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# **TSP<sup>SM</sup> Plays the ACE: Using Architecture-Centric Engineering on a TSP Project**

**Luis Carballo, Bursatec**

**James McHale, SEI**

**Robert L. Nord, SEI**

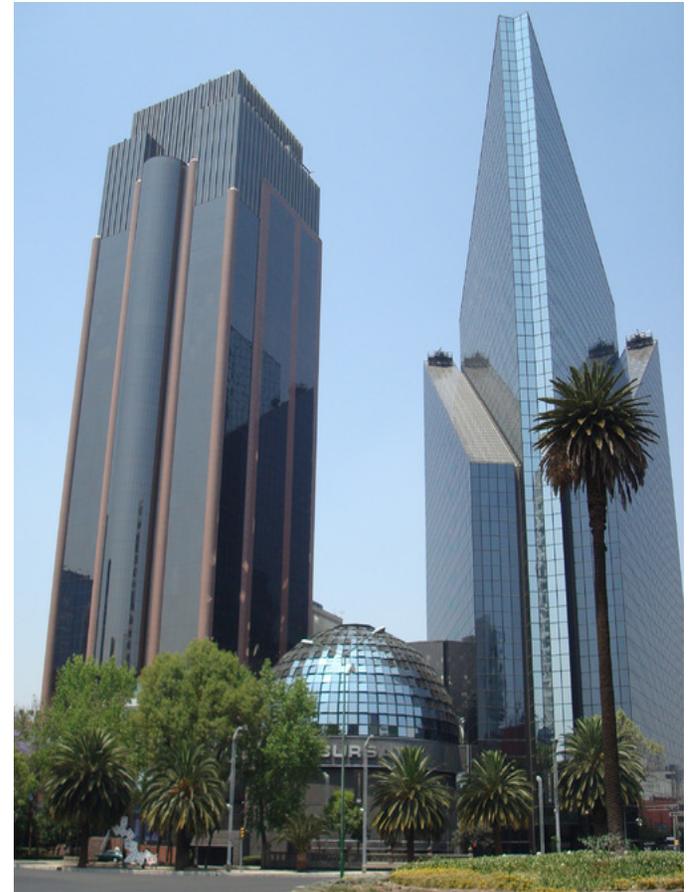


# The Opportunity

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## Background:

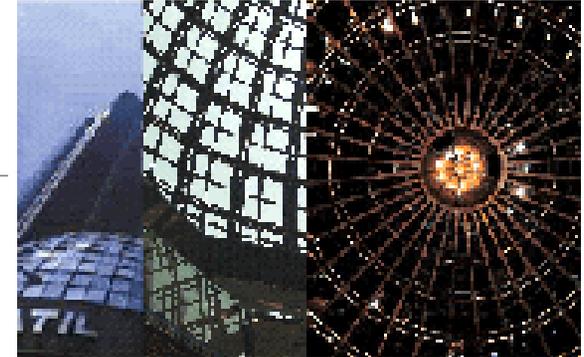
- Bolsa Mexicana de Valores (BMV) operates the Mexican financial markets under license from the federal government.
- Bursatec is the technology arm of the BMV.
- BMV desired a new trading engine to replace the existing stock market engine and integrate the options and futures markets.
- The BMV performed a build vs. buy analysis, and decided to replace their three existing trading engines with one in-house developed system.



# The Project

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Bursatec committed to deliver a trading engine in 8-10 quarters:



- High performance (as fast or faster than anything out there)
- Reliable and of high quality (the market **cannot** go down)
- Scalable (able to handle both spikes and long-term growth in trading volume)

Bursatec approached the SEI for support during design & development.

