

# Introducing Software Architecture Development Methods into a TSP- Based Development Company

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## Outline

- About the authors and Quarksoft
- TSP and architecture
- Quarksoft's TSP and architecture
- Introducing architectural development methods into Quarksoft's TSP
- Lessons learnt and conclusion

## About the authors

- Humberto Cervantes
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  - Software architect at Quarksoft
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  - Corporate training leader at Quarksoft
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  - Professor and researcher at CIMAT
  - On sabbatical at Quarksoft, innovation department leader

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## About Quarksoft

- Quarksoft is a leading software development company in Mexico City
  - Founded in 2001
  - Around 280 people distributed over 3 sites
- Rated at CMMi level 3 since 01/2006
  - Development based on the Team Software Process (TSP)



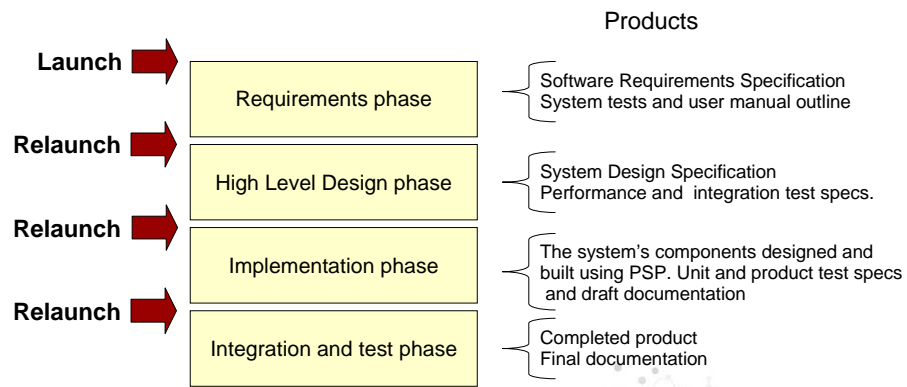
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# TSP Overview

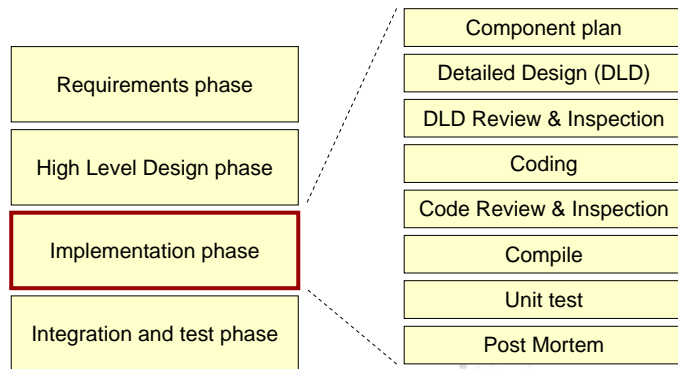
## TSP Project Structure



# TSP Overview

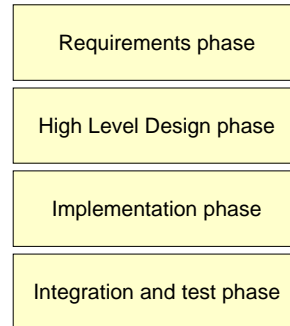
## TSP and PSP

Each component is developed individually using PSP



## TSP and Software Architecture

- TSP does not give detailed guidance with respect to architectural concerns
  - Quality attributes
  - How to design the architecture
  - What is the granularity of a “component”
  - No “architect” role (the closest may be Design and Implementation Managers)
  - No concept of architectural evaluation (only HLD inspection).



