# Testing Quick Reference Handbooks in Simulators

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# 1 Context

## 1.1 Introduction

### Context

Designing aviation checklists is difficult and requires time to test them in simulators and the real world. [1] The simulators require trained pilots to test them to make sure that they work consistently [2], which tests that the procedures in the checklist are concise, achieves the goal of the critical procedure, and will not take too long to complete. These checklists are also carried out in high workload environments, and this workload is elevated if an emergency were to occur.

### Problem

Testing procedures in checklists is often neglected by designers. [1] This is shown as there are certain checklists that are not fit for certain scenarios. An example of this is the checklist for ditching (water landing) which would have been applicable to use on US Airways Flight 1549. This checklist assumed that at least one engine was running [3], but this flight lost both of their engines, and if this checklist was used, it could have ended in an incident that could have resulted in people losing their lives. If occurrences like happened more frequently, this could result in pilots losing their trust in checklists, which could result in pilots not using them, when they are designed to aid in situations where they missing a critical step could be detrimental to the safety of everyone onboard the aircraft. [2]

### Rationale

Therefore, to aid designers in testing checklists, this project will create a tester for checklists to find flaws in checklists by using simulators without the need of trained crew. This will test that the procedures in the checklist can be done in a reasonable amount of time that will not endanger the aircraft and that the procedures will have reproducible results for the given goal of the checklist. With this, the results can be used to show areas of improvement in the checklist.

**LF**: On CL book, Ch1 is about nature of where CL work best; Ch2 explains what a CL is and isn't; Ch3 you can ignore, it talks about checklist for unknown/unexpected scenarios (advanced CL) in building; Ch4 he discussed CL with chefs; Ch5 talks about CL failures and why; **Ch6 is about Boeing's CL "factory"**; Ch7 and 8 are about applying the CL he came up with, here you get the examples of test/baseline criteria for CL; Ch9 he explains it in his own practice (this is daunting read)!.

## 1.2 Key Background Sources

| Resource | Info |
| --- | --- |
| US Airways 1549 NTSB Investigation [3] | **Description:** An investigation on an aircraft that suffered from a dual engine failure from a bird strike forcing the pilots to land on the Hudson River. <br> **Reason:** The investigation found that the QRH was too lengthy and the pilots' used their experience to prioritize essential actions outside the QRH to keep the aircraft in control. |
| Design Guidance for Emergency and Abnormal Checklists in Aviation [4] | **Description:** Provides the challenges and requirements for designing aviation checklists. It also talks about the problems that are in checklist designing. <br> **Reason:** This will guide for certain aspects to look out for whilst testing checklists, such as if certain actions require waiting, or if it could be completed in a different order. |
| Designing Flight-deck Procedures [1] | **Description:** Guidance on the process of developing checklists, which includes steps to focus on and how to make a well designed checklist. <br> **Reason:** This report includes steps on testing checklists which is the focus of this project and will provide guidance on how the tests should be carried out. |
| The Checklist Manifesto [2] | **Description:** Insight into the steps of implementing a checklist in medicine whilst learning about how checklists are designed and used in industries such as aviation and construction. <br> **Reason:** Checklist designer from Boeing is interviewed where they go through the vital design choices to make them effective and how they gain pilots' trust to use checklists. |

# 2 Aims and Objectives

## Aims

1. Test Checklists for flaws that can compromise the aircraft or that the checklist will not take too long and overload pilot further

2. Test multiple conditions for that checklist

3. Find problems in the checklist

4. Find how reproducible the checklist is

   **LF**: See above about "testing" what?

## Objectives

1. Checklist Manager

- (a) Input a checklist
- (b) Add conditions to test

2. Checklist Testing Logic

- (a) Capture state of aircraft
- (b) Simulate a pilot's actions
- (c) Simulate delay in actions **LF**:
- (d) Ensure consistency of checklist logic

3. Simulator connector

- (a) Connect to the flight simulator
- (b) Set up conditions for flight
- (c) Monitor and take Logic's actions