SEI's role—provide methods, techniques, and guidance to improve Bursatec's software delivery capability:

- Training and coaching for the system architects
- Training and coaching for the development team



# A Partial List of Potential Problems

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Complicating factors:

- Pressure – managers replaced when commitments are not met
  - Inexperience - available staff talented but young
  - Large project - scope of the project beyond the organization's recent experience
    - # of person-months
    - # KLOC/function points
    - # of interconnecting platforms
    - # of individual projects
  - Key implementation technologies never used together formally
  - Constant stream of new requirements/changes to business rules
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# The Proposed Solution

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## Architecture-Centric Engineering (ACE)

- Proven technology
- Strongly addresses technical aspect of the early project lifecycle (requirements, high-level design)
- Key managers familiar with technology via training courses

## Team Software Process (TSP)

- Proven technology
- Strongly addresses management and measurement across the project lifecycle, especially later phases (implementation, test)
- Key managers familiar with technology only through word-of-mouth and literature



# Architecture Principles

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ARCHITECTURE

An architecture of a system consists of structures (elements and relationships) and content (responsibilities of the elements).

The structures determine the quality attribute properties of the system and those properties either support or hinder the achievement of the business goals.

The content of the elements determines the functions the system can provide.

Architecting a system means designing the structures and elements of that system in such a way that the quality attribute properties as well as the functions exhibited by the system support the business goals.



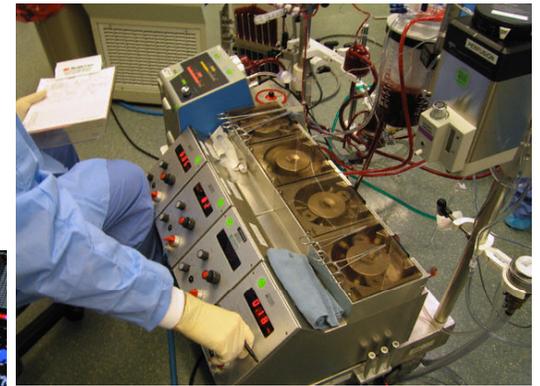
# What is Architecture-Centric Engineering?



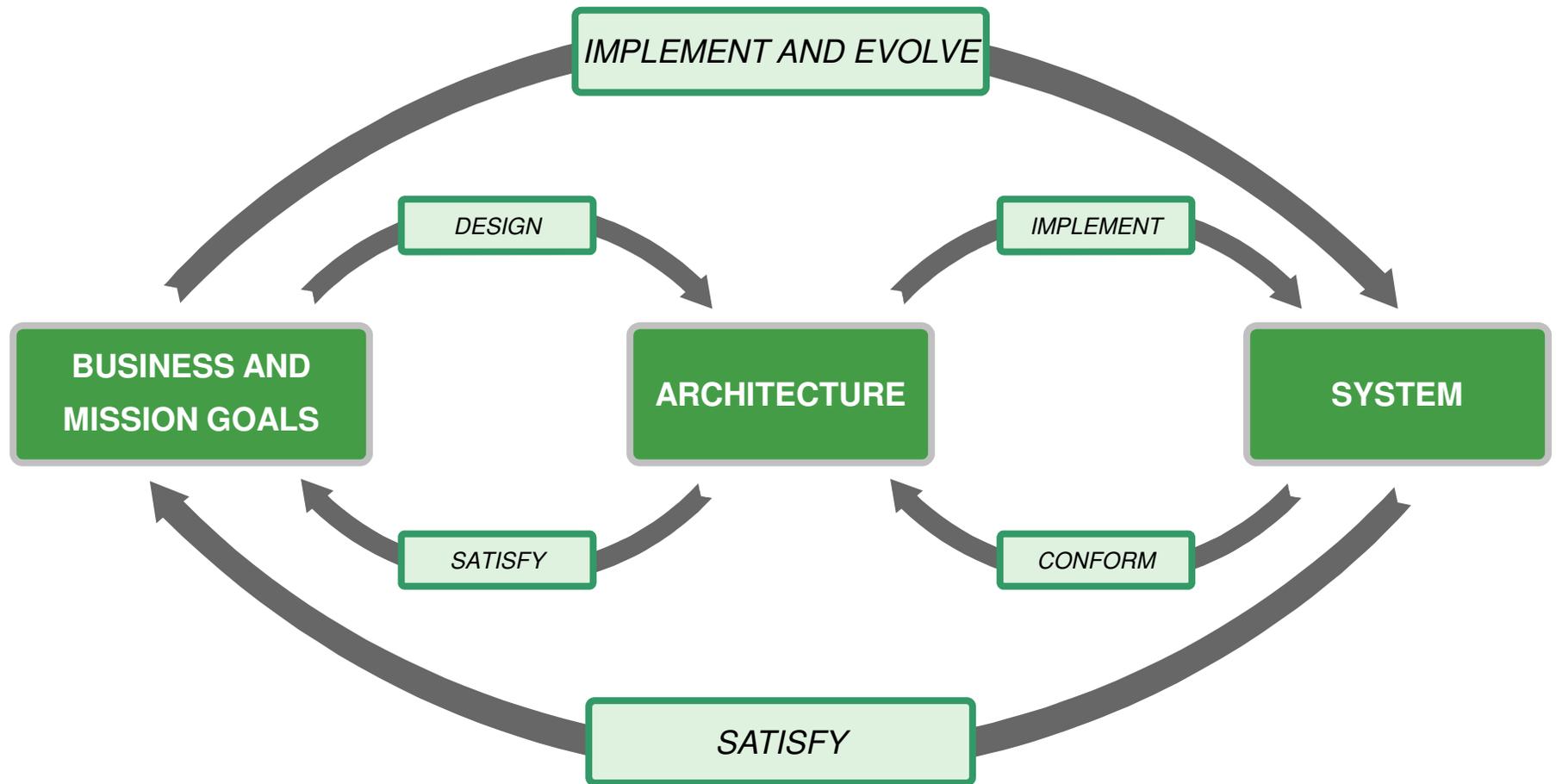
*Architecture is of enduring importance because it is the right abstraction for performing ongoing analyses throughout a system's lifetime.*

