A Convergence of Technologies for Better Software NOW!

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Topics

- Two categories of software errors
- How technologies can help
- Who needs to be involved
- Some experiences
- Questions
- Backup charts with technology descriptions

Two Categories of SW Errors

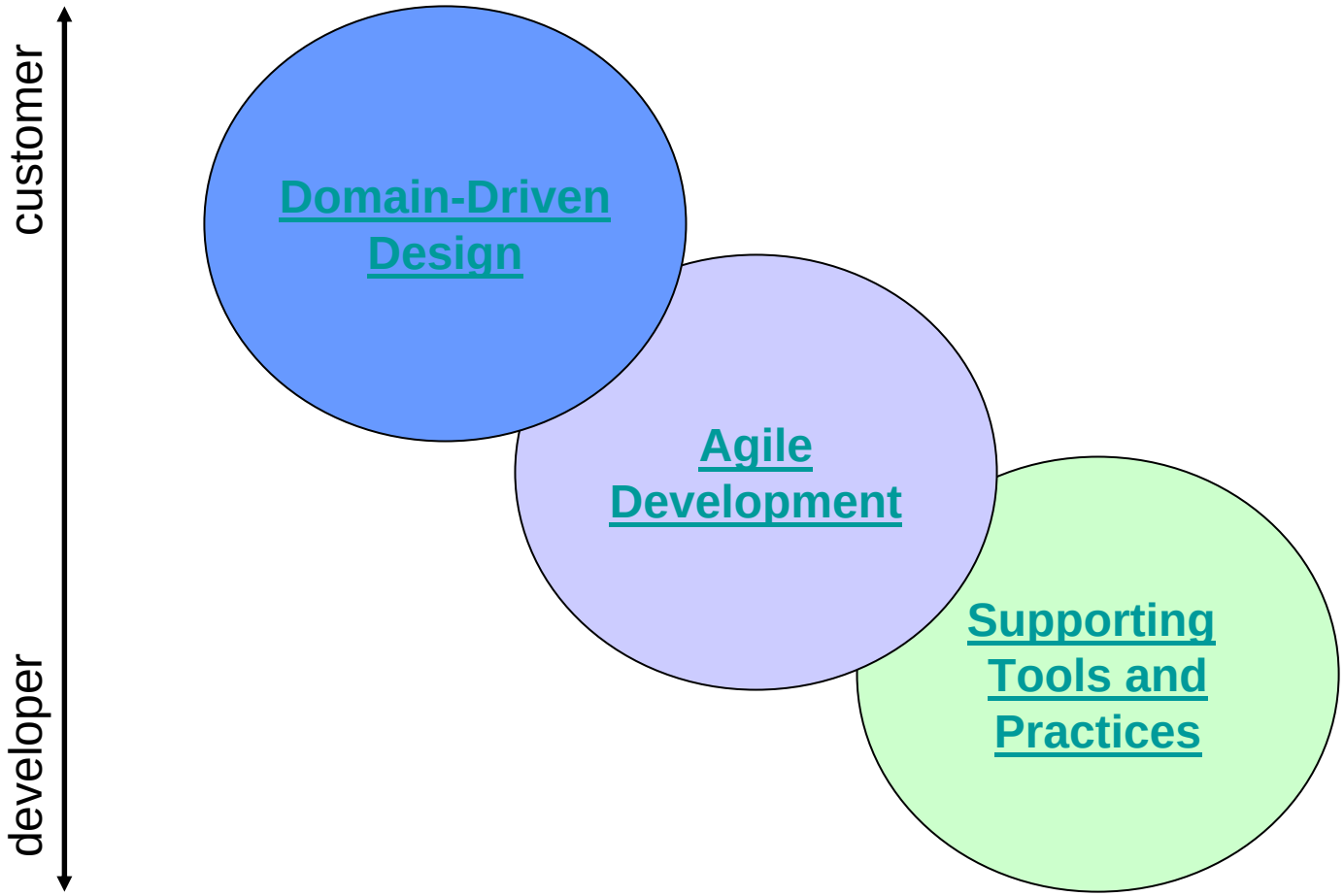
Solving the problem wrong

- Incorrect implementation of requirements (off by one bug, logic errors, etc)
- Bad coding practices that leave security holes
- Interface mismatches
- Delivering too late to be useful
- Un-maintainable code
- Poorly performing software
- Poor user interfaces

