Test Data Management Challenges and Solutions

Software testing naturally involves some "housekeeping chores". One of these chores is managing test data. Perhaps you keep your test data in a relational database. Maybe it's a set of text files or spreadsheets. Some of your tests might require automatic generation of input values when the test is executed.

A variety of data sources are used to set up for, or provide input to, test cases. The actual and expected results from test execution also require varying levels of management. With many available options it can be a challenge to determine the most effective or efficient alternative for handling diverse data sets. This presentation reviews some of the strategies and techniques for obtaining, storing, tracking, and deleting various test data.

Definitions for this presentation

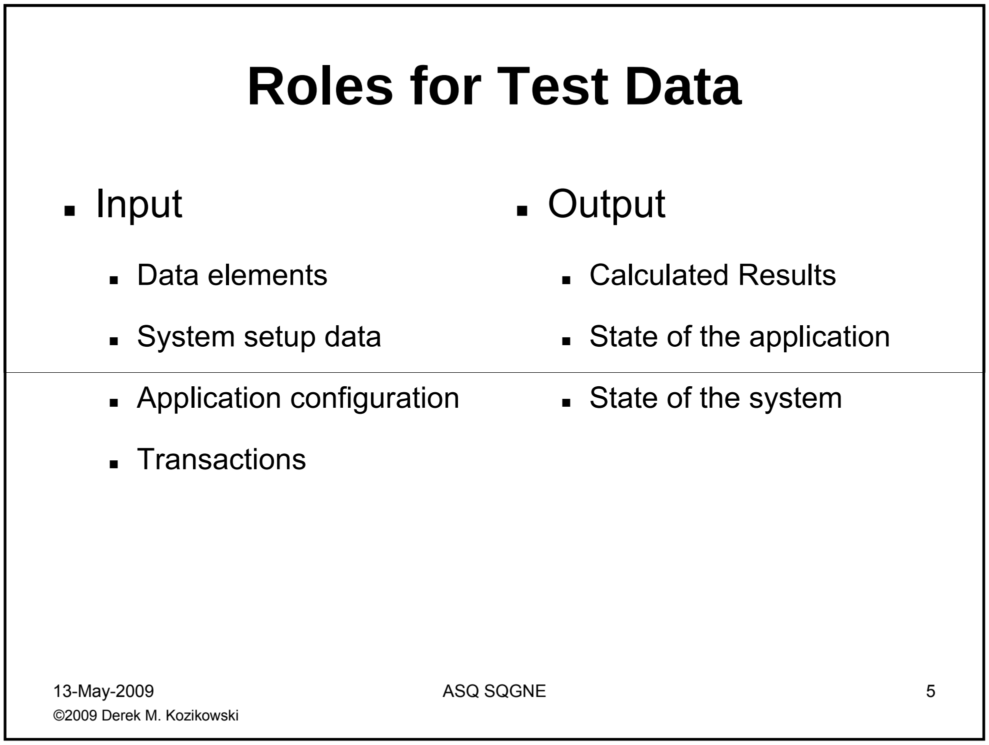
- Test data is information used while executing test cases, or resulting from the execution of test cases
  - Test case management is not our focus
- Data management implies creating or obtaining, storing, tracking, or otherwise guiding or handling test data throughout it's life cycle.

Agenda

- Our Motivation
- Roles Played by Data and The Data Lifecycle
- Data Packaging
- Scenarios and Challenges
- Distilled Requirements
- Some Solutions
- Future Directions

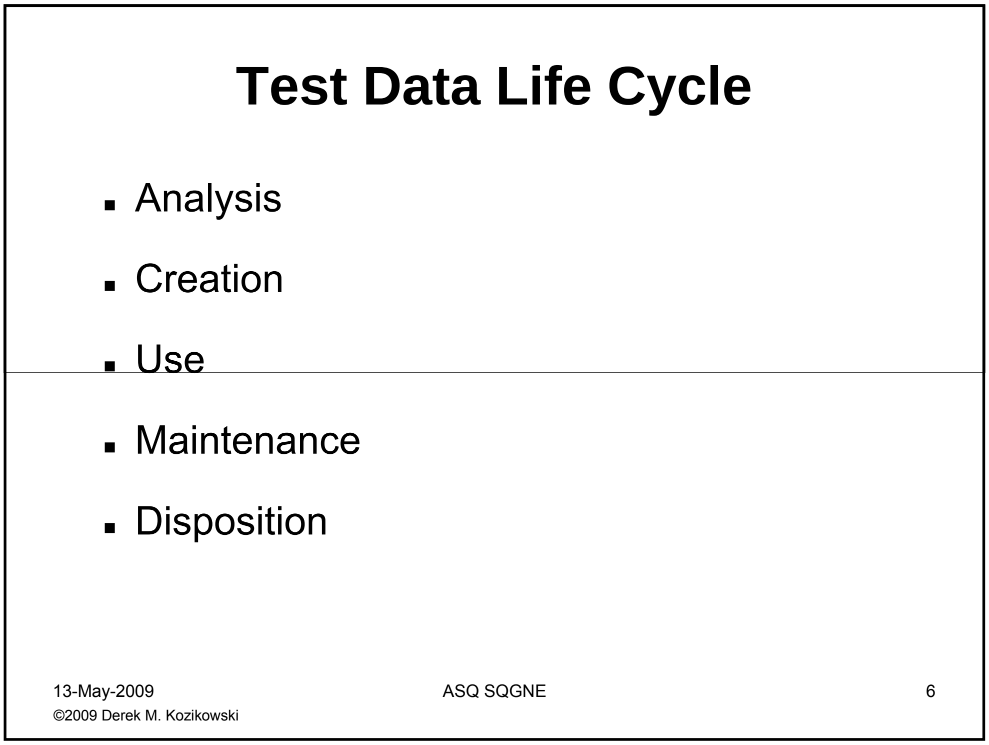
Why Manage Test Data?

- Test case data is an asset
- For data-driven or keyword-driven testing, the data specifies the test cases
- To reproduce any reported bugs, the data used must be available
- Finding relevant data for a test case must be easy to allow efficient execution of the test case
- Quality of the test data is directly related to the quality of the end product
- Redundant data may be cheap to store, but expensive to use



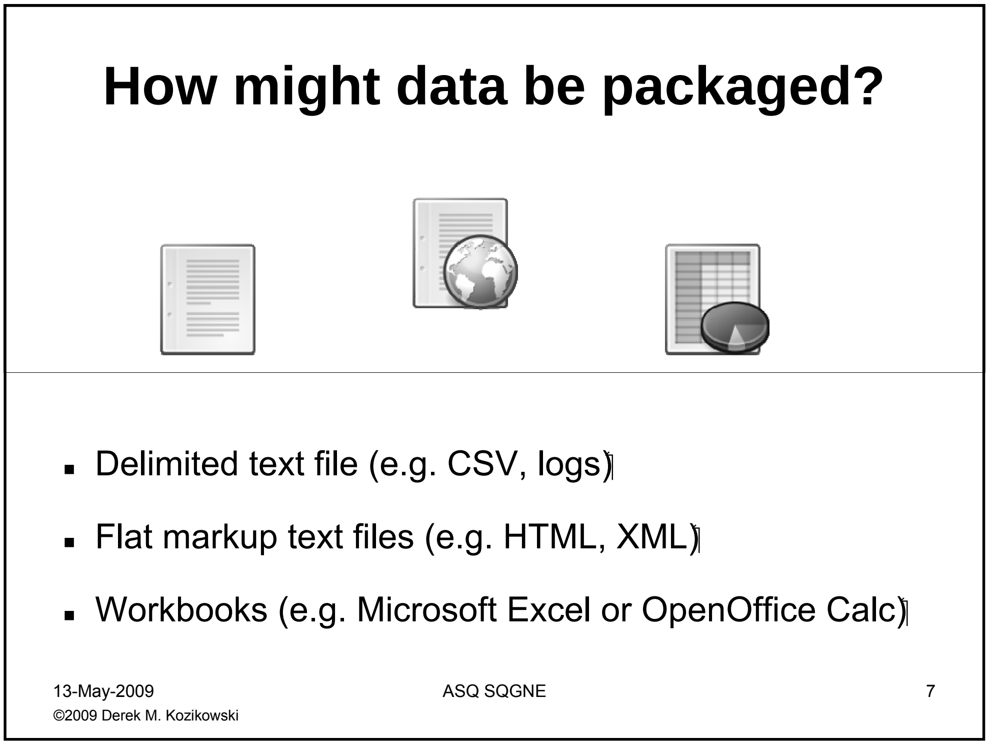
Roles for Test Data

- Input
  - Data elements
  - System setup data
  - Application configuration
  - Transactions
- Output
  - Calculated Results
  - State of the application
  - State of the system



