

Development of a Just-in-Time Railway Maintenance Support Tool



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Aims and Objectives

“Developing an application based on JIT principles to streamline rail vehicle component maintenance procedures and increase the operational efficiency of its vehicles”

To meet this aim the objectives are as follows:

- Understand the **JIT manufacturing and procurement model**
- Explore issues of work scheduling and component procurement with a case study firm
- Build a prototype mobile **support / reference app**
- **Review the application** against usability frameworks
- Identify areas of improvement and future research

Just-in-Time

- Philosophy was **developed in Asia** to rival more successful Western firms.
- The model was **designed by Taiicho Ohno to eliminate wasteful practice** in order to be more competitive.
- The **types of waste could be categorised** into different production traits [1]:
 - Excessive Inventory
 - Over-processing (and over-production)
 - Unnecessary Wait
 - Defect Goods
- The end point of philosophy wasn't a given level of efficiency, rather 'Kaizen'; a mindset of continual improvement [2].
- Tools to increase efficiency have been applied to other industries.

Design and Implementation

- **Feature-Driven Development (FDD)** was selected because it prioritises feature development and its values are comparable to those of JIT.
- The developer undertook site visits to the software customer to understand their current work practices and future software needs.
- The requirement gathering provided system features and user profiles categorised against the MoSCoW framework.
- An initial set of interface 'wireframes' were developed before an SQL database was designed and developed in Management Studio/Azure Data Studio.
- **'Appenate', a lightweight form-centric builder for mobile**, was selected to allow a user to view, edit and delete order and work entries in the schedule.

Mobile Usability and UX

- The study of **usability aims to evaluate the success of system-user interactions** with a software application in its target environment.
- The Morville honeycomb is a rounded model that considers usability one of six software traits. Successful evaluation of the applicable components offers a “valuable” product [3].
- Usability forms part of the wider User Experience (UX) field with ISO FDIS 9241-210 considering UX an extension of usability [4].
- **Context is an important factor in this project.** This is made up of an individual's perception of previous systems, their motivations and the anticipation of a new system.