Solving the wrong problem

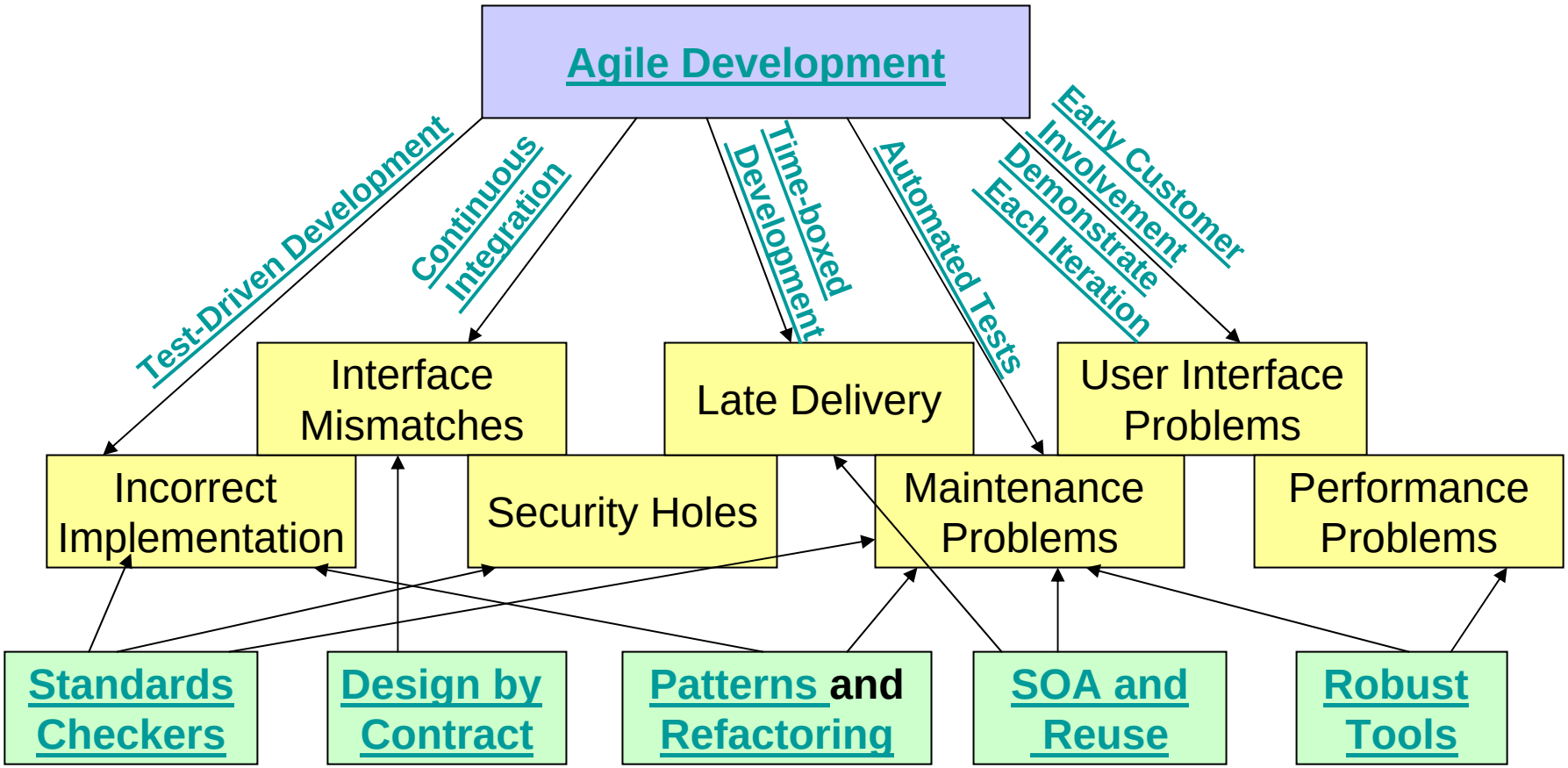
- Misinterpretation of requirements
- Missing requirements
- Unused capabilities
- Obsolete requirements
- Failing to recognize the existence of ‘wicked’ problems (the solution changes the nature of the problem)
- Focusing on generic or supporting domains rather than on the core domain

What are the Technologies?