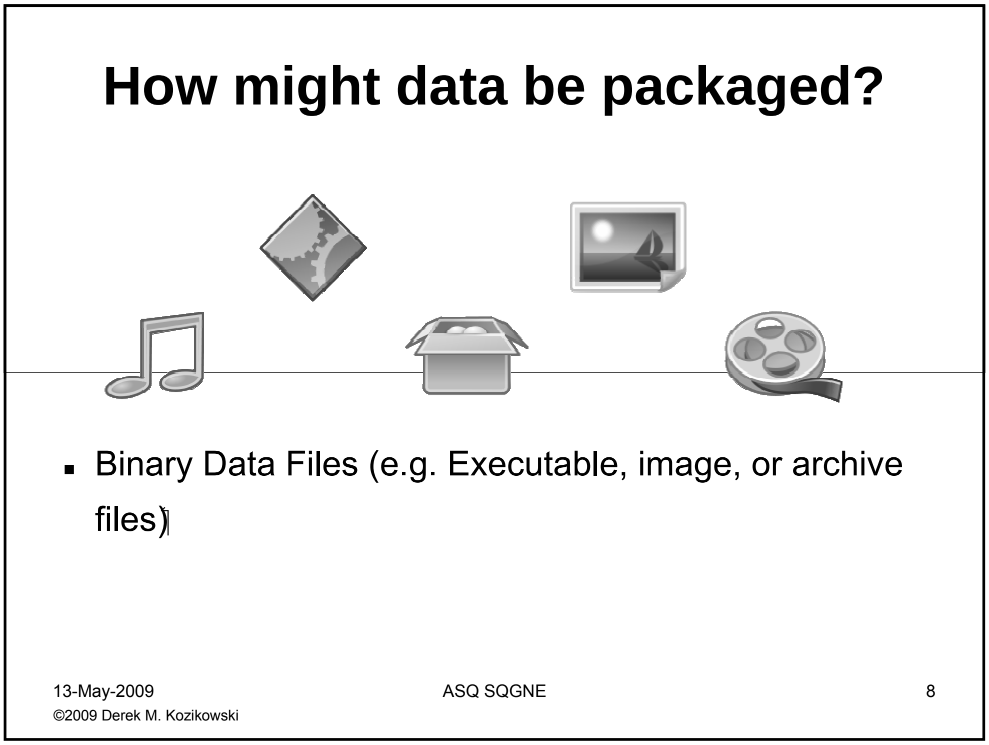
Test Data Life Cycle

- Analysis
- Creation
- Use
- Maintenance
- Disposition



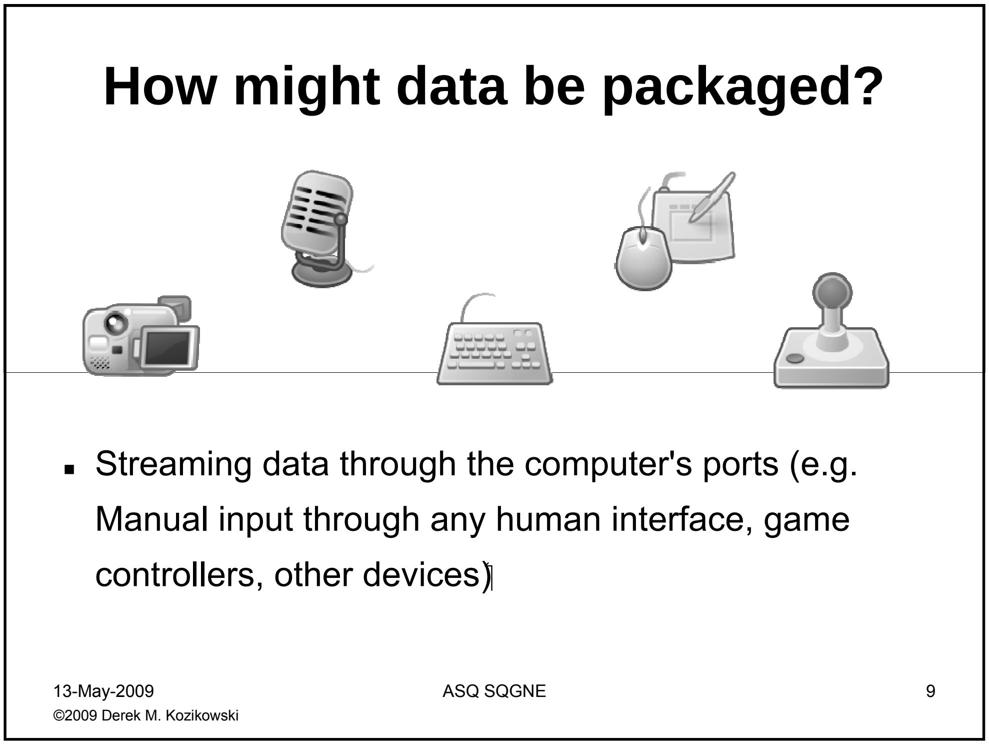
How might data be packaged?

- Delimited text file (e.g. CSV, logs)
- Flat markup text files (e.g. HTML, XML)
- Workbooks (e.g. Microsoft Excel or OpenOffice Calc)



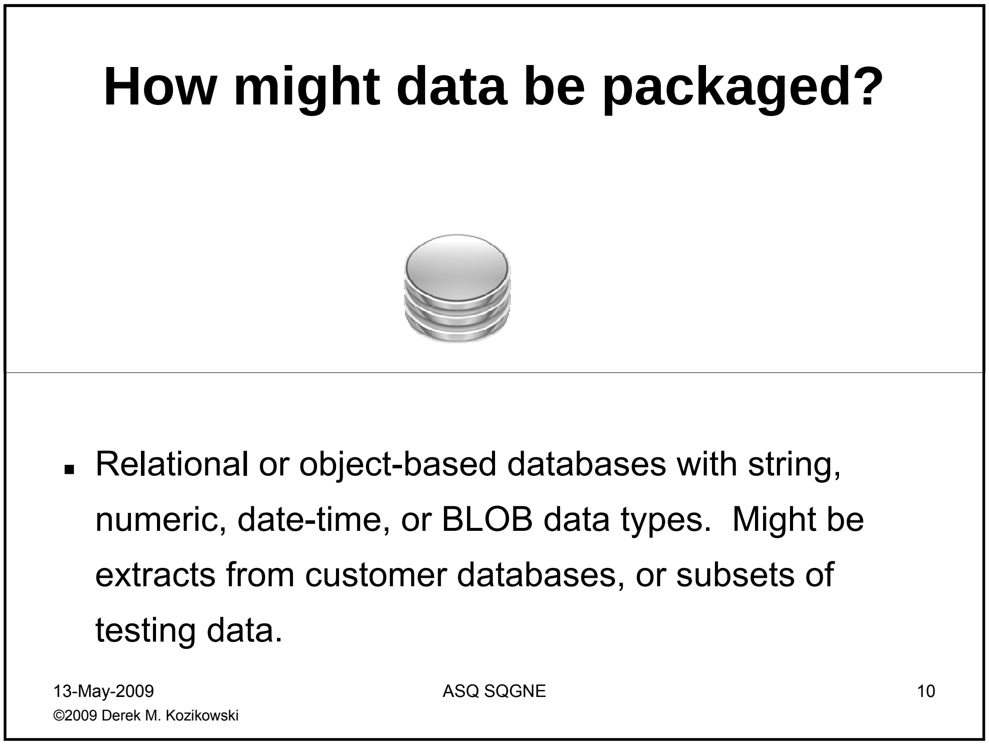
How might data be packaged?

- Binary Data Files (e.g. Executable, image, or archive files)



How might data be packaged?

- Streaming data through the computer's ports (e.g. Manual input through any human interface, game controllers, other devices)



How might data be packaged?

- Relational or object-based databases with string, numeric, date-time, or BLOB data types. Might be extracts from customer databases, or subsets of testing data.

