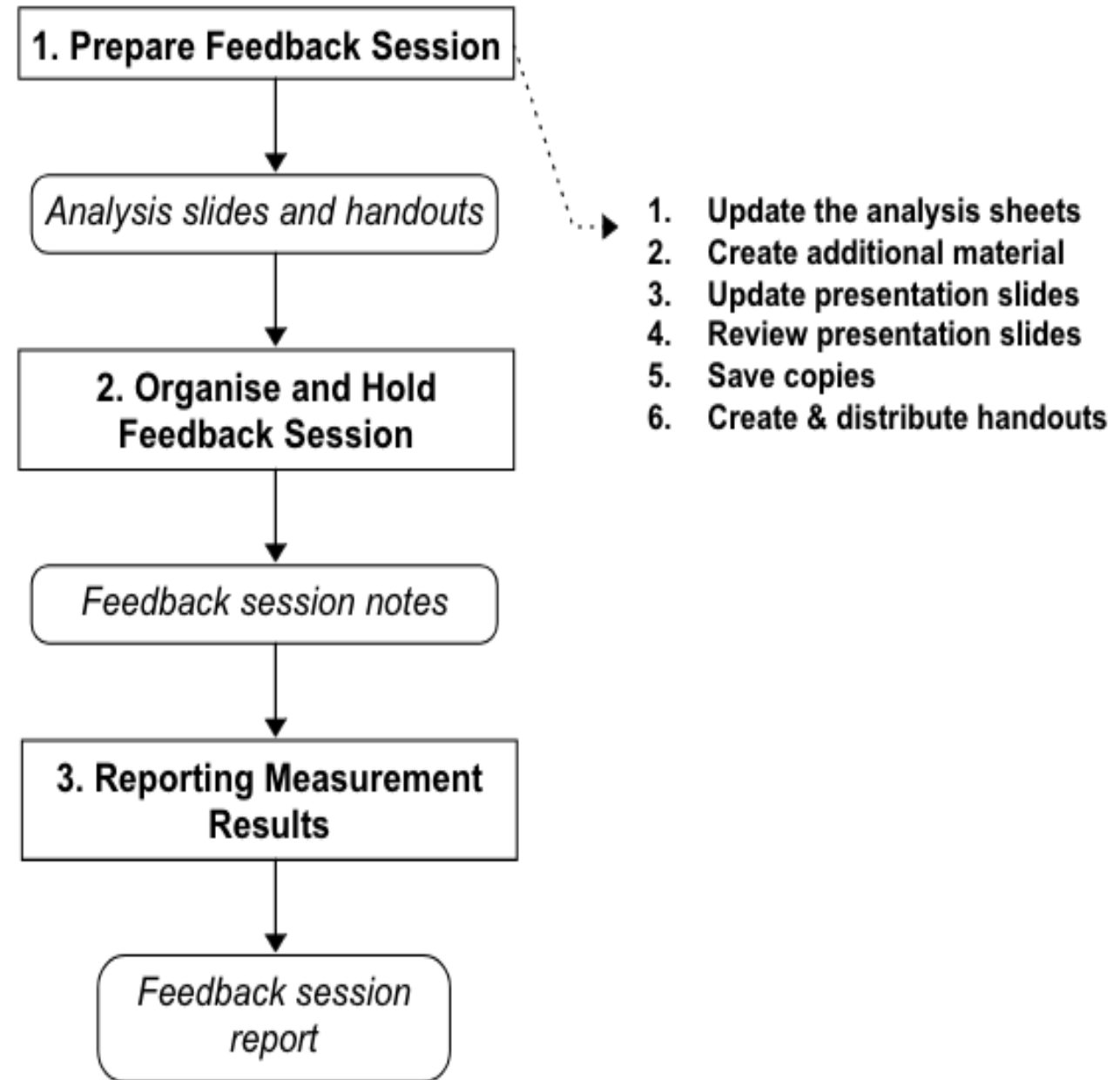# The Definition Phase– Review Plan

- Do project members agree upon the defined goals, questions and metrics?

- Do project members identify any missing or unnecessary definitions?

- Do project members agree with the proposed definition of feedback material?

Deliverable -> Preliminary review plan.

The Data Collection Phase

The Interpretation Phase

1. Prepare Feedback Session

Analysis slides and handouts

2. Organise and Hold Feedback Session

Feedback session notes

3. Reporting Measurement Results

Feedback session report

1. Update the analysis sheets
2. Create additional material
3. Update presentation slides
4. Review presentation slides
5. Save copies
6. Create & distribute handouts

Software Quality Assurance (SQA)

- Evaluating the effectiveness of the software processes (requirements, development, & maintenance)
- **IEEE 730:2014**
  - IEEE 730:2014 provides a foundation for Software Quality Assurance, which in turns provides confidence that software products will conform to their established requirements and satisfy the customer.
    - **Normative sections** describe SQA processes, activities, and expectations
    - **Informative sections** contain:
      - Guidance for creating SQA Plans
      - Assessing product risks
      - Corrective/preventive action processes & root cause analysis

IEEE 730:2014- Section 5- Normative Section

Table 1—Organization of 16 SQA activities

Subclause	Title
5.3	SQA process implementation activities
5.3.1	Establish the SQA processes
5.3.2	Coordinate with related software processes
5.3.3	Document SQA planning
5.3.4	Execute the SQA Plan
5.3.5	Manage SQA records
5.3.6	Evaluate organizational independence and objectivity
5.4	Product assurance activities
5.4.2	Evaluate plans for conformance to contracts, standards, and regulations
5.4.3	Evaluate product for conformance to established requirements
5.4.4	Evaluate product for acceptability