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## Development context at Quarksoft

- Quarksoft develops custom software for customers in several different sectors
  - Insurance, Manufacture, Telecommunication, Retail, Government, Healthcare
- Some particularities
  - Typically, Quarksoft customers require the company to provide a cost and time estimate very early, before the project is approved
  - Requirements are completely specified and then become contractual
  - A core team is usually designed at the beginning of the project (leader, architect, some engineers) and then development may be performed by teams that are spread among the different sites
  - The company is currently in a growth phase

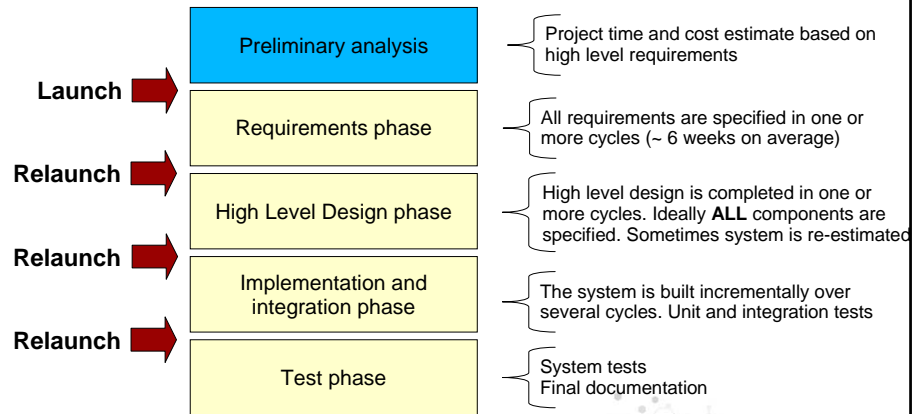
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# TSP at Quaksoft

## • Quarksoft's TSP Project Structure



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# Software architecture at Quarksoft

- Before this project started, a 2-month study was conducted to understand the state of the practice
- The study involved
  - Reviewing process scripts, artifact templates, checklists and other process artifacts
  - Reviewing existing HLD documents
  - Observing a team in the HLD phase

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## Study results

- The study uncovered many “common” issues related to software architecture:
  - Business goals specified inappropriately (too vague)
  - Quality attributes specified inappropriately (not measurable, not aligned to business goals)
  - Poorly documented architecture designs (not always UML, huge diagrams, too high level, underspecified component interfaces)
  - Design focused on satisfying functional requirements
  - Excessive focus on technology (lack of pattern usage)

## Study results (2)

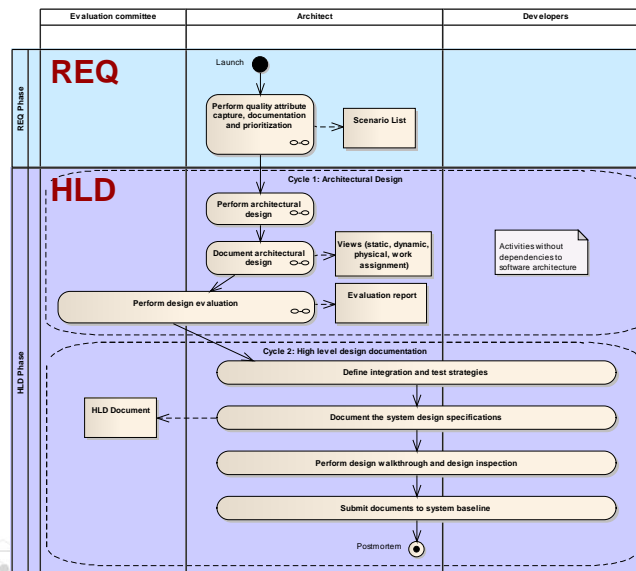
- Other issues were more specific to (Quarksoft’s) TSP
  - Process scripts and templates did not provide guidance to help capturing and documenting quality attributes and perform design in a systematic way
  - HLD inspection, which is performed by team members, took place too late in the HLD phase
- Also some issues were specific to Quarksoft’s context
  - Preliminary analysis constrains development time and cost
  - Requirements and HLD phases are performed sequentially
  - Lack of architects and available ones lack strong theoretical foundations on software architecture