Common Scenario – Text files

- Comma Separated Values (CSV) text file with data where each row is a test case

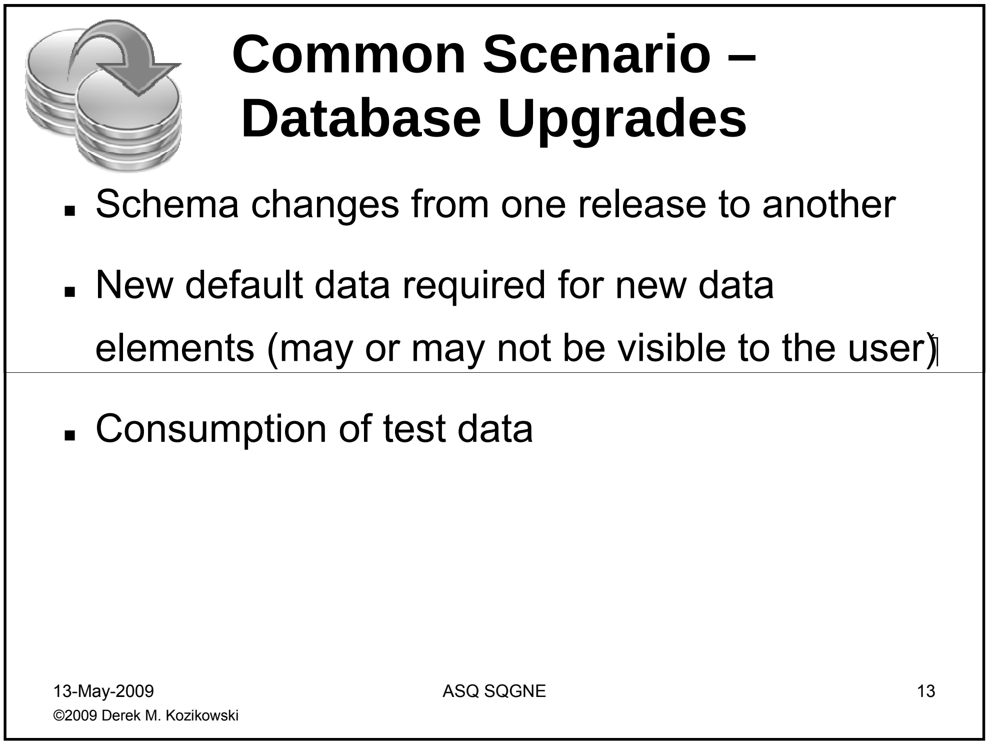
User	Password	ExpectedLogo
rtillerson	bigprofits	exxon.jpg
kdlewis	bigdebt	bankAmerica.jpg
cbartz	nomicrosoft	yahoo.jpg
llelsenhans	cash30pershare	sunoco.jpg

- Changes that might be tracked include adding new rows, removing old rows, editing existing rows

User	Password	ExpectedLogo
rtillerson	bigprofits	exxon.jpg
kdlewis	bigdebt	bankAmerica.jpg
cbartz	nomicrosoft	yahoo.jpg
~~llelsenhans~~	~~cash30pershare~~	~~sunoco.jpg~~
jmimmelt	wwdomain	ge.jpg

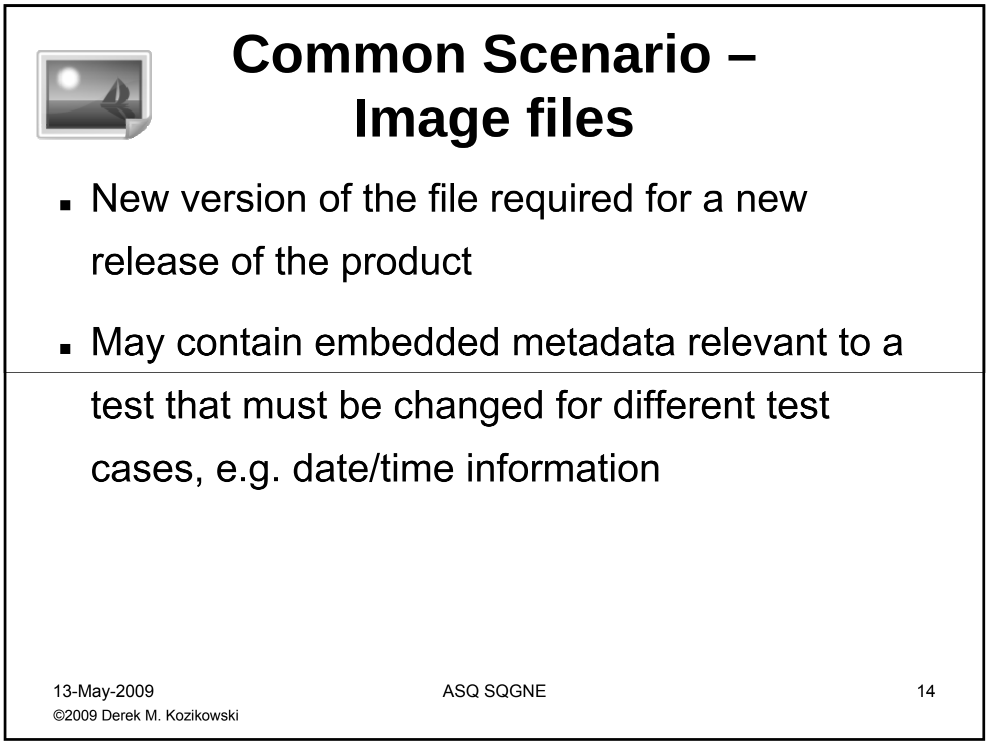
Common Scenario – Shared Data

- System configuration setup required by multiple test cases
- Input data used as part of the same script/instructions by multiple test cases
- Changes required by one test script may adversely affect another test script



Common Scenario – Database Upgrades

- Schema changes from one release to another
- New default data required for new data elements (may or may not be visible to the user)
- Consumption of test data



Common Scenario – Image files

- New version of the file required for a new release of the product
- May contain embedded metadata relevant to a test that must be changed for different test cases, e.g. date/time information

Common Scenario – Streaming Data

- Testing Devices or a Service
- Could effectively be generated in advance or in real time
- Sometimes sample data stored for later replay
- Stored data editable to match requirements for test cases

Common Scenario – Localized Data

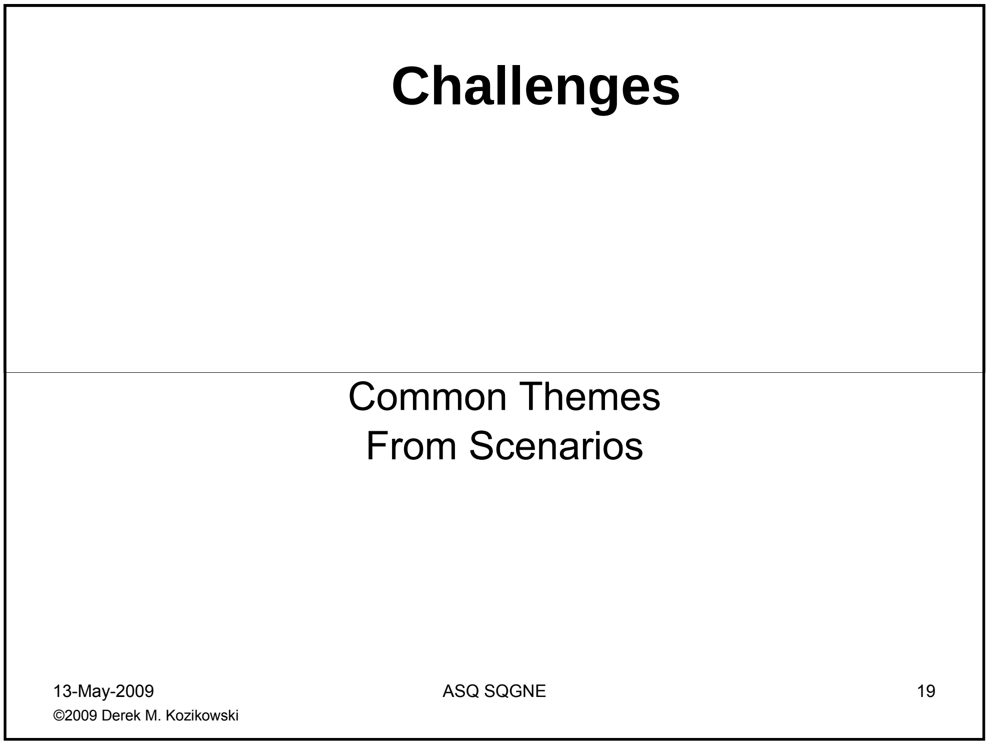
- Need to run the same script using different languages = different text and numeric input
- Data packaging and storage must handle different character encodings

Common Scenario – Exploratory Testing

- Manual or online record of actions and input values
- Previous setup and configuration data
- System output (results, transactions, logs, etc)