# 3 Planning

## 3.1 Diagrammatic Work Plan
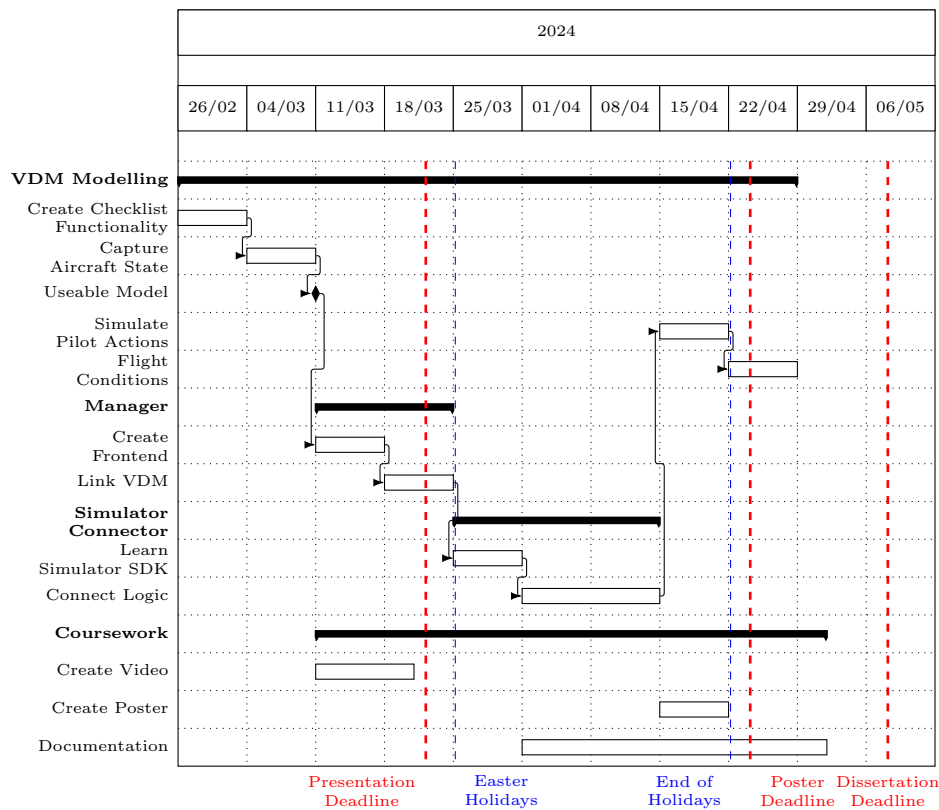
## 3.2   Brief Explanation

- Pretty much put how long each part of objectives should take.

- The deadlines for the Presentation, Poster, Dissertation will be done at the same time as the programming

- The work during the Easter Holidays is there with the expectation of taking a bit of a break, but to not lose momentum once the holidays are over.

- All the items on the gantt chart are more so the worst case scenario for how long each item will take

- The last part of VDM modelling is just in case I run out of time, and they aren't the most important

## 3.3   Risks

- Time management - that's why the last part of modelling is done after the simulator connector as it's not essential, can be done manually

- Simulator not being good enough?

- Simulator could be too complex to be able to link with model.

# 4 Ethics

## 4.1 Ethics Checklist

My project:

1. Will *not* involve working with **animals** or users/staff/premises of the **NHS**

2. Will be carried out **within the UK or European Economic Area**

3. Will *not* have any impact on the **environment**

4. Will *not* work with populations who do *not* have **capacity to consent**

5. Will *not* involve work with **human tissues**

6. Will *not* involve work with **vulnerable groups** (Children/Learning disabled/Mental health issues, etc.)

7. Will *not* involve any *potentially* **sensitive topics** (Examples include but are not exclusive to body image; relationships; protected characteristics; sexual behaviours; substance use; political views; distressing images, etc.)

8. Will *not* involve the collection of any identifiable personal data

## 4.2 Ethical Considerations

This project will involve referencing previous aviation accidents which had deaths involved, however, I will make sure to be respectful towards everyone involved in those accidents.

This project will also not involve the use of any users, so no data collection considerations will need to be taken into account for.

# 5 References

[1] Immanuel Barshi, Robert Mauro, Asaf Degani, et al. *Designing Flightdeck Procedures*. eng. Ames Research Center, Nov. 2016. URL: https://ntrs.nasa.gov/citations/20160013263.

[2] Atul Gawande. *The Checklist Manifesto: How To Get Things Right*. Main Edition. Profile Books, July 2010. ISBN: 9781846683145.

[3] National Tranportation Safety Board. *Loss of Thrust in Both Engines After Encountering a Flock of Birds and Subsequent Ditching on the Hudson River*. Technical Report PB2010-910403. May 2010. URL: https://www.ntsb.gov/investigations/Pages/DCA09MA026.aspx.

[4] Barbara Burian. "Design Guidance for Emergency and Abnormal Checklists in Aviation". In: *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 50 (Oct. 2006). DOI: 10.1177/154193120605000123.