Are you sitting comfortably?

- This a story about:
  - 2 engineers
  - 3 big(ish) projects (so far)
  - inclusive, practical systems engineering
  - and a few mistakes.
A Little Background About Us

- **Jon**
  - Industrial IT, CCTV and Manufacturing Control Engineer (PLCs/SCADA/Software)
  - MetalBox Sponsored
  - Dabbled with UML
  - BEng Electronics
  - PhD in Fault Tolerant Flight Control Systems

- **Mark**
  - Railway Signalling Engineer (Electronic Signalling and Train Control Systems)
  - BR Sponsored Student
  - Dabbled with modelling tools
  - BEng Electrical & Electronic

- Shared view that all engineering is about making things (systems) work in practice.

JNUP Control Centre Communications Project

- New Control Centre for Jubilee and Northern Lines (Tube Lines Ltd)
- Alcatel moving block signalling system
- URS for Communications Systems
  - Telephony (SPT, Auto, Tunnel Telephone)
  - CIS, CCTV, PA
  - BBMS, SimLink.
Concept Design
Morass of Requirements → Solution Architecture & Structured Realistic Specifications
 Identified key Document ☺

Question? How do we capture the requirements from the key documents we have identified?

We looked at what real engineers do with important documents.
Triage & Tagging

320 Source Documents

iProNET Atkins Collaborative Working Tool

Tag Register

<table>
<thead>
<tr>
<th>Doc ID</th>
<th>Tag Ref</th>
<th>Tag Description</th>
<th>Type</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>123</td>
<td>&lt;5&gt;12.1-p2 2</td>
<td>To move people</td>
<td>Business</td>
<td>Green</td>
</tr>
<tr>
<td>23</td>
<td>&lt;5&gt;12.3-p3</td>
<td>Trains with doors</td>
<td>System</td>
<td>Yellow</td>
</tr>
<tr>
<td>25</td>
<td>&lt;5&gt;13</td>
<td>Train 1008</td>
<td>Process</td>
<td>Red</td>
</tr>
</tbody>
</table>

We turn document annotations into Requirement Tags.

We link from tags to output to demonstrate assurance.

JNUP SCC Comms Project

Mobilisation

Option Development and Evaluation

Initial Design Review

Engineering

Final Design Review

Completion

Timescale was 4 months
• What was good?
  – Design was good and we met timescales
  – Assurance Case was made

• What was not?
  – Unnecessary data collected – tagged too quick
  – Linked directly from Output Specifications to Tags
  – Design by Spreadsheet.

Summary of JNUP

Then came VLU SCC

• New Service Control Centre for the Victoria Line (Metronet)
• New Bombardier Rolling Stock/Westinghouse Distance-to-Go signalling system
• Scope was everything inside the boundary fence, including the building.
  – Including integrating with those systems that were “given” – i.e. the Signalling and Radio Systems
• No URS – just LU Operational Concept.
VLU SCC Project

Mobilisation

Requirements Engineering

Initial Design Review

Option Development and Evaluation

Final Design Review

Completion

Timescale was 8 months

VLU SCC Project Lifecycle Stage

Concept Design

Morass of Requirements → Solution Architecture & Structured Realistic Specifications
Tag 1 (from a standard): Communications shall be provided (audio and data) from all Train Control Centres to other Control Centres, and with emergency services and trains. Such communications shall also be recorded.

Tag 2 (from client contract): All incoming and outgoing telephone calls are recorded and the recording tapes are retained.

Tag 3 (from User Requirement document): Recording method must provide safe, secure protection for the recorded data with no ability to modify, delete, edit the material except under formal authorised methods.

Tag 4 (from User Requirement document): For post incident review and operational training purposes, all communications in and out of the Control Centre shall be recorded and the ability for selective playback provided. Conversation within the Control Room shall also be recorded.

Assumption: It is assumed that recorded material will be retained for a minimum of 28 days.
“All voice/audio messages received shall be recorded by the audio recording service.”

“All auto telephone service calls into the Control Centre will be recorded by the audio recording service.”

“All conversations within the control room of the Control Centre shall be recorded via a system of microphones.”

“Recorded material shall be stored for a minimum of 28 days.”

“The recording method must provide safe, secure protection for the recorded data.”

“The recording method must provide safe, secure protection for the recorded data.”

“Facilities are to be provided to record all communications in and out the Control Centre control room. This will include conversations within the control room.

Assumption: It is assumed that recorded material will be retained for a minimum of 28 days.

This leads to Fully Compliant Requirements for an audio recording system with interfaces to Auto Telephone system, which can provide the following facilities:
- selective playback
- authorised access only
- no modification, editing or deletion possible”
• What was good?
  – Metrics
  – Design – but not yet through assurance

• What was not?
  – Building not followed the process
  – Missed the significance of no URS.
    • Took too long to realise that the Ops Con was key
  – Arguments inconsistent

• Design a Airport Baggage SCADA System
• Biggest Baggage SCADA Atkins ever designed
  – Combines 8 existing systems
• Clear Client URS
• Output is a consolidated Functional Specification and design specifications from which the system may be built
Five key Triage Questions

- Does it contain **Business Requirements** *(viz. what the client wants the system to achieve)* that relate to the defined **scope** – Answer Yes/No?
- Does it contain **System Requirements** *(viz. what the system must actually do)* that relate to the defined **scope** and **lifecycle** phase – Answer Lots/Some/None?
- Does it contain **Process Requirements** *(viz. how the project team should deliver its remit)* that relate to the defined **scope** and **lifecycle** phase – Answer Lots/Some/None?
- Does it contain **Domain Knowledge** *(viz. relevant facts about the environment into which the system must integrate)* that relate to the defined **scope** and **lifecycle** phase – Answer Yes/No?
- Does it contain requirements or domain knowledge that relate to a later lifecycle phase – Answer Yes/No?

Timescale was 4 months
This example shows that the approach works for “Non-Rail” applications and different lifecycle stages.

- We clearly identified key architecture drivers and developed taxonomy quickly.
- Really good triage and tag data.
- Produced good and consistent assurance arguments first time.
  - Clearly understandable assurance case.

Key points to our Approach:

- Clear Information Model and Project Plan.
- Register and Triage all docs.
  - Ask a few key questions.
- Develop an outline design/architecture.
  - Based on the Business Requirements.
- Tag the requirements using a simple taxonomy, based on the architecture.
- Complete the necessary engineering.
- Complete assurance arguments to link to tags.
  - Follow strict template.
• What did we actually do
  – We did the basics – plan, managed information, communicate
  – We used triage and tags to get the whole team doing SE!
• Next?
  – CrossRail, Type A Re-signalling, ...

Questions?

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