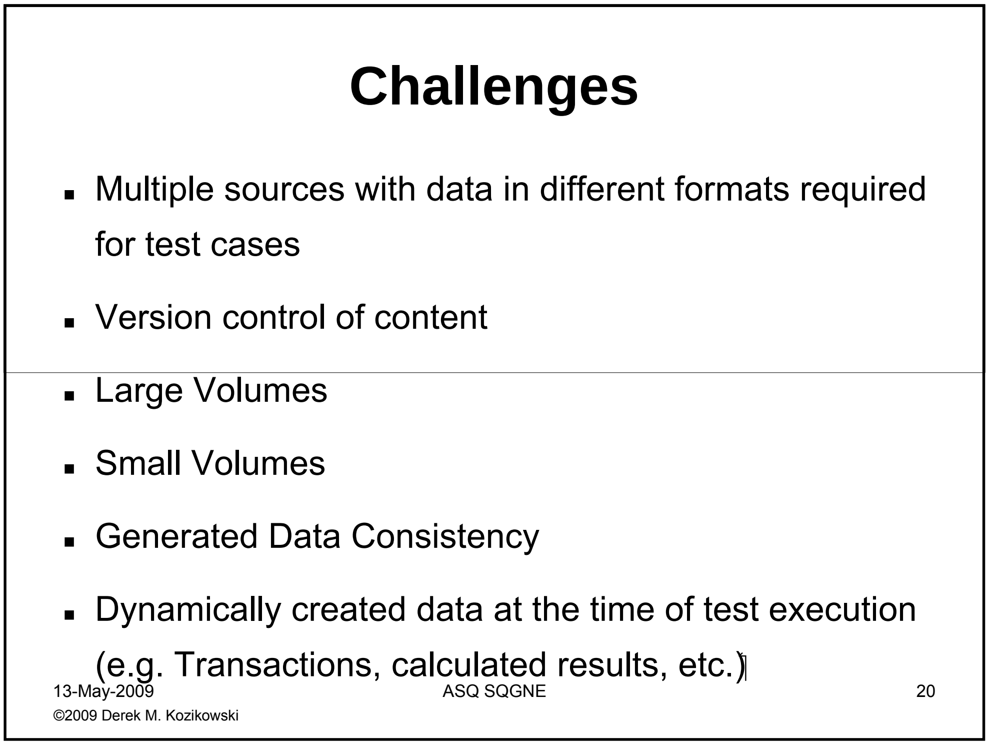
Common Scenario – Business Rule Changes

- Steps for some actions might change
- Additional (or less) test data required for existing test cases
- Additional data required as expected results
- New data required for new test cases



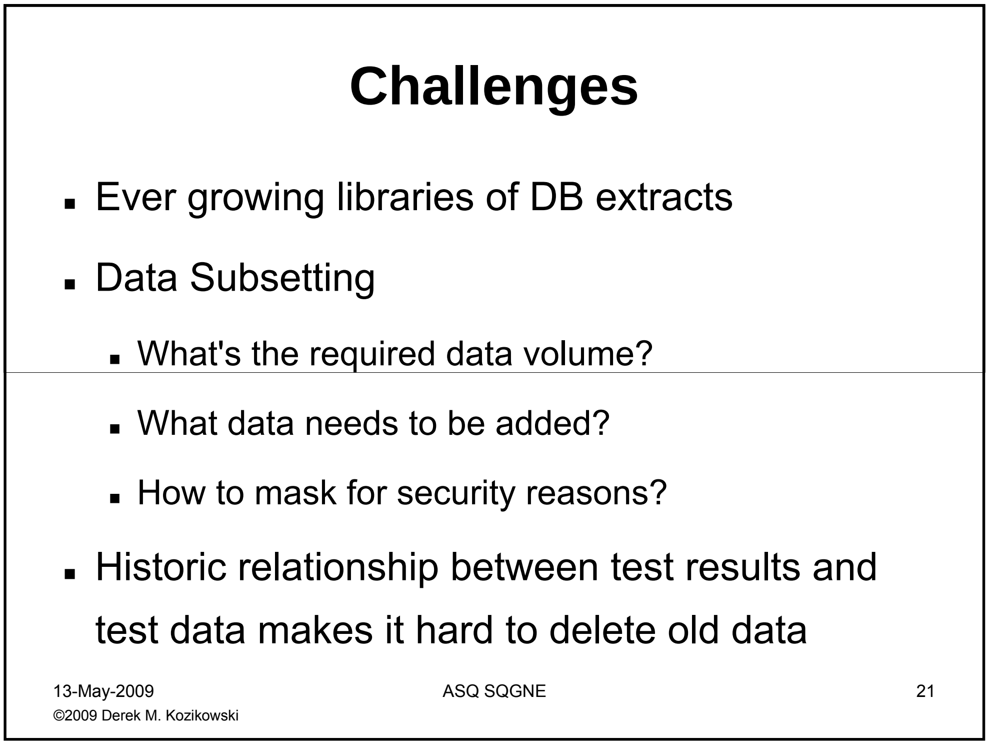
Challenges

Common Themes
From Scenarios



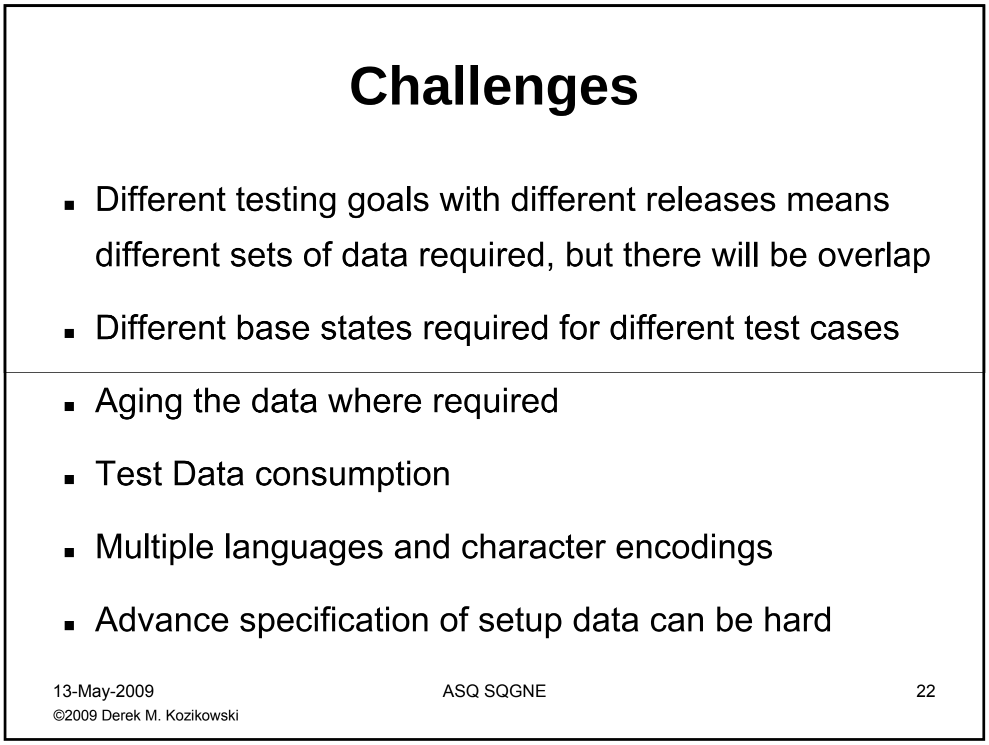
Challenges

- Multiple sources with data in different formats required for test cases
- Version control of content
- Large Volumes
- Small Volumes
- Generated Data Consistency
- Dynamically created data at the time of test execution (e.g. Transactions, calculated results, etc.)