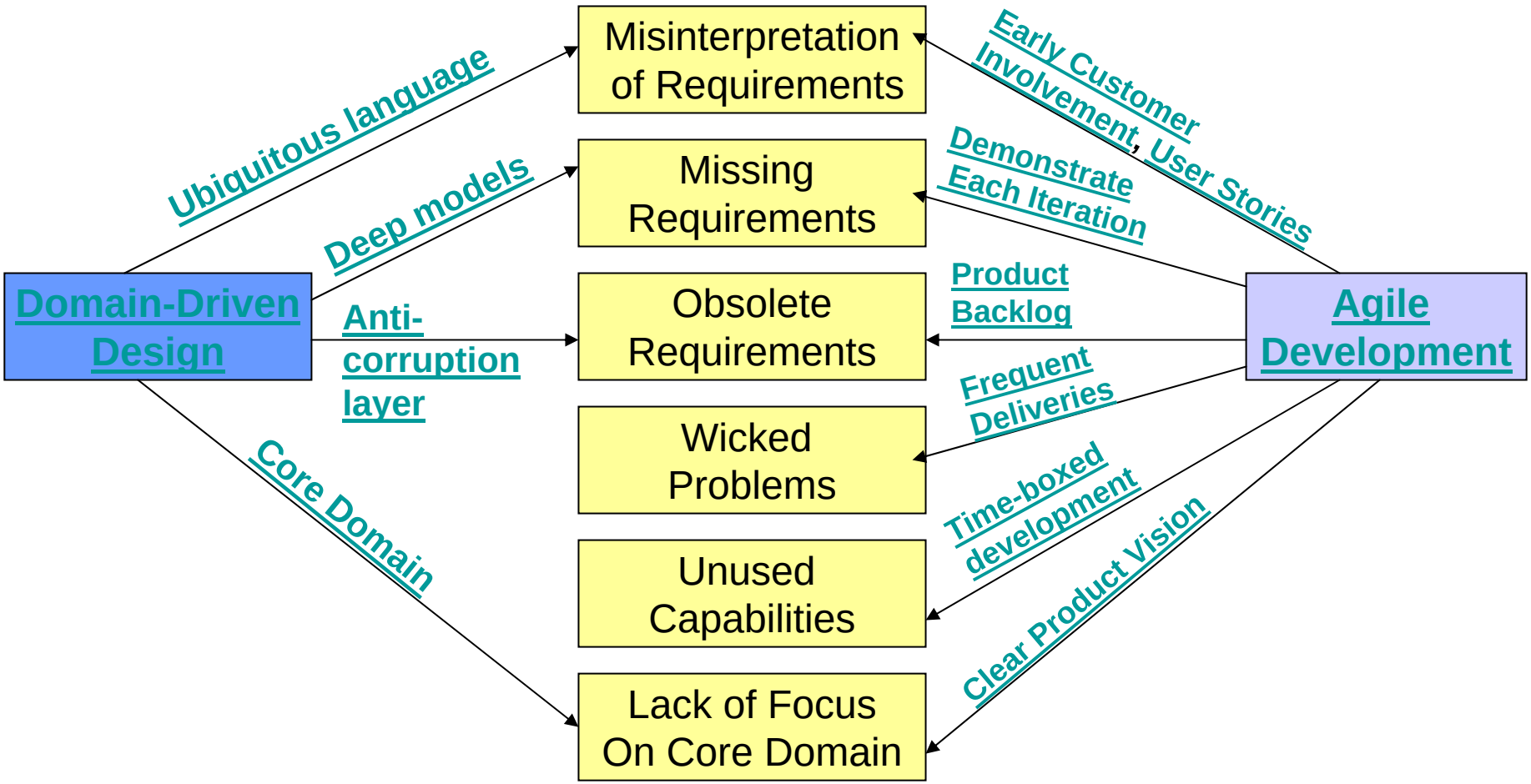
The Good News

Some technologies help with the issue of solving the problem wrong.