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Prototype Development

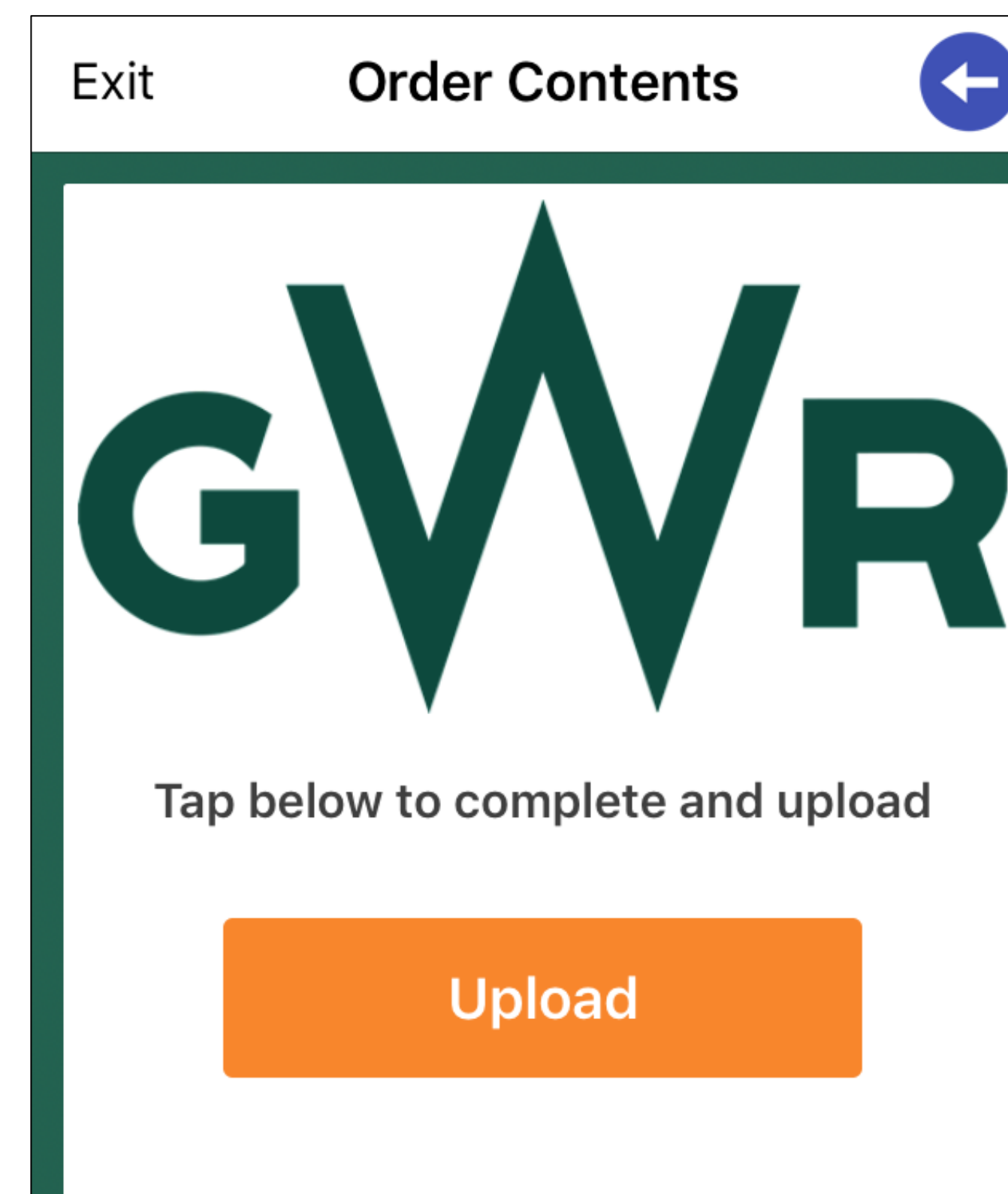
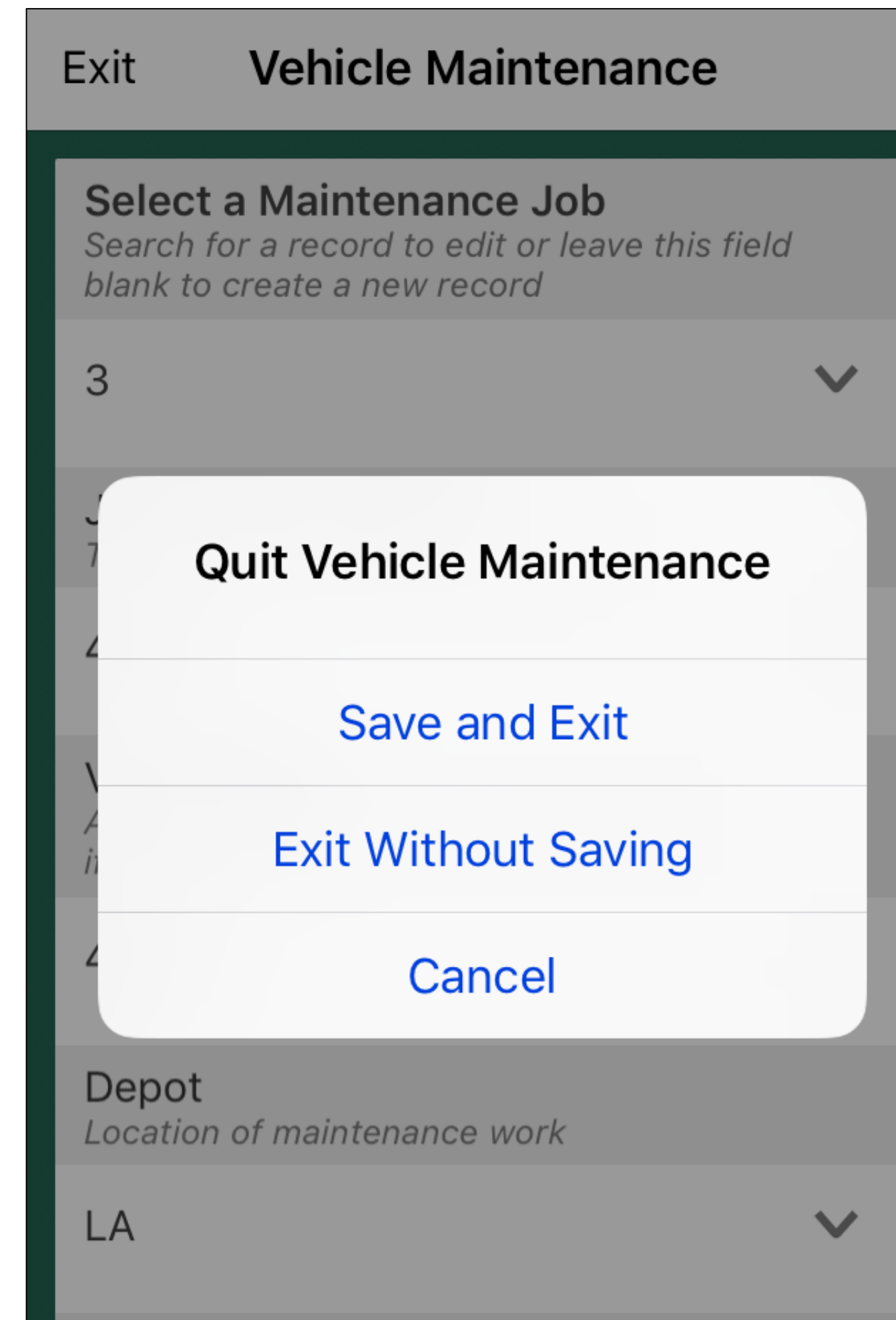
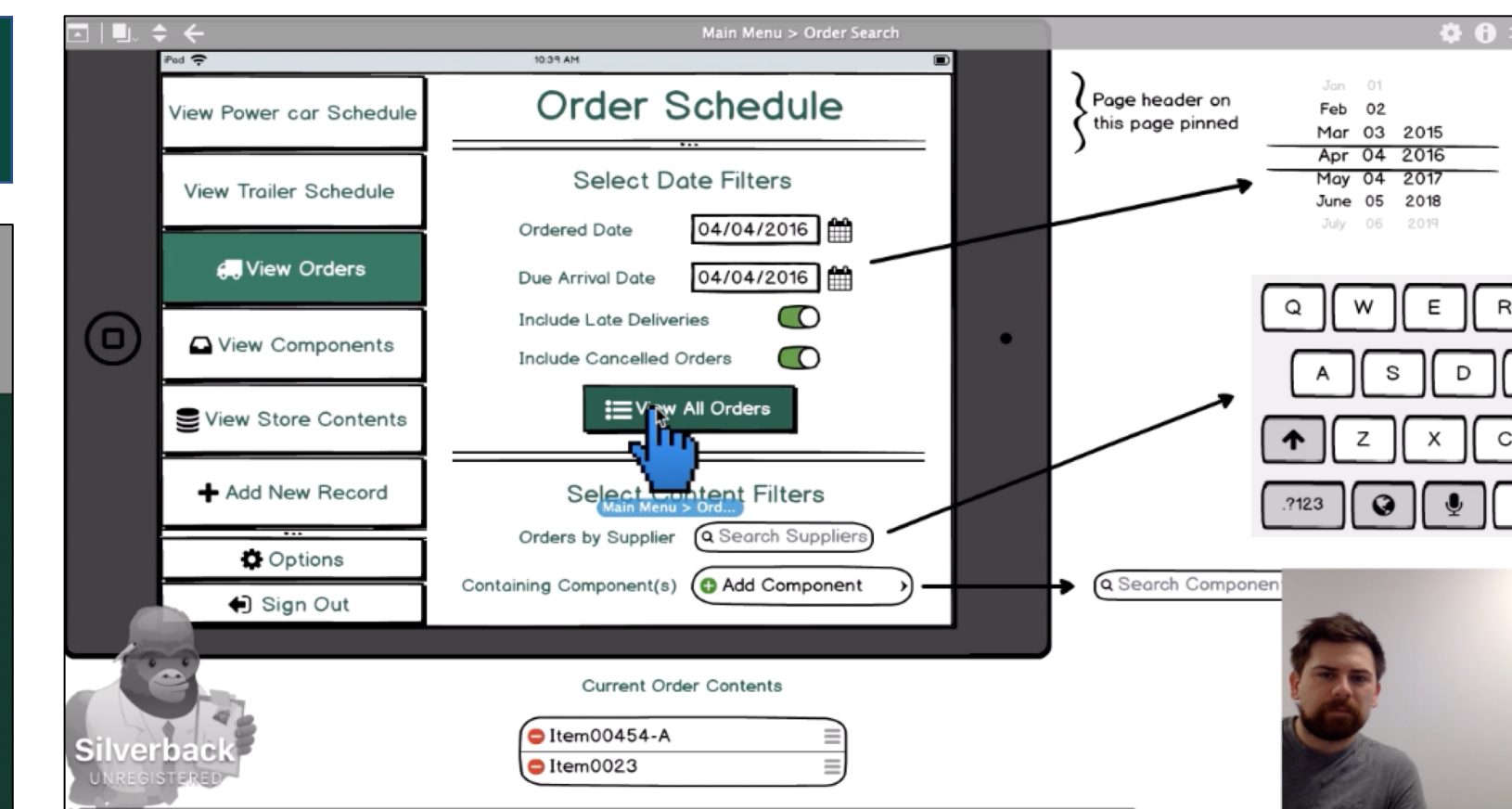