Challenges

- Ever growing libraries of DB extracts
- Data Subsetting
  - What's the required data volume?
  - What data needs to be added?
  - How to mask for security reasons?
- Historic relationship between test results and test data makes it hard to delete old data



Challenges

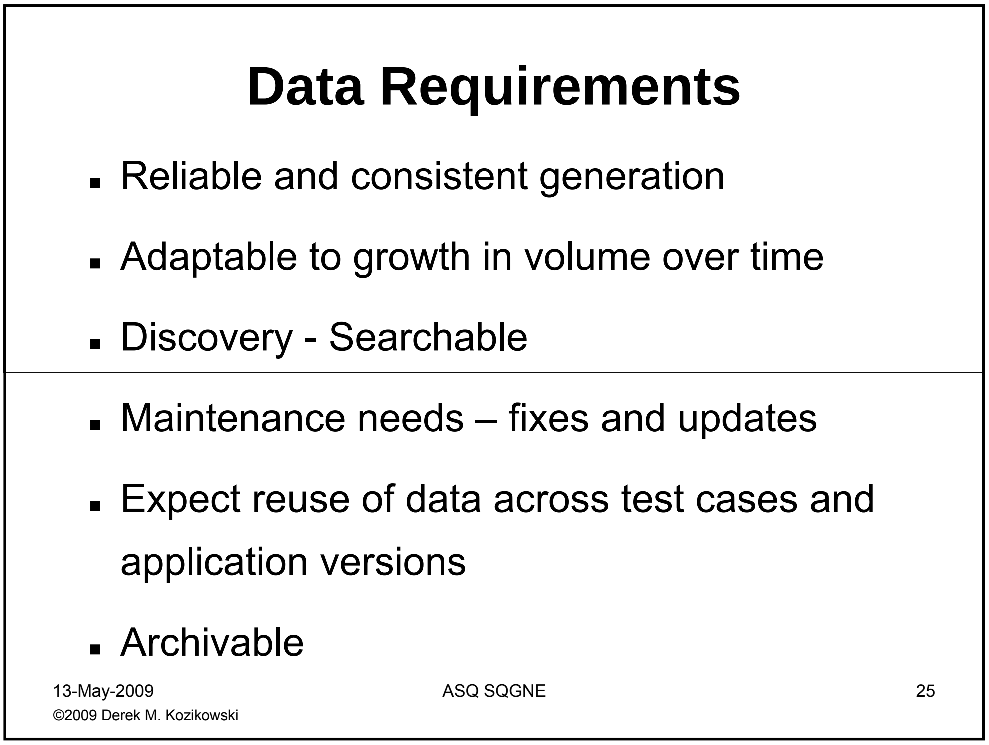
- Different testing goals with different releases means different sets of data required, but there will be overlap
- Different base states required for different test cases
- Aging the data where required
- Test Data consumption
- Multiple languages and character encodings
- Advance specification of setup data can be hard

Requirements

For Different
Solutions

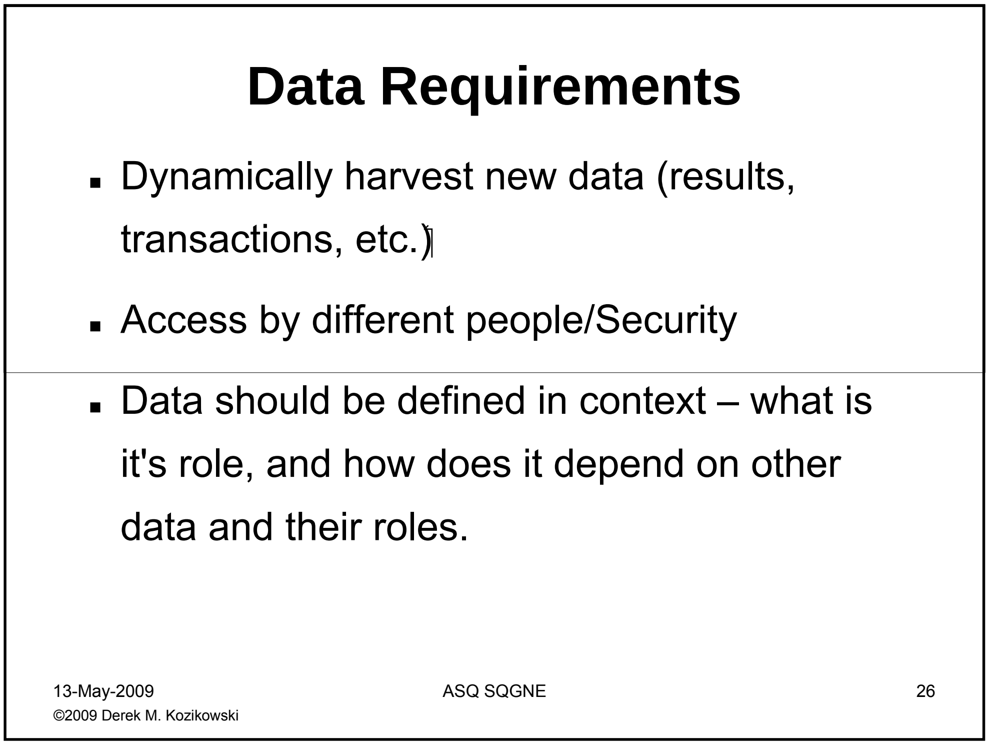
Data Requirements

- Configuration management support
  - Version control
  - History
- Provenance:
  - Where does it come from?
  - How has it been modified?
  - Where was it used?
- Package content, or metadata, is accessible



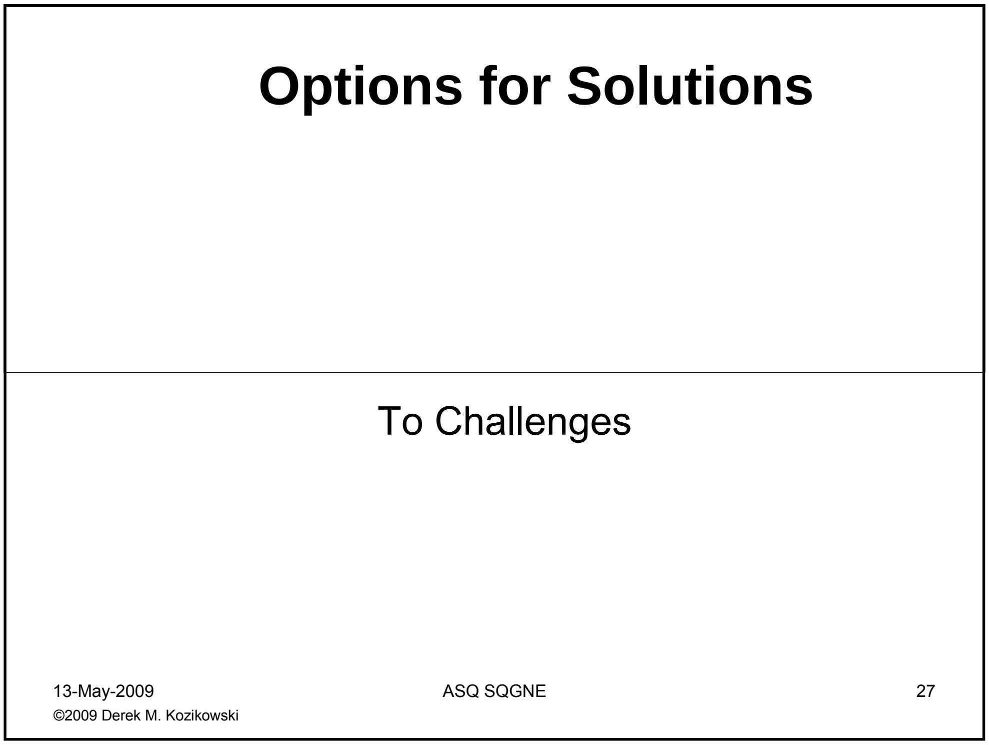
Data Requirements

- Reliable and consistent generation
- Adaptable to growth in volume over time
- Discovery - Searchable
- Maintenance needs – fixes and updates
- Expect reuse of data across test cases and application versions
- Archivable



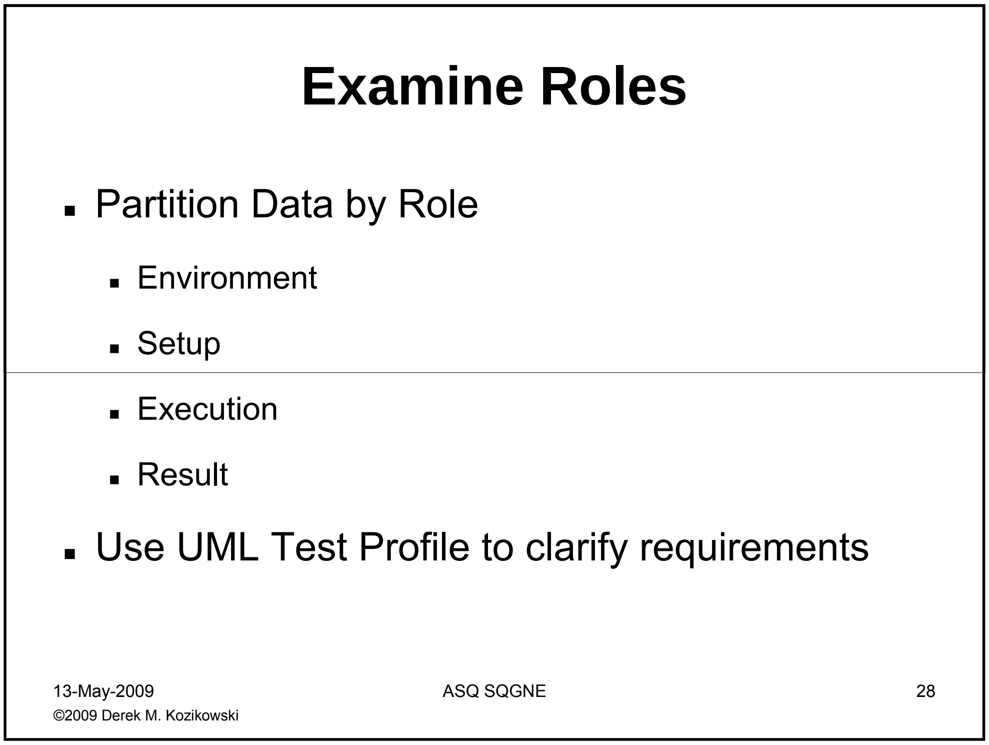
Data Requirements

- Dynamically harvest new data (results, transactions, etc.)
- Access by different people/Security
- Data should be defined in context – what is it's role, and how does it depend on other data and their roles.