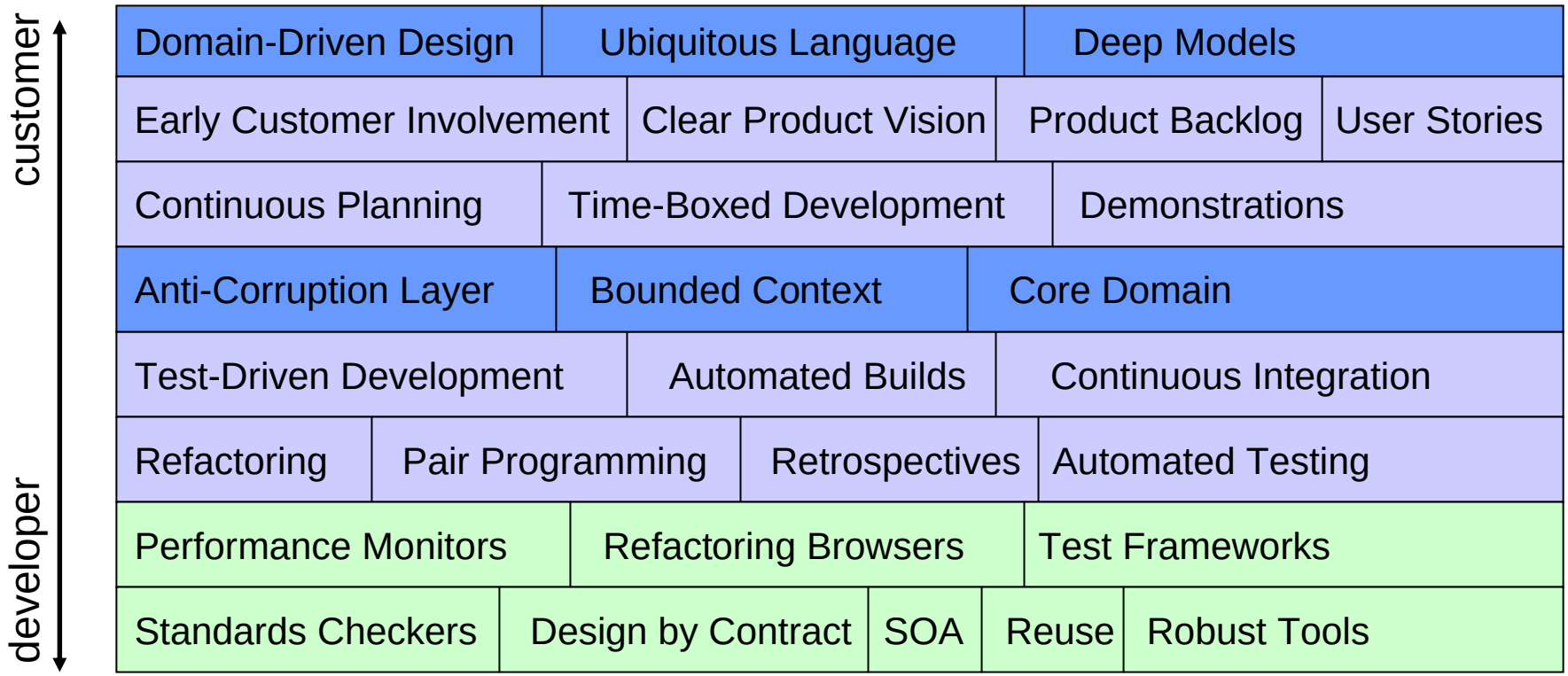
The Better News

Some technologies help with the more difficult issue of solving the wrong problem.



The Best News

- **The technologies are synergistic**



- **The barriers to adoption are relatively low**
  - **Good FOSS tool support to get started**
    - **COTS tools also available with additional capabilities**
  - **Adequate literature and experience base for training**

Who is Involved?