Fig. 1 (top left): Saving an edited order or work job within the app **Fig. 2 (top right)** Usability testing interview process. **Fig. 3 (above):** Syncing staff changes made on the app back to Appenate's dashboard view (or a future GWR database)



Results and Key Findings

- The developer performed developer-level system **Cognitive Walkthroughs** on the wireframes to eradicate clear system inconsistencies.
- **User-testing** was then performed on wireframes which highlighted elements to improve. The user-testing process might have been focused more accurately.
- A second round of cognitive assessment was performed with the prototype app to understand the initial usability of the first mobile prototype.
- Elements of the Cognitive Walkthrough that failed were system components over which the developer had limited control.
- The limited customisability was a considerable drawback of the development environment. This produced the forms that were usable but menu and synching structures needed correcting.
- The next clear step is **to perform user-based testing with the client** - essential before future development.
- Despite the interface the usability of a **form based reference app has real potential** and has been shown to offer a valuable product.

References

- [1] G. Singh and I. S. Ahuja, “Just-in-time manufacturing: literature review and directions,” *Int. J. Bus. Contin. Risk Manag.*, vol. 3, no. 1, p. 57, 2012.
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- [3] P. Morville, “User Experience Design,” *Semantic Studios*, 2004 [Online]. Available: https://semanticstudios.com/user_experience_design/. [Accessed: 18-Dec-2018].
- [4] N. Bevan, “What is the difference between the purpose of usability and user experience methods?,” *Proc. Work. UXEM*, vol. 9, pp. 1–4, 2009.