Case Study:
Big Lots Store Inventory Management

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Information Technology

Big Lots
Columbus, Ohio
Agenda

- Introduction to Big Lots
- Project Overview
- Application Demo
- Technology Choices
- Technical Patterns
- Conclusions
Company Overview

- Fortune 500 retailer founded in 1967
- ~1350 stores across the U.S.
- Closeout deals
Case Study Project

- Store technology refresh initiative – “MARS”
  - Year 1 – point-of-sale hardware/software
  - Year 2 – inventory management software
    - Inventory Counts
    - Transfers
    - Item Inquiry
    - Inventory Adjustments
    - Trailer Reconciliation
    - Vendor Receiving and Returns
Project Constraints

- Tight deadlines driven by business needs
- User technology maturity
- Substantial bandwidth limitations from central office to the stores
- Need for “offline” support – store must function even if disconnected from corporate headquarters ("central office")
Applications Demo

Alerts

<table>
<thead>
<tr>
<th>Description</th>
<th>Start Date/Time</th>
<th>End Date/Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welcome to JBoss World 2008</td>
<td>01/13/2008 12:00 PM</td>
<td>02/15/2008 03:00 PM</td>
</tr>
<tr>
<td>Phone donations welcome :)</td>
<td>01/13/2008 12:00 PM</td>
<td>02/15/2008 03:00 PM</td>
</tr>
</tbody>
</table>

Open To Do Items

<table>
<thead>
<tr>
<th>Status</th>
<th>Date</th>
<th>Type</th>
<th>Description</th>
<th>Last Updated</th>
<th>Updated By</th>
</tr>
</thead>
<tbody>
<tr>
<td>incoming</td>
<td>12/11/2007</td>
<td>Vendor Receiving</td>
<td>UNITED SLEEP PROD</td>
<td></td>
<td></td>
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<tr>
<td>incoming</td>
<td>12/11/2007</td>
<td>Vendor Receiving</td>
<td>SOUTHERN HOME TEXTILES</td>
<td></td>
<td></td>
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<tr>
<td>incoming</td>
<td>12/11/2007</td>
<td>Vendor Receiving</td>
<td>SERTA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Technical Choices

- Open Source
  - Flexibility
  - Transparency
  - Community support
  - Big Lots contribution – SymmetricDS.org

- JBoss (4.0.4)
  - Stability
  - Industry leading
  - Java5
  - Customizable stack
Technical Choices: Web Stack

- EJB3 (RC7) / JPA (1.0)
  - Industry standard
  - Java 5
  - POJO

- JSF (1.2 RI)
  - Industry standard
  - Componentized

- Facelets (1.1.12)
  - !JSP
  - Easily viewable
  - Templating

- JBoss Seam (1.2)
  - Bridges gap between EJB3 and JSF
  - State management
  - Security
  - Integrates with almost everything

- Ajax4JSF (1.1.1) / RichFaces (3.0.1)
  - Rich user experience
  - Integration with Seam/JSF
Application Architecture - FASE

- Facelet
- Action (POJO)
- Service (EJB / JPA)
- Entity (POJO)
Technical Patterns Overview

- Infrastructure
- Devices
- Usability
- User Technology Maturity
Patterns: Infrastructure

How do we make authorization rules so simple even a manager can do it?

- Use JAAS
- Seam Security supports EL \((s:\text{hasRole}, s:\text{hasPermission})\)
  - Views
  - Components
  - Config files
- Content Organization
  - Split between protected/unprotected
  - Divided by domain
  - Matching view-id pattern simplified
Patterns: Infrastructure

How do we consistently implement Conversations?

- Transactional pages
  - @Begin
  - @End
  - FlushModeType.MANUAL

- Cleanup on abandonment?
  - @Stateful EJB3 - @Destroy inconsistently invoked
  - @Destroy needs to reinitialize @In’s for EJBs & POJOs

- Be aware of:
  - Lifecycle of @Injected components
  - Conversation timeouts / synchronous requests
Patterns: Devices

How do we support a touch screen monitor?

- Maximize click areas
  - Links styled like buttons
  - Table cells/rows clickable with custom \texttt{dataTable} widget
- Font size and negative space reduces fat fingering
- \textbf{Scrollable \texttt{modalPanel} and \texttt{dataTable}}
Patterns: Devices

How do we support a handheld device with limited resources and no keyboard or mouse?

- Screen flow designed for
  - Stylus
  - Number pad
- Maximize use of JSF components, Minimize use of JavaScript
- Limit page size & number of components
- Extends .Net WebBrowser component
  - Maximizes screen size
  - Eliminates multiple clicks
  - Activates Barcode Scanner
Patterns: Devices

How do we deal with (very) large search results?

- Push “paging” to Service to limit resource usage
- Extend `java.util.List` and provide accessors to start index, page size and total record count.
- Use start index and page size to move the “cursor”
- Custom ` dataTable` and ` dataPager` implementation
Patterns: Devices

How do we handle browser specific CSS or JavaScript?