- Who is involved in making a change to agile and domain-driven design?
  - Everyone!
    - Customers, Users, Systems Engineering, Software Development, Test, Specialty and Support Disciplines, Management, etc.
  - Software developers usually like the change because it is a more natural way to solve problems
  - Systems engineers and managers sometimes have a harder time adapting
    - Managers fear the loss of the perception of being in control
    - Systems engineers sometimes struggle with the need to keep the big picture in mind while going deeper into selected areas for near-term development
- Benefits generally outweigh the negatives
  - Earlier feedback on requirements, architecture and design
  - Earlier visibility into problem areas
  - Good vehicle for transferring domain knowledge

Some Experiences (1)

- Program applying many of the practices
  - Program Characteristics:
    - Mission critical technical application, critical algorithms
    - Adopted both domain modeling and agile practices
    - Part of a larger system doing traditional development
  - Results:
    - High quality product, with good quality measurements
    - Able to make substantial change to add capability and improve performance with very little impact
    - Happy engineering team and happy customers
    - Practices spreading to other teams

Some Experiences (2)

- Program applying just a few of the agile practices
  - Program characteristics
    - New capability being added to large existing system
    - Many new developers
    - Experts still involved in previous release that was behind schedule
    - Focused on standards, daily status meetings, continuous integration, refactoring, automated builds
  - Results
    - New capability developed on time and budget
    - High quality code, based on early test results and independent quality assessment
    - Happy team and happy customers

Summary

- Domain-driven design and agile development together offer substantial opportunities for improving how we do business
  - Tool support is now robust enough to support iterative development
  - Adequate material is available for training
  - Substantial and sustained improvements are becoming evident

Questions

Backup Material

- Descriptions of the Key Technologies
  - Description
  - Benefits
  - References
    - Additional descriptive material
    - A book for further study

Agile Development

- Description:
  - An approach to software development that uses short, time-boxed iterations to support early delivery of the customer's highest value capability
    - Each iteration is potentially shippable
  - Agile approaches use continuous planning, analysis and design rather than completing those activities up-front, before development begins
    - Customer is involved in prioritizing and clarifying requirements throughout each iteration
  - Examples:
    - Scrum, XP, Disciplined Agility, FDD, Adaptive Project Management
- Benefits:
  - Produces early value for customers
  - Accommodates changing requirements
  - Improves quality and productivity
- References:
  - http://en.wikipedia.org/wiki/Agile_software_development
  - Agile Software Development: The Cooperative Game by Alistair Cockburn

Test-Driven Development

- Description:
  - An approach to development that uses tests to drive the production of SW
  - Write a test, write the code, run the test, refactor
  - Examples:
    - Test frameworks include the xUnit family of FOSS tools (JUnit, cppUnit, nUnit, etc) as well as commercially available tools
- Benefits:
  - Produces high quality code with good interfaces and few dependencies, which improves the maintainability of the system
  - Makes future changes easier since all code has a suite of tests
- References:
  - http://en.wikipedia.org/wiki/Test-driven_development
  - Test-Driven Development: By Example by Kent Beck

Continuous Integration

- Description:
  - With continuous integration, developers check in their code several times a day, as soon as they complete each small chunk of functionality
  - When the code is checked in, a series of automated tests are run to ensure that both the new code and the existing code base function as expected
- Benefits:
  - Defects are discovered soon after they are introduced, so they are easier to find and fix
  - Fewer unpleasant surprises late in development
- References:
  - http://en.wikipedia.org/wiki/Continuous_integration
  - Continuous Integration: Improving Software Quality and Reducing Risk by Duvall, Matyas and Glover

Time-Boxed Development

- Description:
  - Each short iteration is scheduled for a specified duration – usually from 2-4 weeks
  - If the scheduled work cannot be completed, it is deferred to the next iteration
- Benefits:
  - Establishes a project rhythm that improves productivity
  - Provide early and frequent status based on working code
  - Forces hard choices about capability
    - The content must be allowed to change since schedule and quality are fixed
- References:
  - http://en.wikipedia.org/wiki/Timebox
  - Agile Project Management: Creating Innovative Products by Jim Highsmith