**Architecture-Centric Engineering (ACE)** is the discipline of using architecture as the focal point for performing ongoing analyses to gain increasing levels of confidence that systems will support their missions.

The **ACE Initiative** develops principles, methods, foundations, techniques, tools, and materials in support of creating, fostering, and stimulating widespread transition of the ACE discipline.



# ACE Design and Analysis



# QAW/BTW – Building Quality Attribute Scenarios

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The Quality Attribute Workshop (QAW) and Business Thread Workshop (BTW)

- bring together important internal and external stakeholders
- develop and validate key quality attribute scenarios that *quantitatively* define the most important *non-functional* requirements
- QAW focuses on developing quality attribute scenarios
- BTW focuses on business context to validate scenarios



# Attribute-Driven Design (ADD) Method

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ADD uses quality attribute scenarios to drive architectural design.

The process was time-boxed two ways.

- Six-week boxes to focus on
  - initial architectural (v1) while training architect team
  - refined architecture (v2) for early review or ATAM<sup>1</sup>
  - “complete” (not final) architecture (v3) for use by developers<sup>2</sup>
- Two-week boxes that focused on
  - developing the architecture
  - preparing for and performing ATAM-based peer-reviews with the “architecture coach”

1. ***Development team was launched at this point***

2. ***ATAM actually occurred at this point***

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# Active Review of Intermediate Designs (ARID)

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An ARID was held in conjunction with a TSP relaunch.

The purpose of ARID is to

- put the architectural documents into the hands of developers
- ensure that the documents are fit for development use (right information recorded at sufficient level of detail)
- provide early “live” feedback to the architecture team