# Proposal

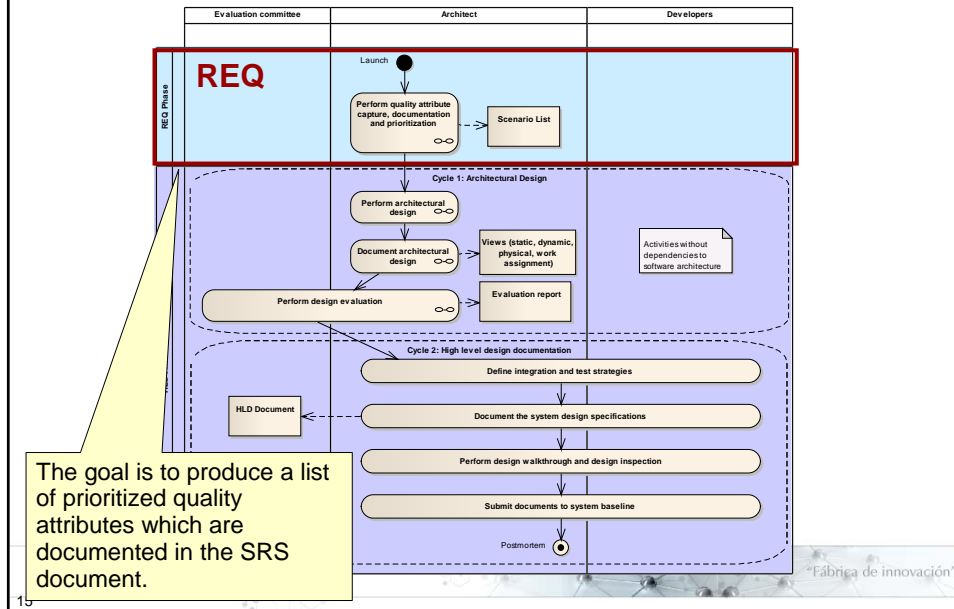
- To overcome these problems, a strategy focused on introducing architecture development methods was defined
- The original idea was to directly introduce SEI's methods: QAW, ADD, VaB and ATAM
  - An initial study led us to conclude that we could not introduce them directly, the methods had to be adapted (and simplified) to the particular problem's context
  - Furthermore, they had to be introduced into Quarksoft's TSP

# Method introduction overview

- Architecture development methods are introduced in the Requirements (REQ) and High Level Design (HLD) phases of TSP
- HLD activities are divided in two:
  - Architectural design
  - Other HLD activities

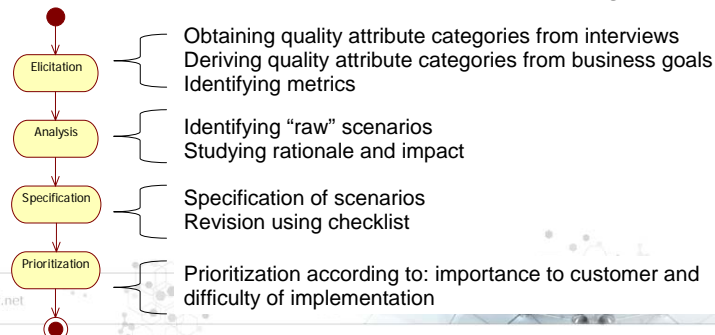


# Architectural requirements



# Requirements method

- Standard QAW was not chosen primarily because of the perceived difficulty of involving customers in scenario related activities
  - The essence of QAW which involves identifying quality attribute scenarios aligned to business goals is maintained
- Quality attribute related activities were integrated inside standard requirements activities of the existing process