Automated Tests

- Description:
  - Test automation can occur at any level of testing
    - Unit test automation is supported through test frameworks like JUnit
    - Both FOSS and COTS products are available for automating aspects of higher level testing
  - Automated tests are designed to be run frequently, so they must be fast and free of side effects
    - Usually automated unit tests are run as an integral part of development (see TDD) and each time the code is checked into the CM system
- Benefits
  - Improved feedback to the developer and increases the quality of changes to the code
  - Automated tests are especially valuable for regression testing
  - Provide a safety net for future changes
- References:
  - http://en.wikipedia.org/wiki/Automated_testing
  - http://www.junit.org/
  - Fit for Developing Software: Framework for Integrated Tests by Rick Mugridge and Ward Cunningham

Early Customer Involvement

- Description:
  - Customers create and prioritize items in the product backlog
  - Daily interaction between customer and developers both clarifies requirements details and allows for the deeper understanding that helps manage the complexity associated with most domains
  - Examples:
    - Business person working with developers to clarify requirements for a payroll system or invoice system
    - Hardware engineer working with developers to clarify interactions between new hardware and controlling software
    - Systems engineers working with developers to develop algorithms for scheduling access to specific resources
- Benefits:
  - Reduces the need to capture requirements detail early in the life cycle
- References:
  - http://en.wikipedia.org/wiki/Extreme_Programming_Practices#Whole_team
  - Extreme Programming Explained: Embrace Change (Second Edition) by Kent Beck and Cynthia Andres

Demonstrate Each Iteration

- Description:
  - At the end of each 2-4 week iteration, the features developed during that iteration are demonstrated to the customer
    - Customer feedback drives priorities for future iterations
- Benefits:
  - Promotes better understanding of additional or different needs
  - Working code demonstrates real progress
- References:
  - http://www.scrumforteamsystem.com/ProcessGuidance/Process/SprintReview.html
  - Agile Software Development with Scrum by Ken Schwaber and Mike Beedle

User Stories

- Description:
  - Short descriptions of features that can be implemented in 2 days to 2 weeks
  - Three pieces to a user story
    - Short written description
    - Conversations about the story to flesh out the details
    - Tests that convey and document details and that can be used to determine when a story is complete
- Benefits:
  - Provide a good basis for estimating size as well as a mechanism for understanding user needs
  - Force a shift to verbal communication for feature details, which is much higher band-width and supports rapid feedback cycles
  - The tests associated with the stories provide executable documentation of user requirements
- References:
  - http://en.wikipedia.org/wiki/User_story
  - User Stories Applied for Agile Software Development by Mike Cohn

Product Backlog

- Description:
  - A product backlog is a prioritized list of features desired for a product
    - Grows and changes over time as more is learned
    - Scope line shows how much can be accomplished with current funding
  - Prioritization is primarily based on customer needs, but must also consider technical dependencies
  - Commercial and FOSS tools are available to help manage both the product backlog and iteration backlogs
- Benefits:
  - Prioritized development of functionality maximizes customer value
  - Allows users to add, subtract or change features based on new needs
  - Scope line provides on-going visibility into features that can be developed with current funding
- References:
  - http://www.mountaingoatsoftware.com/product_backlog
  - Scaling Software Agility: Best Practices for Large Enterprises by Dean Leffingwell

Frequent Deliveries

- Description:
  - Short iterations allow early delivery to customer
    - Each iteration should be potentially shippable
  - Often multiple iterations are grouped for delivery to customer
    - Functionality is complete with each iteration, but there may be need for a ‘hardening’ iteration before shipment to address publication of user documentation, final system tests, etc
- Benefits:
  - Allows customers to get early benefit from the system
  - Use of the system in the customer environment gives improved opportunities to discover ‘the real requirements’
- References:
  - http://www.stsc.hill.af.mil/CrossTalk/2002/10/mccabe.html
  - Lean Software Development, An Agile Tool Kit by Mary and Tom Poppendieck