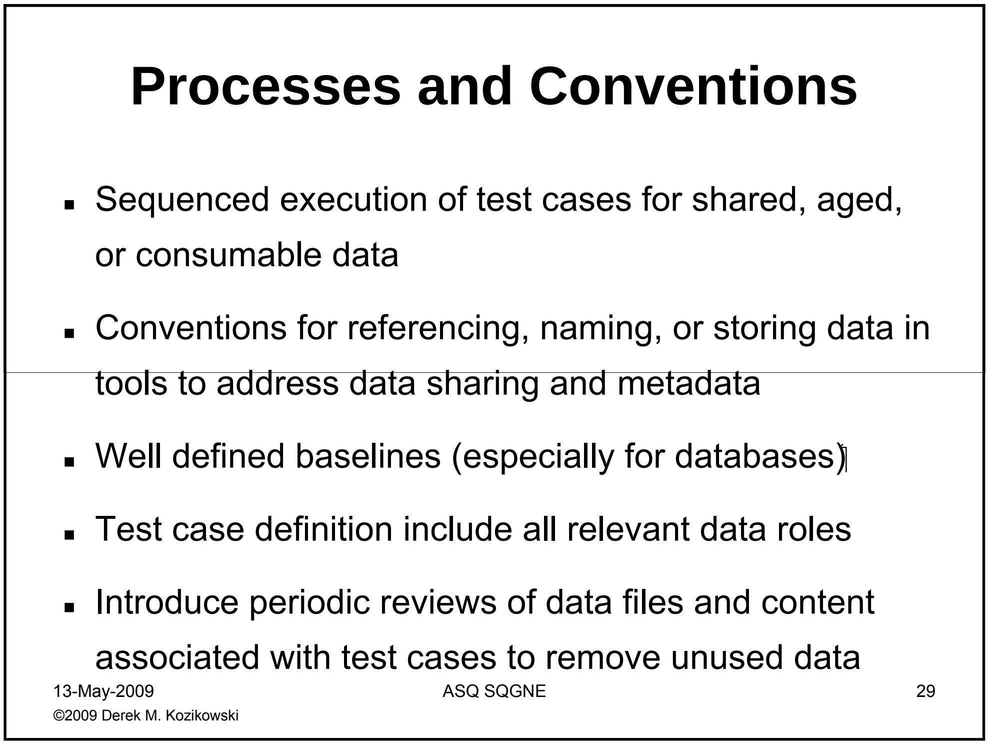
Options for Solutions

To Challenges



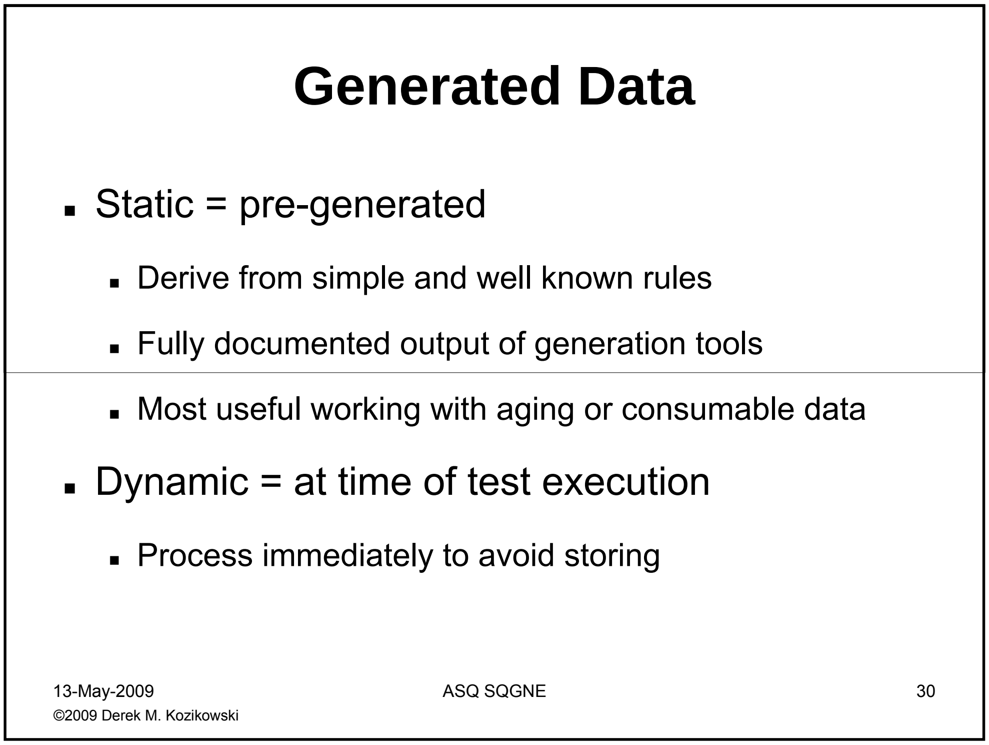
Examine Roles

- Partition Data by Role
  - Environment
  - Setup
  - Execution
  - Result
- Use UML Test Profile to clarify requirements



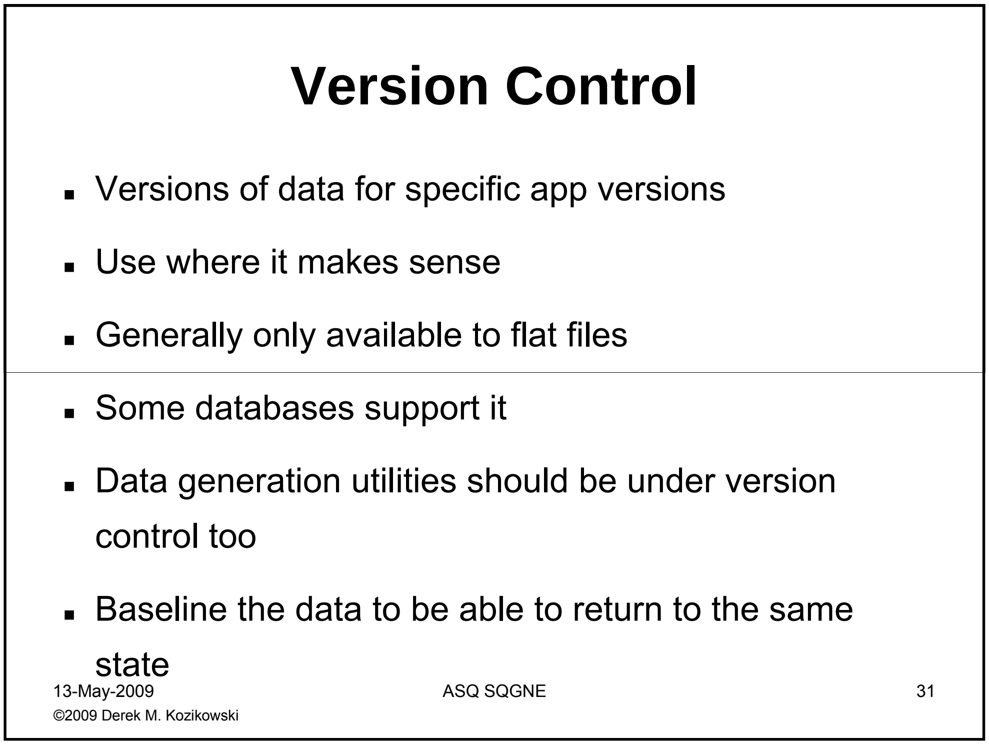
Processes and Conventions

- Sequenced execution of test cases for shared, aged, or consumable data
- Conventions for referencing, naming, or storing data in tools to address data sharing and metadata
- Well defined baselines (especially for databases)
- Test case definition include all relevant data roles
- Introduce periodic reviews of data files and content associated with test cases to remove unused data



