System Integration

Mini Case Studies

Introduction to System Integration

Shawn A. Butler, Ph.D.
Senior Lecturer, Executive Education Program
Institute for Software Research
Carnegie Mellon University

Lecture Objectives

- Understand what system integration means for this course
- Understand the motivations for integrating systems
- Be aware of some very important heuristics

System Engineers

Success comes from wisdom

Wisdom comes from experience

Experience comes from mistakes

References

- Ruh, William A. Maginnis, Francis X. Brown, William J. “Enterprise Application Integration”, Wiley Computer Publishing, 2001

- Maier, Mark W. and Rechtin, Eberhardt “The Art of Systems Architecting”, 2nd Ed. CRC Press, 2002

- Cummins, Fred A. “Enterprise Integration”, OMG Press, 2002

What Does System Integration Mean?

- More than one application, module, or component that…
- Share data and…
- Present user with consistent information
- Examples:
  - Travel systems that present the user with a complete itinerary including travel, hotel, and entertainment bookings
  - Enterprise accounting and project management systems
  - Human resource and payroll systems

Before You Begin …

- Why are you integrating these components/applications/systems?
- What is the impact to the organization's business processes?
- Are there proprietary or unique legacy systems involved?
- Has a different contractor already failed at this task?
- Who will benefit from the integration?
- What is the benefit from the integration?

Why are you integrating?

- Adaptable systems and processes
- Streamlined business processes
- Management information
- Support for electronic commerce
- Integrated security
- Replaceable components
- Reliable and recoverable systems
- Economies of scale

Adaptable System and Processes

- Systems and processes are tightly coupled to computer applications
- Process changes are difficult to support with existing components
- Application knowledge is lost
- Changes are time consuming, costly, and complex

Organizations want systems that are more flexible to change

Adaptable Systems

- Responsibility and control over each business function is defined and assigned
- Each business function is defined once, performed in a consistent manner
- Coupling and dependencies between business functions are minimized

Information Management

- Data consistency
- Data accessibility
- Process consistency
- Exception reporting
- Historical data analysis

Just because we can share the data – should we?

Support for Electronic Commerce

- Compatibility with the systems and applications of customers and business partners
- Mechanisms for timely and reliable communication of information
- Greater security risks
- Data exchanged between your organization and an external entity create issues of trust

New technologies facilitate electronic interchange

Integrated Security

- Firewalls
- Authentication
- Authorization
- Integrity
- Confidentiality
- Nonrepudiation

Security integration is much more difficult than you think!

Replaceable Components

- Historically, large proprietary systems could not decouple components and functionality
- Really difficult to reuse components
- Also difficult to adapt systems to different customers
- Dependent on small number of vendors 
- Integration often created duplicate functionality

Trend is towards finer-grained, loosely coupled components

Reliable System Operations

- Minimize the risk that the system will fail
  - A safe environment with reliable power
  - Testing of equipment and software prior to operation
  - Solid change control processes
- Detect malfunctions early
  - Design and a solid testing program
- Limit the impact of failure
  - Redundancy
  - Backup and recovery designed into the system

Economies of Scale

- An integrated system should cost less to operate and adapt to changing needs
- Duplication should be eliminated unless it supports reliability
- Complexity should be reduced
- Economies are achieved through:
  - Standards
  - Software reuse
  - Common infrastructure
  - Consolidated systems operations

Standards alone in not sufficient to achieve the benefits from system integration

Technology Enablers

- Middleware Technologies
- Web Technologies
  - User Interface
  - Ubiquitous Access
- XML
  - Descriptive Tags
  - Facilitates Transformation
- Distributed Objects
  - CORBA
  - COM+
  - Enterprise Java Beans

The Value of Integration Heuristics (Maier and Rechtin)

- System engineers have only worked on a few complex systems in their lifetime
- System engineering does not yet have the rules and formulas that form the foundation of other engineering disciplines
- Although they seem obvious, every systems engineer will violate the heuristic at some time during the design and development of their system

Heuristic 1

Don’t assume that the original statement of the problem is necessarily the best, or even the right one.

Heuristic 2

Build and maintain options as long as possible in the design and implementation of complex systems.
You will need them.

Heuristic 3

Simplify, Simplify, Simplify

Heuristic 4

In partitioning, choose the elements so that they are as independent as possible; that is, elements with low external complexity and high internal complexity.

Summary

- Before you start thinking about integration, make sure that the purpose is clear and feasible
- Clearly understand the goals of the integration
- Good systems engineers use heuristics to guide them in design of a system
  - Don’t assume that the customer knows exactly what they want
  - Keep the integration simple
  - Keep your options open
  - Keep components independent