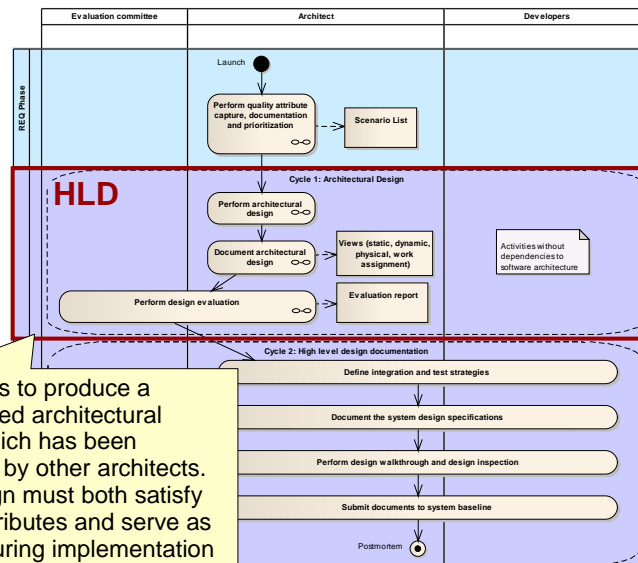




# Requirements method and TSP

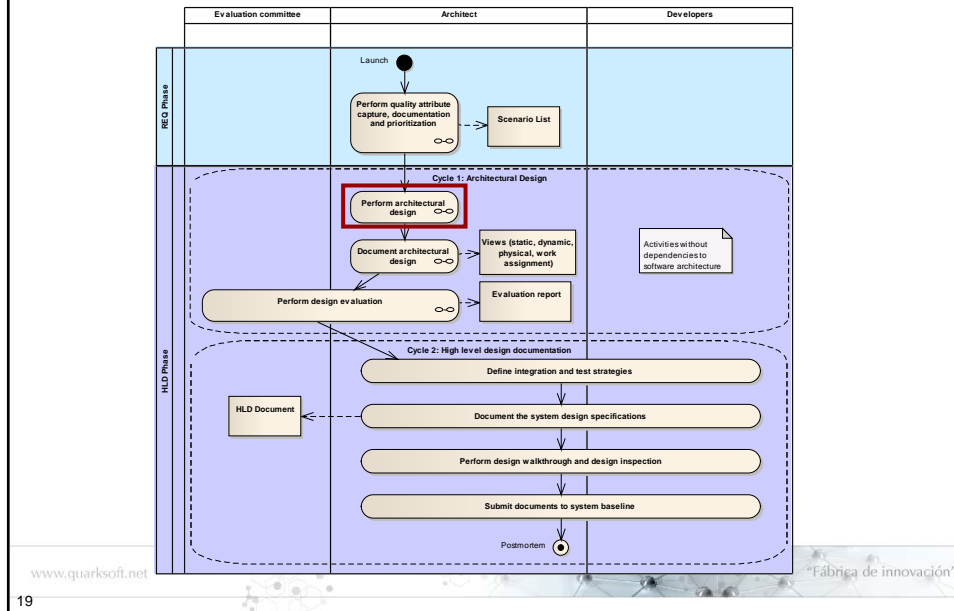
- Software architects already participate in project requirement activities as other project members
  - The idea was to maintain the architects participation but to focus their activities on quality attributes
  
- Process elements created to support the method
  - Quality attribute process script
  - Quality attribute template
  - Quality attribute checklist
  
- Changes in existing requirements script

# Architectural design



The goal is to produce a documented architectural design which has been evaluated by other architects. This design must both satisfy quality attributes and serve as a guide during implementation