- Separate files for browser specific behavior, styles
  - Dynamically loaded using JSF Function
  - `UserAgent` identifies browser
- Browser support is now modular
- Browser specific JavaScript is `@private` (e.g., `_myFunc()`)
Patterns Example: Item Inquiry Demo

<table>
<thead>
<tr>
<th>Item #</th>
<th>UPC/EAN</th>
<th>Description</th>
<th>Department</th>
<th>Mfg. Part #</th>
<th>Vendor</th>
<th>Perm Price</th>
<th>Temp Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>550009237</td>
<td>N/A</td>
<td>MP3 150MB TUNER</td>
<td>550 ELECTR</td>
<td>R60120</td>
<td>THOMSON C...</td>
<td>49.99</td>
<td></td>
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<tr>
<td>310004830</td>
<td>N/A</td>
<td>ESSESS/CAFF MAKER PU</td>
<td>310 APPLA</td>
<td>ECFMP38</td>
<td>SUNBEAM CORP</td>
<td>39.99</td>
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<tr>
<td>550009503</td>
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<td>550 ELECTR</td>
<td>MF68490</td>
<td>HOFER /...</td>
<td>29.99</td>
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<td>550009644</td>
<td>N/A</td>
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<td>C17H1349</td>
<td>ATICO INT...</td>
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<td></td>
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<td>29.99</td>
<td></td>
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<tr>
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<td>550 ELECTR</td>
<td>MP3639</td>
<td>HOFER /...</td>
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<tr>
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<td>POWER INVERTER 360 WATT</td>
<td>220 AUTO...</td>
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<td>MP3223</td>
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<tr>
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<td>550 ELECTR</td>
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<td>550 ELECTR</td>
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<td>550 ELECTR</td>
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<td>550009916</td>
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<tr>
<td>550010427</td>
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<td>550 ELECTR</td>
<td>97554</td>
<td>JASCO</td>
<td>4.99</td>
<td></td>
</tr>
</tbody>
</table>
Patterns: Usability

How do we provide user and developer friendly validation?

- Use Hibernate Validator annotations on Entities as well as Actions and supplement with inline business logic
- Extend Seam UIDecorate
  - Intercept `processDecodes()`, `processUpdates()`, `processValidators()`
  - Label attribute exposed for use in error messages
- Use Ajax4JSF to re-render
  - Labels
  - Messages
  - Styled input components
Patterns: Usability

How do we incorporate exception handling in a web application?

- Common exceptions handled in `pages.xml`
- Expected runtime exceptions handled in common Actions
- Unexpected exceptions handled in `error-page` servlet
  - JSF lifecycle invalid as soon as exception propagated from Java code
  - Captures error data
  - Redirect to JSF error page
Patterns: Usability

How do we work around time consuming operations?

- Render page quickly with available data
- Ajax4JSF poll kicks off time consuming operation
  - Fetched data merged by Actions and re-rendered
  - Refresh friendly
Patterns: Usability

How do we make an Autocomplete work like an HTML Select?

- Custom JSF component extends YUI Autocomplete
  - Accepts converters
    - Decouple the input value from the Entity key
  - Facets allow customization of Autocomplete
    - Headers
    - Footers
    - Labels
Patterns Example: Item Inquiry Demo

- Item #: 110029744
- Description: POTTED MEAT 3 OZ
- Mfg. Part #: 08594
- Combo: No
- Buyer: HALASZ, KAI
- Vendor: BIG LOTS #725930

UPC/EAN
N/A

Category Information
- Department: 110 FOOD
- Class: CANNED PRODUCTS
- Sub-class: MEAT
- Brand: LIBBY'S
- Size: 3 OZ
- Color: N/A

Permanent Pricing Details
- Permanent Price: 0.33
- Effective Date: 09072000
- Compare To: N/A

Temporary Pricing Details
- Temporary Price: N/A
- Effective Date: N/A
- End Date: N/A

Additional Item Details
- Item Discount: Yes
- Employee Discount: Yes
- Store Count: No
- Inactive Item: No

Item Availability
- Search Districts
- Store: orlando
- On Hand: 82
- In-Transit: 0
- Backorder: 0

Select a store name/number
- 03524 - ORLANDO, FL (EAST)
- 03954 - US COLD STORAGE
- 01481 - ORLANDO, FL
- 01678 - ORLANDO, FL
- 01973 - SANFORD, FL

5 results
Patterns: Users

How do we forgive a clickaholic / typeaholic?

- Act on most recent event, ignoring all unprocessed priors
- **Ajax4JSF** `eventQueue` & `requestDelay` almost, but not quite
- Custom `eventQueue` widget
  - Only handles last event
  - Events before delay are discarded
- Prevents
  - Multiple clicks
  - Simultaneous events on different widgets
Patterns: Users

How do we forgive transaction abandonment?

- 1\textsuperscript{st} JSF component attaches \texttt{window.onbeforeunload} event
- 2\textsuperscript{nd} JSF support component ignores \texttt{window.onbeforeunload} (e.g., Save, Next buttons)
- Traps
  - Window closing
  - Cancel buttons
  - Unintended Actions
Patterns: Users

How do we deal with confusing multi-window operation?

- `window.open()` problematic on touch screen
- RichFaces `modalPanel`
  - inline PDFs
  - wizards
- Page flow designed to be deterministic
Wrap Up

- Successfully developed and deployed store inventory management applications
  - Currently used in 860+ stores nationwide
  - Full deployment expected during 2008

- Web development is challenging, but the right technology choices can ease the pain
For further information …

Links

- www.biglots.com
- www.symmetricds.org
- labs.jboss.com/jbosssseam

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