# Architecture Trade-off Analysis Method (ATAM)

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## ATAM

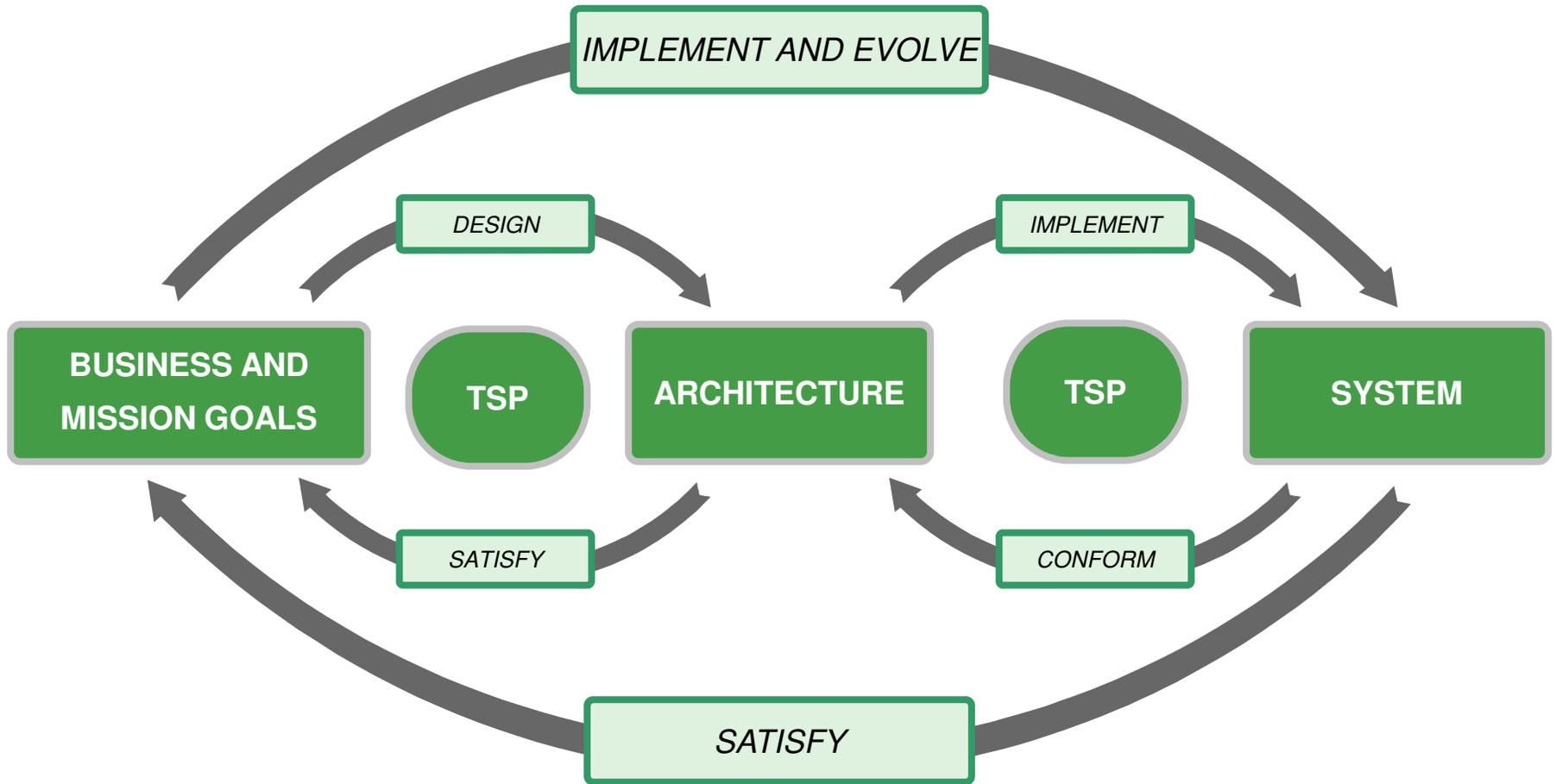
- brings together a system's stakeholders
- evaluates the existing architecture with respect to the quality attribute scenarios
- focuses on surfacing architectural risks
- promotes & requires adequate documentation of the architecture

As mentioned previously, two-day ATAM-based peer-reviews were used by the architecture coach during development.