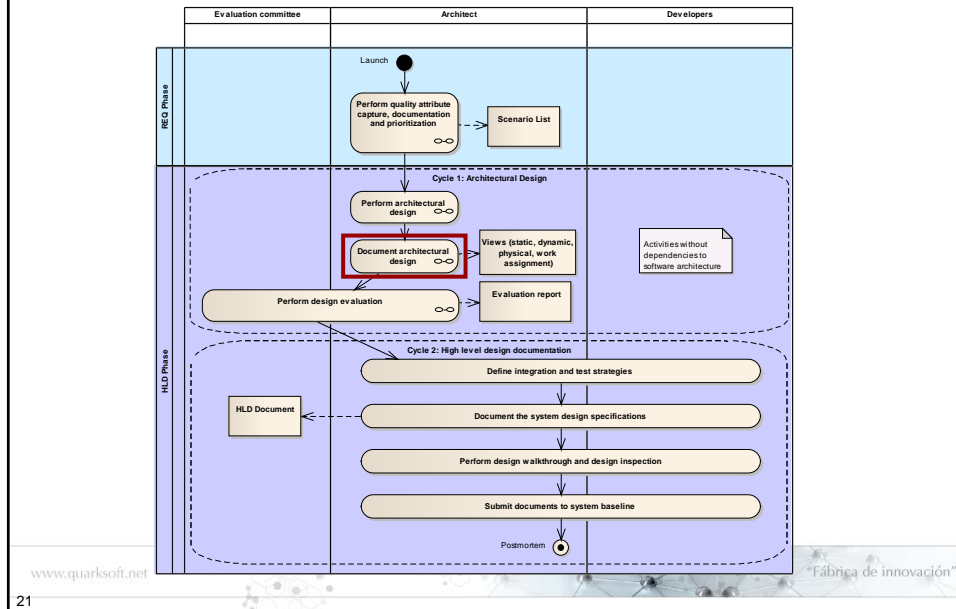
# Design method



# Design method and TSP

- The design method that was introduced is ADD
  - Iterative design method, starting with domain model
  - Not only “conceptual” design (based on patterns and tactics), but also technological choices are made during design iterations
- Integration with TSP
  - One iteration is specifically focused on defining the list of components that will be developed independently using PSP in the implementation phase (work assignment)
  - Design time has to be planned at the beginning of the HLD phase
  - Process elements: Design script, changes in HLD script

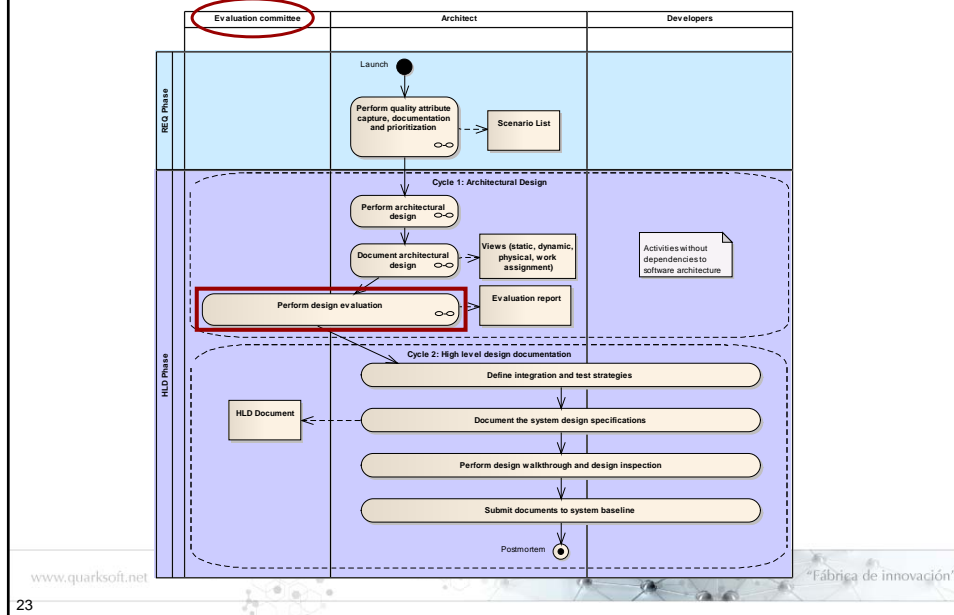
# Documentation method



## Documentation method and TSP

- Documentation is based on the VaB templates, but limited to a number of views to ease migration from 4+1 and to help in planning activities
  - Logical
  - Physical
  - Runtime
  - **Work assignment**
- Process elements: Documentation Script, View Template, View Checklist