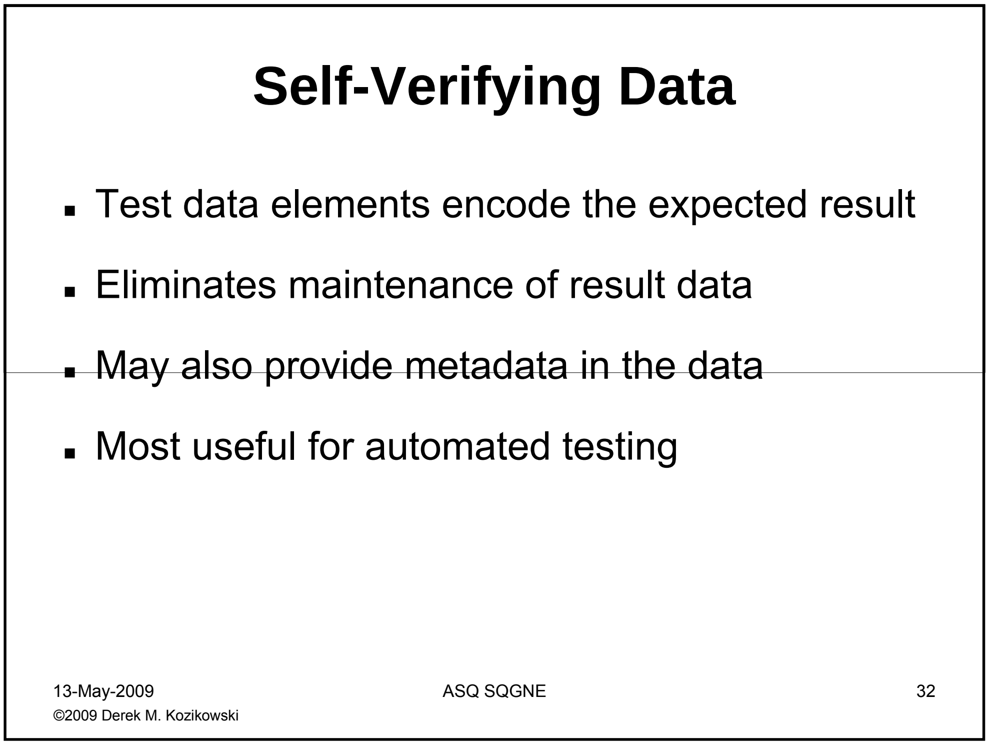
Generated Data

- Static = pre-generated
  - Derive from simple and well known rules
  - Fully documented output of generation tools
  - Most useful working with aging or consumable data
- Dynamic = at time of test execution
  - Process immediately to avoid storing



Version Control

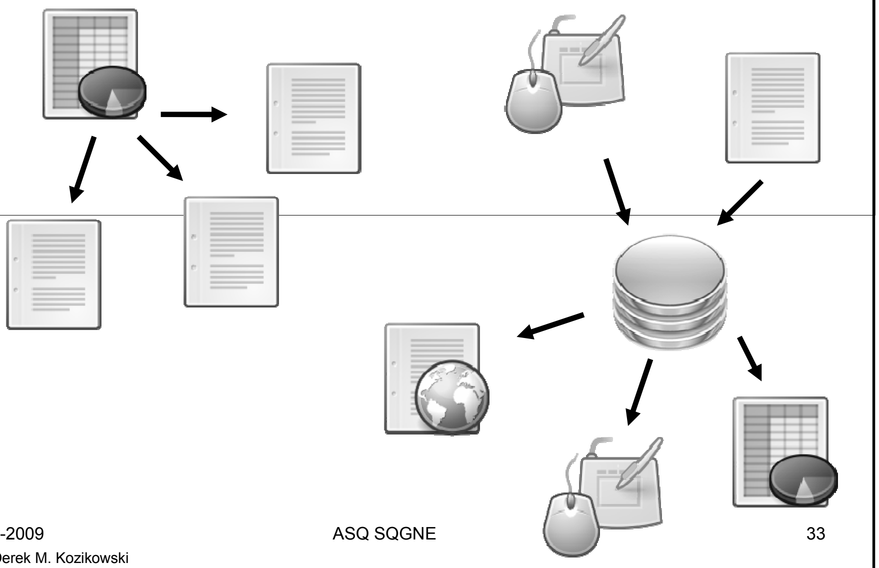
- Versions of data for specific app versions
- Use where it makes sense
- Generally only available to flat files
- Some databases support it
- Data generation utilities should be under version control too
- Baseline the data to be able to return to the same state



Self-Verifying Data

- Test data elements encode the expected result
- Eliminates maintenance of result data
- May also provide metadata in the data
- Most useful for automated testing

Change the Packaging



Tools

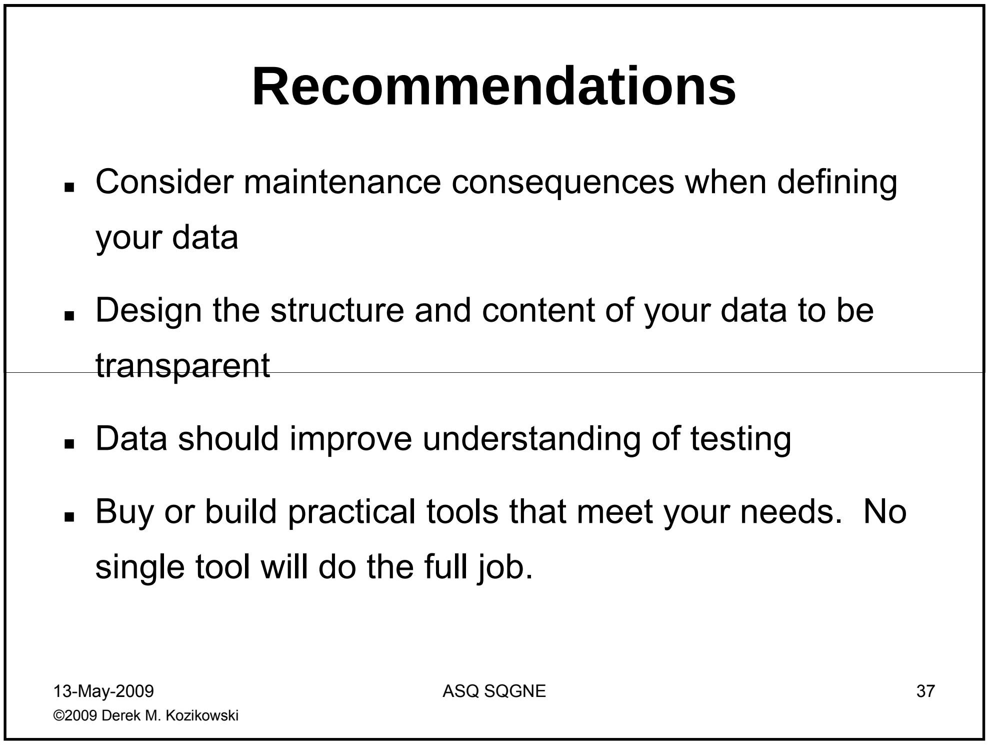
- Data Management or Digital Asset Management
- Something with API that allows integration with test automation and test case management tool.
- Home-grown lists or folder structures
- May need multiple tools with diversity of data packaging or requirements.