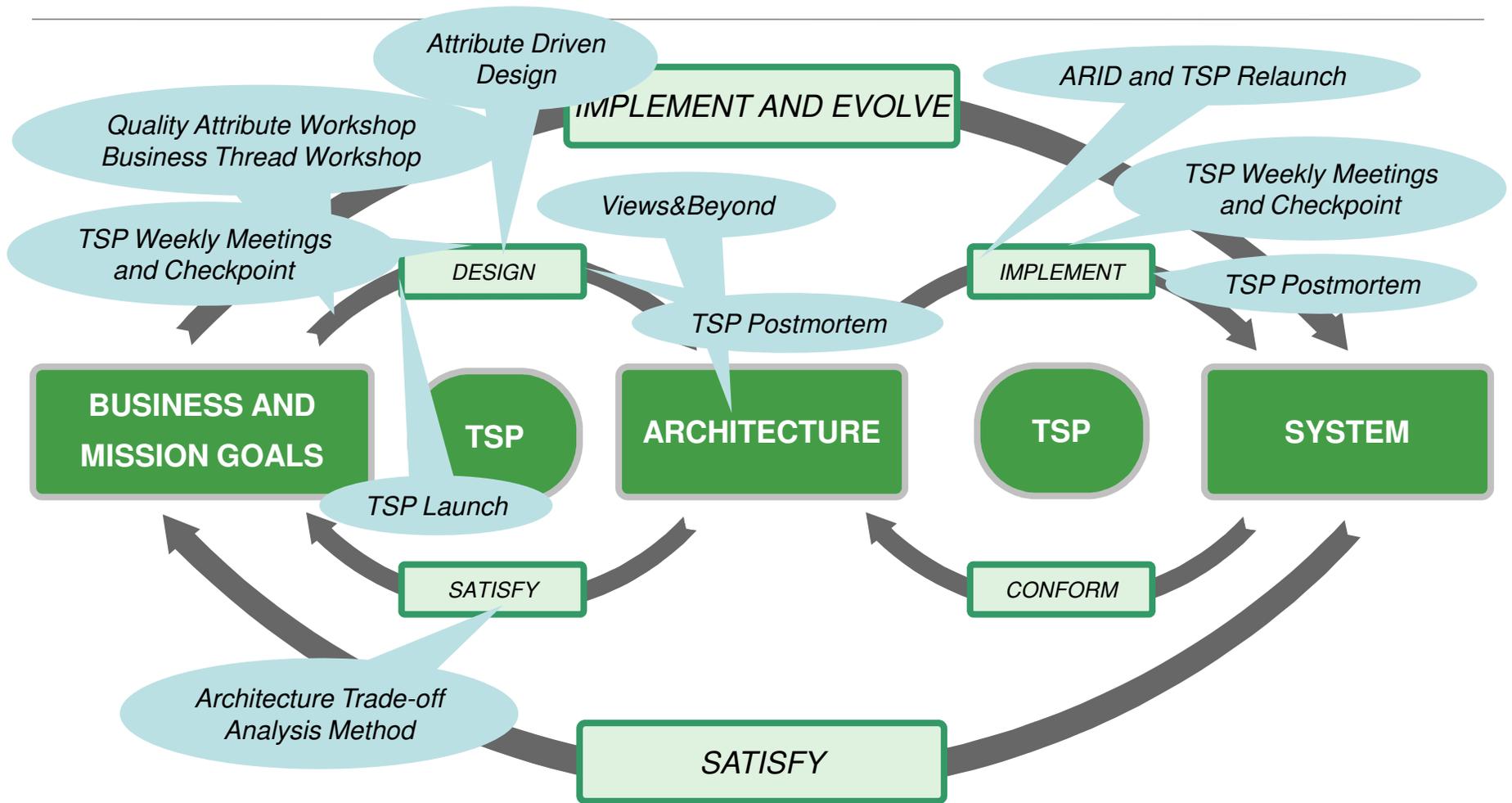
- on-the-job training for architecture team
  - forced adequate documentation from the start
  - fewer risks surfaced at formal ATAM than expected for size/scope of project
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# ACE Design and Analysis – with TSP