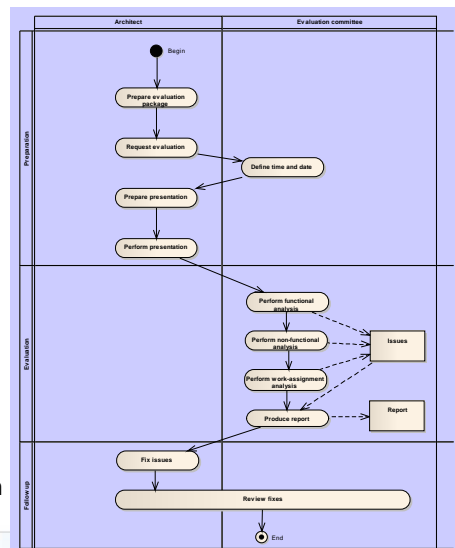
# Evaluation method



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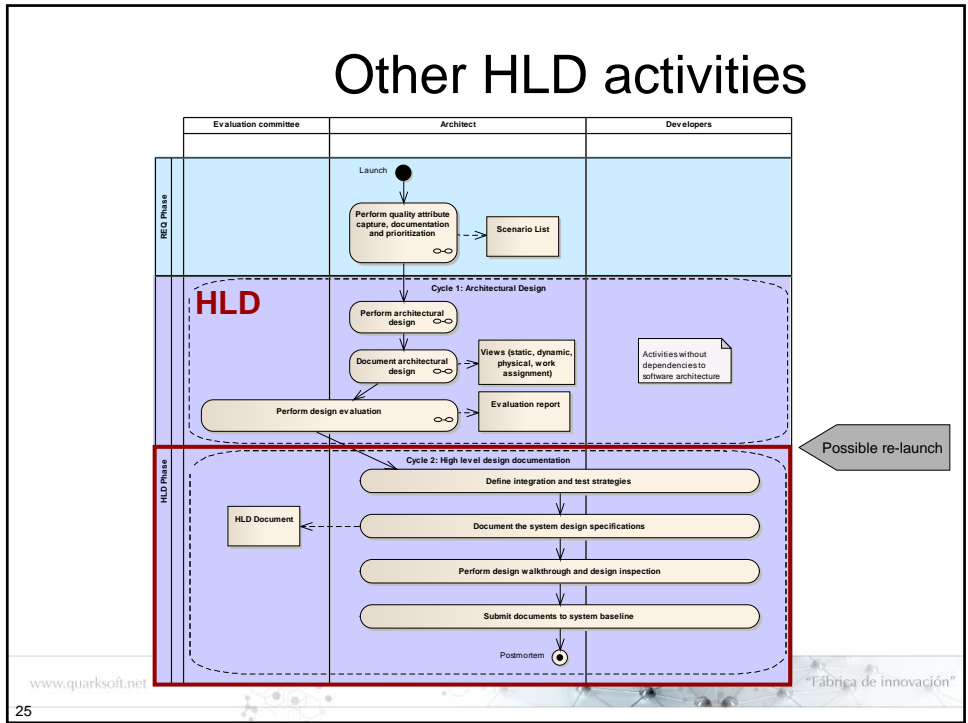
# Evaluation method and TSP

- A scenario - based evaluation method based on ACDM was introduced
  - Short evaluation (1/2 to 1 day)
  - No driver discovery (as opposed to ATAM), use of an "evaluation package" composed of drivers + views
  - Evaluation committee is composed by other architects from the company
- Integration with TSP
  - Defects identified during evaluation are collected
  - Risks can be used in next re-launch
  - Evaluation script