Future

- Grid or Cloud Computing
- GrayWulf – clustered architecture for data intensive computing
- Your Own Data Warehouse

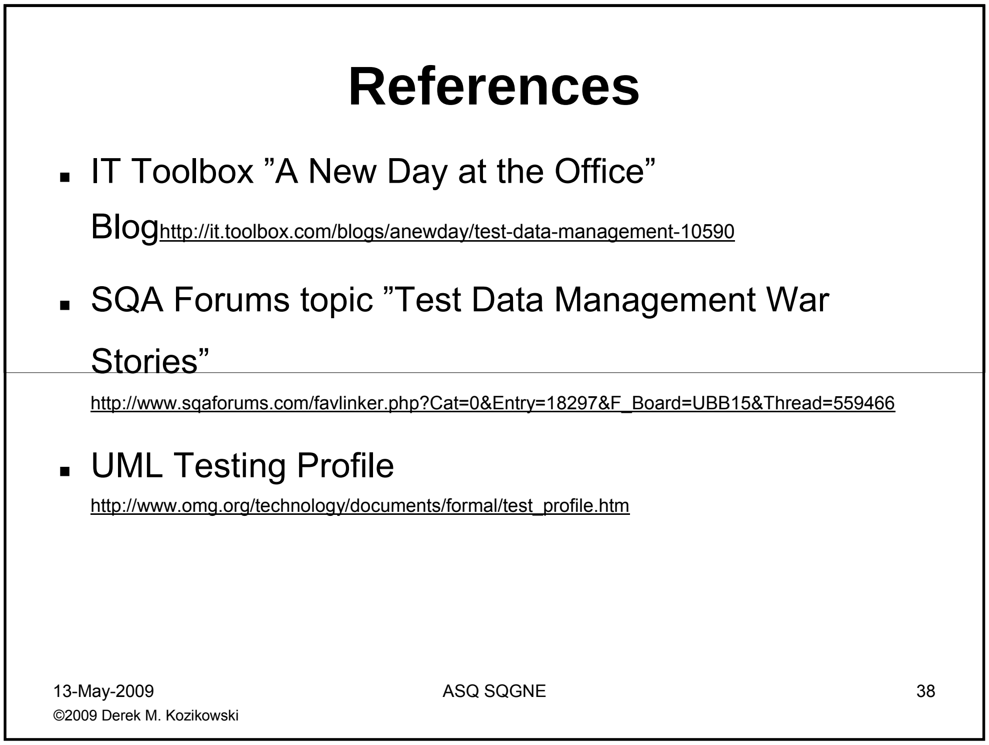
Summary Recommendations

- There is no one ”right way” to meet the diversity of data management needs
- Careful analysis of needs – do you really need to manage it?
- Review options
- Adopt a composite, or hybrid approach, blending techniques that fit your organization's needs



Recommendations

- Consider maintenance consequences when defining your data
- Design the structure and content of your data to be transparent
- Data should improve understanding of testing
- Buy or build practical tools that meet your needs. No single tool will do the full job.



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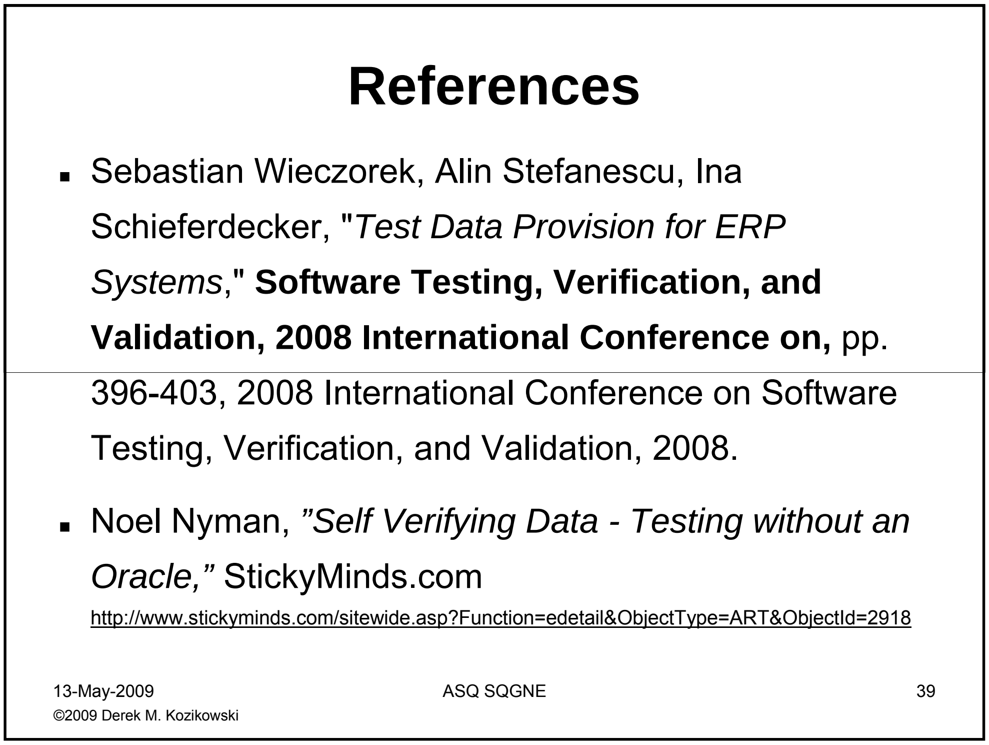

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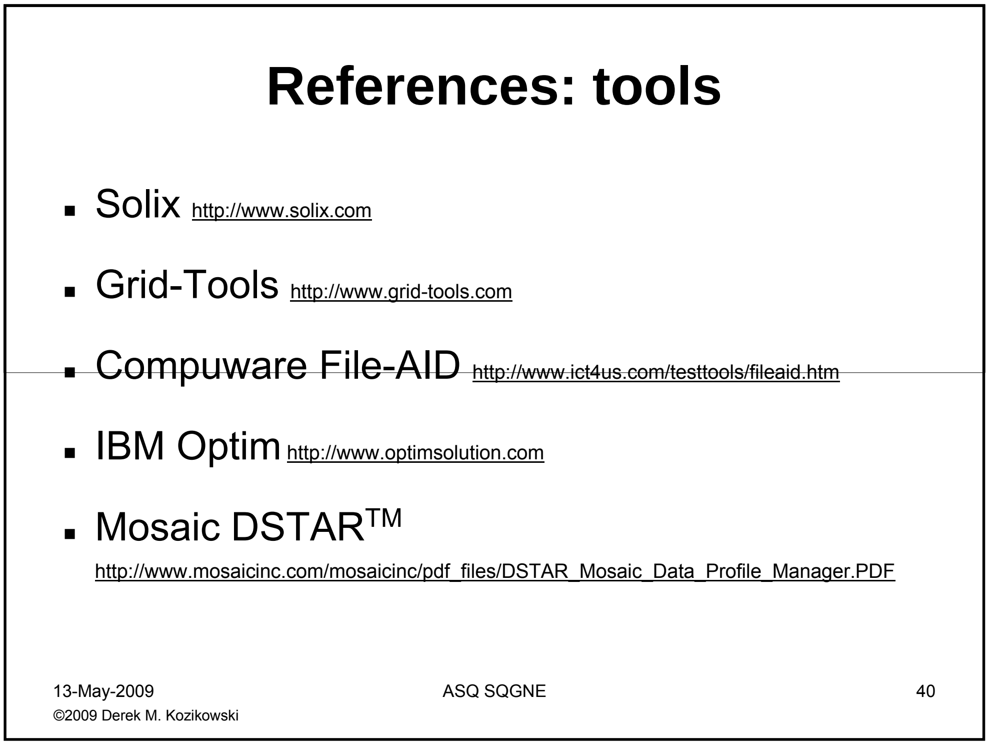

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Speaker	Affiliation	Date	Topic
1. Lou Cohen	**None**	**9/10/08**	**Introduction to using Quality Function Deployment on Software Projects**
2. Brian LeSuer	**Star Quality**	**10/8/08**	**A Survey of Test Automation Projects**
3. Howie Dow and Steve Rakitin	**None**	**11/12/08**	**Estimating using Wideband Delphi Method - An interactive exercise**
4. Russ Ohanian	**Tizor Systems**	**12/10/08**	**Integrating Agile into the Development Process**
5. Johanna Rothman	**Rothman & Assoc.**	**1/14/09**	**Schedule Games**
6. Carol Perletz	**None**	**2/11/09**	**The Nitty Gritty of QA Project Management**
7. Robin Goldsmith	**GoPro Management**	**3/11/09**	**Testing the Untestable**
8. Paco Hope	**Cigital Networks**	**4/8/09**	**Automating security testing of web apps using cURL and Perl**
9. Derek Kozikowski	**None**	**5/13/09**	**Automated Functional Test Design**
10. Stan Wrobel	CSC	6/10/09	Test Tool - Make or Buy?
11. Everyone		7/9/09	Annual Hot Topics Night…

Tonight's Speaker...

Test Data Management Challenges and Solutions
Derek Kozikowski

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Bio:

Derek is a Principal Software Quality Engineer with SAP, in Cambridge, MA, and holds an ASQ CSQE certification. He has 20 years experience in the software quality field working with real time systems, operating systems, image processing systems, and most recently enterprise web applications.

Working in large, medium, and small companies, Derek has introduced software development process improvements, developed automated and manual testing strategies and frameworks, written and executed far too many test cases to count, and implemented various tools that help to make software testing just a little bit easier.