Clear Product Vision

- Description:
  - Product vision is established early to guide future development efforts
    - Essential when requirements are not fully detailed initially
  - One technique to establish the vision is to design the ‘box’ for the product
    - Differences between boxes designed by different teams can illuminate areas of disagreement on product priorities
- Benefits:
  - Helps focus customers and developers on the essentials of the product
  - Guides lower level implementation decisions
- References:
  - http://www.innovationgames.com/game/PRODUCTBOX.aspx
  - Agile Project Management: Creating Innovative Products by Jim Highsmith

Automated Builds

- Description:
  - Goal is to reduce the build process to a simple us-of-a-button action
    - Every programmer can perform a build whenever it is needed
      - Incremental builds can help make this a reality
    - With today's tools it is possible for even the largest systems to build multiple times a day
  - Enables effective Test-Driven Development
- Benefits:
  - Reduces time programmers spend on repetitive build tasks
  - Improves ability to run tests for every change, which improves quality and productivity
- References:
  - http://www.electric-cloud.com/solutions/agile_software_development.php
  - Integrating Agile Development in the Real World by Peter Schuh

Pair Programming

- Description:
  - Two individuals work side-by-side, sharing a single workstation, to design or code
  - Pairing with testers and engineers can be beneficial when requirements clarification is needed
- Benefits:
  - Provides a real-time peer review
  - Good mechanism for knowledge transfer
  - Improves code quality
- References:
  - http://en.wikipedia.org/wiki/Pair_programming
  - Pair programming Illuminated by Laurie Williams and Robert Kessler

Retrospectives

- Description:
  - At the end of each iteration, each team meets to celebrate the completion of the iteration and to capture lessons learned for the next iteration
  - Three topics to consider
    - What worked well and should be continued
    - What should the team stop doing
    - What needs to be done differently
- Benefits:
  - Identifies areas for improvement in the next iteration
  - Improved morale when team members know that the are listened to
- References:
  - http://www.retrospectives.com/
  - Agile Retrospectives, Making Good Teams Great by Esther Derby and Diana Lawson

Domain-Driven Design

- Description:
  - A way of accelerating software projects that have to deal with complex domains
  - Fundamental principles
    - The primary focus should be on the domain and domain logic
    - Complex domains should be based on a model
  - Agile approaches enable domain-driven design
    - Work with customers to develop models that reflect domain concepts
    - Provide rapid feedback to clarify complex areas
- Benefits:
  - Deeper understanding of the domain
  - Better communication between developers and domain experts
  - Ability to make breakthroughs at a faster pace
- References:
  - http://domaindrivendesign.org/
  - Domain-Driven Design: Tackling Complexity in the Heart of Software by Eric Evans

Ubiquitous Language

- Description:
  - A common language, based on the domain model, that serves as a communication vehicle between engineers, developers and domain specialists
    - Use of model-based terms in all project communication facilitates deeper understanding of the domain by everyone
    - One of the best ways to refine a model is to explore with speech, trying out loud various constructs from possible model variations
- Benefits:
  - Improved communication, which results in better models and better software
  - Helps in the discovery of hidden concepts
    - Often these arise in areas where the language does not flow smoothly
- References:
  - http://domaindrivendesign.org/discussion/messageboardarchive/UbiquitousLanguage.html

Deep Models

- Description:
  - An incisive expression of the primary concerns of the domain experts and their most relevant knowledge
    - A deep model sloughs off superficial aspects of the domain and naive interpretations
    - A deep model distills the most essential aspects of a domain into simple elements that can be combined to solve the important problems of the application
- Benefits:
  - Deep models enable acceleration of discovery and innovation within a domain
  - Keeps entire project on the same page
- References:
  - Domain-Driven Design: Tackling Complexity in the Heart of Software by Eric Evans

Core Domain

- Description:
  - The distinctive part of the model, central to the user's goals, that differentiates the application and makes it valuable
    - Efforts to refine and distill models should be focused on the core domain
- Benefits:
  - Identification of core, supporting and generic domains can help drive the company's strategy for what they develop, outsource or purchase
  - Helps identify the impact of changes
- References:
  - Domain-Driven Design: Tackling Complexity in the Heart of Software by Eric Evans