The 16 SQA activities are organized into three groups

IEEE 730:2014- Section 5- Normative Section

Table 1—Organization of 16 SQA activities (continued)

Subclause	Title
5.4.5	Evaluate product life cycle support for conformance
5.4.6	Measure products
5.5	Process assurance activities
5.5.2	Evaluate life cycle processes and plans for conformance
5.5.3	Evaluate environments for conformance
5.5.4	Evaluate subcontractor processes for conformance
5.5.5	Measure processes
5.5.6	Assess staff skill and knowledge

The 16 SQA activities are organized into three groups

IEEE 730:2014- Section 5- Normative Section

- Each activity has four sections:
  - **Reference to IEEE12207:** The text of the ISO/IEC/IEEE 12207:2008 subclause relevant to the activity

  > 7.2.3.3.2.2   It shall be assured that software products and related documentation comply with the contract and adhere to the plans.

  - **Purpose:** Defines the **activity's intention**
  - **Outcome:** **Specific observable results** of the successful achievement of activity's purpose. An outcome may an **information item** (e.g., records, documents), a change in the state or an attribute of an information item**, a change to a project constraint**, or a change to an attribute (e.g., training, experience, capability) of a project team member.
  - **Task:** **Specific actions** that are intended to contribute to the achievement of one or more of the stated outcomes of the activity

5.5.2 Evaluate life cycle processes and plans for conformance

- **Reference to IEEE12207:** The text of the ISO/IEC/IEEE 12207:2008 subclause relevant to the activity

> **7.2.3.3.3.1** It shall be assured that those software life cycle processes (supply, development, operation, maintenance, and support processes including quality assurance) employed for the project comply with the contract and adhere to the plans.

> **7.2.3.3.2.1** It shall be assured that all the plans required by the contract are documented, comply with the contract, are mutually consistent, and are being executed as required.

- **Purpose:**
  - Determine whether the project life cycle processes and plans conform to the established process requirements. Determine whether execution of software activities conform to the project's processes and plans.
- **Outcome:**
  - Documented software life cycle processes and plans are evaluated for conformance to the established process requirements.
  - Non-conformances are raised when software life cycle processes and plans are not adequate, efficient, or effective.
- **Task:**
  - Identify applicable process requirements that may affect the selection of a software life cycle process.
  - Determine whether the defined software life cycle processes selected by the project team are appropriate, given the product risk.
  - Audit software development activities periodically to determine consistency with defined software life cycle processes.
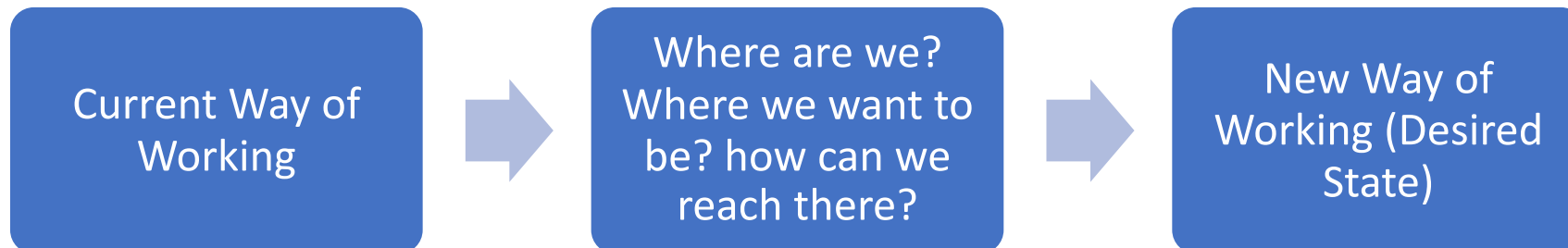
An Exercise Together!

Go to **www.menti.com** and use the code **49 52 32 8**

Coaching

"A professional, collaborative and outcomes-driven method of learning that seeks to develop an individual and raise self-awareness so that he or she might achieve specific goals and perform at a more effective level."

- Develop and clarify their goals / desired state

- Clarify their current reality

- Develop ideas and options

- Develop action plans which will lead to results

Current Way of Working	→	Where are we? Where we want to be? how can we reach there?	→	New Way of Working (Desired State)

Coaching Models

- **GROW** (**G**oals, **R**eality, **O**ptions, **W**rap up/**W**ill)
- **CLEAR** (**C**ontract, **L**isten, **E**xplore, **A**ctions, **R**eview)
- **SOAR:** (**S**tory, **O**ptions, **A**ctions, **R**eview)
- **ARROW**: (**A**ims, **R**eality, **R**eflections, **O**ptions, **W**hat next)
- **POWER**: (**P**urpose, **O**bjectives, **W**hats happening, **E**mpower, **R**eview)
- **CREATE**: (**C**urrent **R**eality, **E**xplore **A**lternatives, **T**ap their **E**nergy)
- **ACHIEVE** (**A**ssess current situation, **C**reative brainstorming, **H**one goal, **I**nitiate option generation, **E**valuate options, **V**alid action, **E**ncourage momentum
- **5A**: (**A**ims, **A**wareness, **A**nalysis, **A**ction, **A**ssessment)

Software Reviews

- A method involving a structured encounter in which a group of technical personnel analyzes or improves the quality of the original work product as well as the quality of the method

- The IEEE Standard for Software Reviews defines 5 types of review:
    - Management Reviews
    - Technical Reviews
    - Inspections (Formal Peer Review)
    - Walk-throughs
    - Audits

Check/read Links for more details:
1) https://www.ida.liu.se/~TDDC88/theory/lectures.shtml
2) https://www.ida.liu.se/~TDDC90/timetable/index.en.shtml