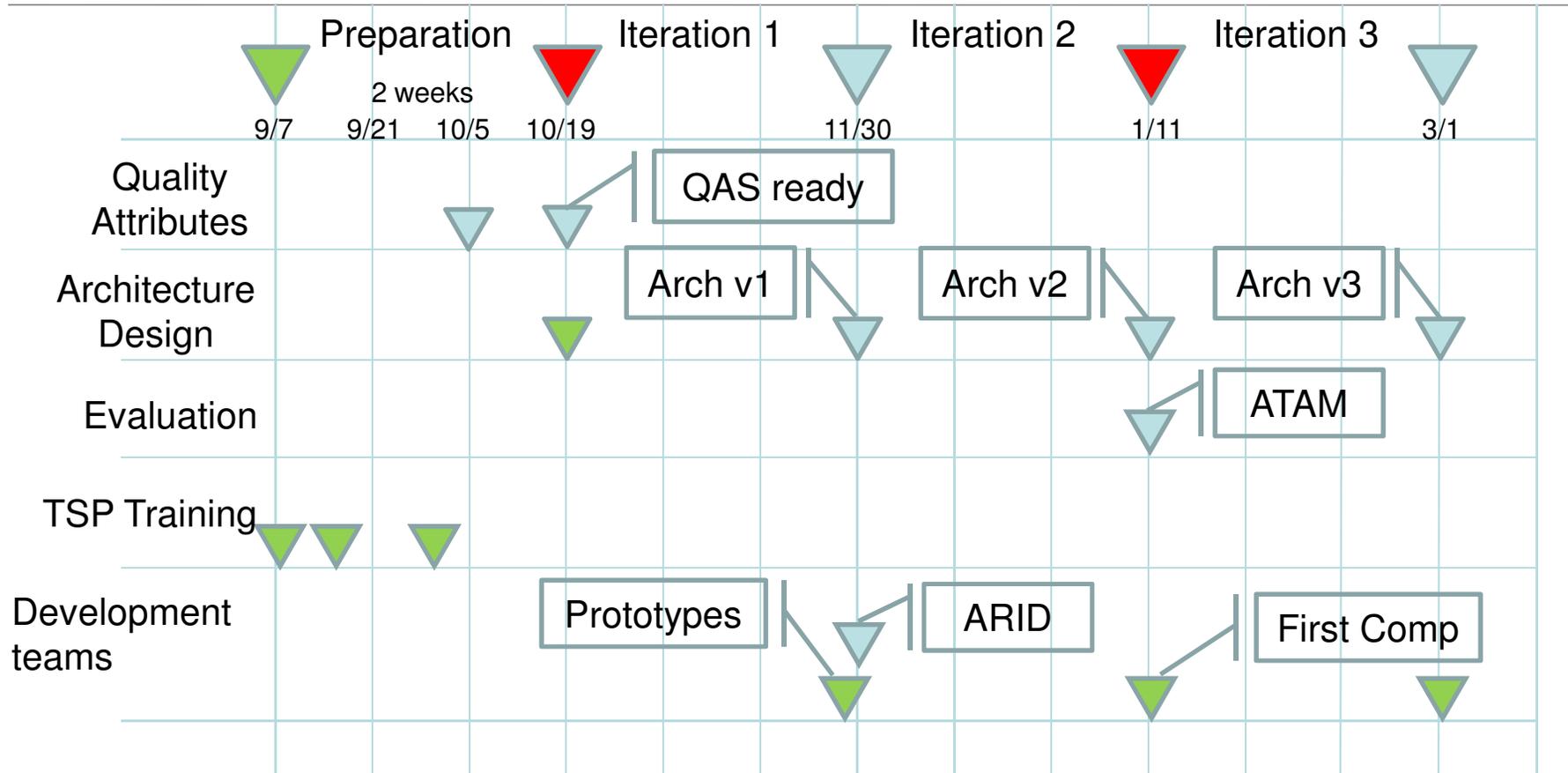
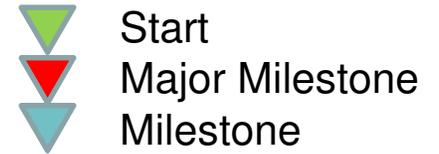


# ACE / TSP Design, Analysis, & Implementation



# Bursatec overall schedule – Phase I

(based on an initial notional schedule by SEI)



# The Work

Type	Duration	Purpose	Tasks
I. Architectural Design and Analysis	During architecture development Months 1-6 of project	Launch the project team Build architecture and development skills	<ul style="list-style-type: none"> <li>•Architecture Coaching including Launch</li> <li>•Quality Attribute Requirement Refinement</li> <li>•Architectural Design (iterative)</li> <li>•Quality Attribute Modeling</li> <li>•Documentation Support</li> <li>•Architecture Review</li> <li>•PSP / TSP Introductory Training</li> </ul>
II Implementation Support	During software development Months 6-18 of project	Keep the project on track and develop a quality trading engine, on-time.	<ul style="list-style-type: none"> <li>•Architecture Coaching, Focusing on Review of Development Infrastructure</li> <li>•TSP Team Launches (2 teams)</li> <li>•Weekly TSP Development Team Coaching</li> <li>•Architectural Conformance Verification</li> <li>•Quality Attribute Modeling</li> <li>•TSP Cycle End / Team Re-Launch (2 teams)</li> </ul>
III Architecture support, development support, and self-sustainment support	Remaining life of project Months 18-30 of project	Provide architectural support s needed and develop TSP self-reliance.	<ul style="list-style-type: none"> <li>•Architectural Support (as necessary)</li> <li>•Continued TSP Team Coaching</li> <li>•PSP Advanced Programming Course</li> <li>•TSP Coach Development</li> <li>•TSP Instructor Development</li> </ul>