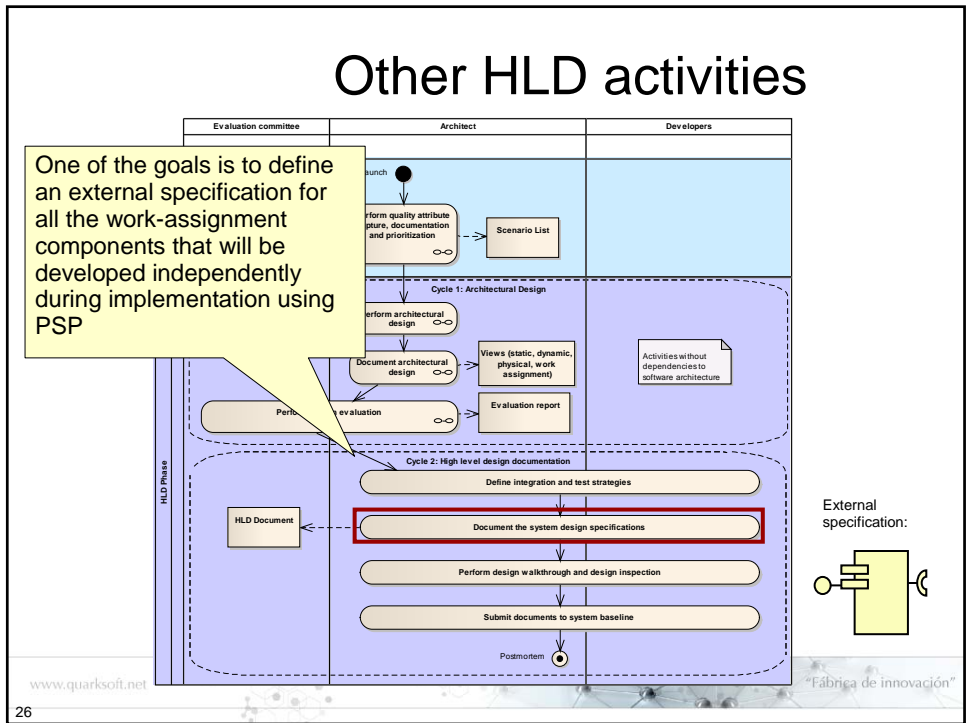


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# Other HLD activities



# Other HLD activities



## Introduction strategy

- The proposed introduction strategy considers starting with changes in requirements
  - Start with new projects
  - “Just in time” training: before REQ and before architectural design
- Hopefully, the introduction of changes in HLD will be smoother for these projects
  - They start with clarity with respect to drivers

## Evaluating the results

- Only one pilot project so far...
  - The collected data does not allow conclusions to be made yet but the project artifacts show significant differences with respect to what was observed in the initial study
- Metrics that we will be studying
  - Defect data from evaluation will be a very valuable source of information
    - Quantify the benefits of the approach
    - It can help focus training activities
  - Time data is also important
    - Greater time in architectural design should show reduction in integration and (system) test time

# Lessons learnt

- Requirements

- Business goals must be correctly specified
- Metrics to specify quality attributes may be hard to identify

- Design

- The architect must really have clarity with respect to architectural drivers before starting design
- A bridge must be made between “conceptual” (pattern-based) design and frameworks
- A work assignment structure is fundamental to guide development and also very helpful for re-estimation
- Best ways to use case tools to support design must be identified
- Estimating design time is not straightforward

# Lessons learnt

- Documentation

- Documentation activities take a long time so moving design from CASE tools to documents must be straightforward

- Evaluation

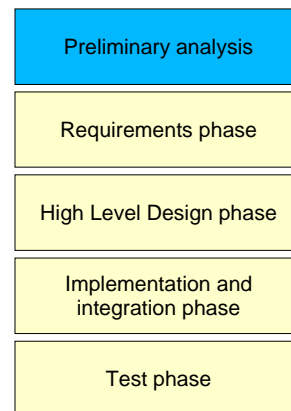
- Doing evaluations in a short time is difficult but longer evaluation can be a logistics challenge
- It can be hard for the architect to effectively communicate drivers and design decisions in a short time
- Architects are not automatically good evaluators
- Defect data gathered from evaluation is extremely valuable

## Lessons learnt

- The introduction of architecture development methods into Quarksoft's TSP has required considerable time and work
  - There is an impact on several process elements: Scripts, Templates, Checklists (mainly from REQ and HLD)
  - The introduction of development methods must also consider training and technology issues
    - A complete course covering the methods has been created
    - Software engineers must also receive some training as they participate in related activities
- Other aspects must be considered
  - Integration with CMMi for example: Decision Analysis and Resolution (DAR)

## Lessons learnt

- Preliminary analysis imposes many constraints on software architecture
- A subset of architecture tasks need to be performed during this phase to improve estimates
- The amount of information and limited time make this difficult





## Conclusion

- Architecture development methods can be integrated into TSP without requiring significant changes to the process
- However, the biggest challenges are at the organization level
  - Process elements changes, training development, technology...
  - A gradual introduction strategy may be undertaken
- The data collection framework of TSP should provide us with data that will help to understand the benefits of the approach in a measurable way

## Thank you

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