Bounded Context

- Description:
  - Defines the scope of each domain model
    - Identifies what has to be consistent and what can be developed independently
    - Defines the boundaries for continuous integration
  - Relationships between contexts can take multiple forms
    - Shared kernel, customer/supplier development teams or conformist
- Benefits:
  - Clearly identifies boundaries, which improves ability to integrate across teams
  - Understanding of relationships between contexts drives appropriate program behavior
- References:
  - Domain-Driven Design: Tackling Complexity in the Heart of Software by Eric Evans

Anti-Corruption Layer

- Description:
  - Allows new models to interface with legacy systems, without losing the clarity needed for deep modeling
  - Creates an isolation layer so that the new model can avoid corruption caused by needing to adapt to the semantics of the old system
  - Can be implemented by a combination of façade and adapter patterns, but it is more sophisticated than either of those
- Benefits:
  - Keeps one side of a bounded interface from leaking into the other, so the new models are not corrupted
    - Provides a translation between parts of the system that adhere to different models
- References:
  - http://domaindrivendesign.org/practitioner_reports/peng_sam_2007_06.pdf

Design by Contract

- Description:
  - An approach to software design that makes pre- and post-conditions explicit for each public method
    - Uses asserts (or equivalent) to enforce the contracts
  - Defensive programming is used at system boundaries, but not for interfaces within a boundary
- Benefits:
  - Interface mismatches are detected immediately, rather than indirectly through the errors that result from the mismatch
- References:
  - http://en.wikipedia.org/wiki/Design_by_Contract
  - Object-Oriented Software Construction, Second Edition, by Bertrand Meyer

Patterns

- Description:
  - A pattern is a repeatable solution to a common problem in software design
    - Captures lessons learned about use of the solution in various situations
  - Catalogs of patterns exist at various levels, including architecture patterns and design patterns
- Benefits:
  - Leads to higher quality designs that are easier to maintain with fewer dependencies
  - Enhanced communication of intent, based on the pattern selected
    - The pattern name conveys a lot of information in a few words
- References:
  - http://en.wikipedia.org/wiki/Design_pattern_%28computer_science%29
  - Design Patterns: Elements of Reusable Object Oriented Software by Gamma, Helm, Johnson and Vlissides

Refactoring

- Description:
  - An approach that systematically changes the internal structure of code without changing its behavior
  - An integral part of test-driven development
  - Often done prior to making major changes to code, in order to make it easier to make the changes
    - Each small change is tested so any errors are detected immediately
- Benefits:
  - Cleaner code, fewer dependencies, fewer defects
  - Supported by refactoring browsers, so it is a relatively safe way to make code changes
- References:
  - http://en.wikipedia.org/wiki/Refactoring
  - Refactoring: Improving the Design of Existing Code by Martin Fowler

SOA and Reuse

- Description:
  - SOA is an architectural style where existing or new functionalities are grouped into atomic services
    - The goal of SOA is to allow fairly large chunks of functionality to be strung together to form ad-hoc applications which are built almost entirely from existing software services
- Benefits:
  - Supports large-grained reuse of independently developed services
    - Enhanced productivity and quality through reuse
  - Enables increased focus on the core domain
- References:
  - http://en.wikipedia.org/wiki/Service_oriented_architecture
  - Service-Oriented Architecture: Concepts, Technology and Design by Thomas Erl

Robust Tools

- Description:
  - There are many tools available today that actually help in the development of software
    - Standards checkers, and standards checking services, Refactoring browsers, Test frameworks, Performance monitors, Modeling tools, especially those with reverse engineering capabilities
  - Need to make sure that the selected tools do not drive extra work
- Benefits:
  - Improved developer productivity
  - Improved quality
  - Enablers for iterative development – manual processes not adequate to support short development cycles
- References:
  - http://www.opensourcetesting.org/functional.php
  - http://www.opensourcetesting.org/unit_java.php
  - http://www.ddj.com/TechSearch/searchResults.jhtml;jsessionid=MPJGHOHFWKVKCQSNDLOSKH0CJUNN2JVN?queryText=tools