# Some Early Challenges of the “Mind Meld” -1

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## Size estimates and size measurements

- TSP does a *conceptual design* for initial estimates and structuring of project plans
- ACE calls for initial *architectural concepts or approaches*, parts of which will often survive into the final architecture.
- Bursatec had already done a lot of analysis for the buy vs. build decision, including effort estimates and initial architectural concepts.

The launch fell back on these initial estimates plus a number of user stories based on the *quality attribute scenarios* from the QAW.

The early architectural concepts helped to get better size estimates and to think about work allocation earlier.

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# Some Early Challenges of the “Mind Meld” -2

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## Defect management

- ACE focuses on *architectural risks*, but a TSP coach might be tempted to call them “*defects injected in HLD*”.
- In TSP, *risks* are usually *risks to the project plan* – but that might include *architectural risks* as well!
- The good news – at least one team in Mexico hasn’t had any trouble dealing with potentially ambiguous English terminology.



# Some Early Challenges of the “Mind Meld” -3

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## Other process issues

- early design is exploratory in nature, becoming progressively more conventional
- ARIDs and ATAMs – not just new names for a review or inspection
- Agile practices – daily meetings, planning poker without the cards, two levels of time-boxing
- Bursatec added a Performance Manager role to oversee one of the top quality attributes of the system to ensure it was being addressed in the development of key components
- Architecture conformance checks included in the cycles



# TSP and ACE – Principles in Common

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On the surface, TSP and ACE are very different disciplines.

- TSP is a self-directed management and measurement process.
- ACE provides technical development practices.

Common principles allow TSP and ACE to work well together.

- emphasis on business and quality goals
- emphasis on engineering excellence
- emphasis on defined processes and process discipline
- emphasis on teamwork



# Important Lessons Learned (So Far)

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TSP and ACE are not simply compatible, they are complementary.

Learning cycles can be shortened; they *cannot* be short-cut!

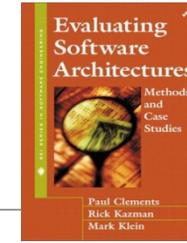
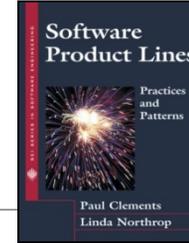
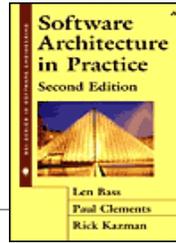
Architecture can be coached.

TSP provides a disciplined framework for measuring and managing any structured intellectual activity.

Architectural awareness helps to structure the team and the work in addition to the product.



# ACE Training



	CERTIFICATE PROGRAMS		CERTIFICATION
Requirements	Software Architecture Professional	ATAM Evaluator	ATAM Leader
Software Architecture: Principles and Practices course	●	●	●
Documenting Software Architectures course	●		●
Software Architecture Design and Analysis course	●		●
Software Product Lines course	●		
Software Architecture: Principles and Practices Exam	●	●	●
ATAM Evaluator Training course		●	●
ATAM Leader Training course			●
ATAM Observation			●



# Questions?

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# For More Information

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SEI website at [www.sei.cmu.edu](http://www.sei.cmu.edu) (~/tsp or ~/architecture)

Luis Carballo [lcarballo@bursatec.com.mx](mailto:lcarballo@bursatec.com.mx)

Jim McHale [jdm@sei.cmu.edu](mailto:jdm@sei.cmu.edu)

Rod Nord [rn@sei.cmu.edu](mailto:rn@sei.cmu.edu)



# Intellectual Property

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