# Connected Places Catapult

## Safety Case Summary

Testing in a Car Park -
Autonomous Valet Parking

November 2019

CATAPULT
Connected Places

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# Notice

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Any entity seeking to conduct autonomous vehicle trials will need to develop and publish a safety case specific to their own trials (as specified by the government's Centre for Connected & Autonomous Vehicles (CCAV) Code of Practice for Automated Vehicle Trialling) and gain permission to do so.

This document has 8 pages including the cover.

## FUNDING:

The Autonomous Valet Parking project is part-funded by the Centre for Connected and Autonomous Vehicles (CCAV), delivered in partnership with Innovate UK. It is part of the government's £100 million Intelligent Mobility Fund, supporting the Future of Mobility Grand Challenge.

As a key part of the UK government's modern Industrial Strategy, the Future of Mobility Grand Challenge was announced in 2017 to encourage and support extraordinary innovation in UK engineering and technology, making the UK a world leader within the transport industries.

This includes facilitating profound changes in transport technologies and business models, to make the movement of people, goods and services across the nation greener, safer, easier and more reliable.

## AUTHORISATION:

| ACTION | SIGNATURE BLOCK | NAME AND POSITION WITHIN CPC |
|---|---|---|
| Written by: | Maysun Hassanaly | Maysun Hassanaly<br>Systems Engineer |
| Reviewed by: | Lovedeep Brar | Lovedeep Brar<br>Senior Systems Engineer |
| Authorised by: | Stuart Rowell | Stuart Rowell<br>Principal Systems Engineer |

## RECORD OF CHANGES:

| REALEASED TO | VERSION | REASON FOR CHANGE | DATE |
|---|---|---|---|
| Parkopedia | 0.1 | First Draft | 08/10/19 |
| Parkopedia | 0.2 | Second Draft | 30/10/19 |
| Parkopedia | 1.0 | First Release | 18/11/19 |

# 1. Introduction

This document summarises the evidence that has been collected prior to commencing Autonomous Valet Parking testing in a car park in accordance with the document 'Safety Plan – Autonomous Valet Parking'. All the evidence required by the safety plan has been collected, and therefore it is agreed by CPC and Parkopedia that testing in a car park can commence.

# 2. Safety Plan Context

The plan for what evidence will be collected for each stage of testing, plus the overall safety argument describing how these pieces of evidence combine to ensure the overall safety of the project, can be found in the Safety Plan document. In order to avoid duplication, the safety argument shall not be repeated here, and therefore this document should be considered in conjunction with the Safety Plan.

The safety plan describes what evidence will be collected throughout the life of the project, i.e. it covers all phases of testing. However, individual 'Safety Cases' will be constructed for each separate phase of testing, with each Safety Case consisting of:

- The Safety Plan describing the safety objectives and argument, and summarising the overall project
- The individual pieces of evidence required prior to the commencement of the stage of testing in question. This evidence will be a document such as a Risk Assessment and Method Statement (RAMS) or a Failure Modes and Effects Analysis (FMEA)
- The Safety Case Summary for the particular phase of testing (of which this document is an example); this acts as a covering document to refer readers to the Safety Plan and individual pieces of evidence described above

The necessary documentation for each Safety Case shall be stored in a location where it is accessible to the AVP consortium.

# 3. Safety Evidence for each Trial Activity

Table 1 shows the evidence required for each phase of testing, reproduced from the Safety Plan. The column identifying which evidence is required for the current phase of testing ('AVP Testing in a Car Park) is highlighted, and the evidence required according to this table is as follows:

- Test Report from the testing in a private track (controlled environment) v1.0
- RAMS 3 v1.0 – this is the Risk Assessment and Method Statement describing safe operational procedures to ensure appropriate operational safety for this particular phase of testing
- Requirements Review v2.0 – the Requirements spreadsheet shall be reviewed for completeness and correctness prior to the start of each test phase. This has been completed for the testing in car parks
- Failure Modes and Effect Analysis (FMEA) v1.0 This has been completed for the testing in car parks (Table 3)
- System Safety Argument (HARA) v1.0. This has been completed for the testing in car parks (Table 3)
- Verification and Validation of Requirements from previous tests (shown in the Requirements spreadsheet)

- StreetDrone User Manual – this is a document provided to the consortium by StreetDrone describing the base vehicle, it's limitations, and override methods that the safety driver can use
- Incident Reporting Spreadsheet – this must be used throughout tested, updated on an ongoing basis as and when incidents occur, to enable an overall picture of the level of safety to be built up. The document template is complete, agreed with the consortium, and ready for data entry.

| | **Activity (required evidence must be in place BEFORE this activity commences)** | | | | | |
|---|---|---|---|---|---|---|
| **Evidence** | **Manual driving: Data gathering** | **Automated: Testing in a controlled environment** | **Automated: AVP testing in car parks** | **Automated: Demonstration** | **Description** | **Responsible** |
| Risk Assessment and Method Statement (RAMS) 1 for driving around in car parks using manual mode | X | | | | **Minimal Safety Analysis** needed.<br>Risk comparable to normal driving | CPC |
| RAMS 2 | | X | | | **Moderate Safety Analysis** needed.<br>Involves operation of relatively immature AV, but in controlled environment | CPC |
| Trial Plan – Testing in a controlled environment | | X | | | Plan showing detailed test cases and test aims | Parkopedia |
| Test Report - (Testing on Private Track) | | | X | | Report showing that test cases were carried out and no safety issues were identified | Parkopedia |
| RAMS 3 | | | X | | **Detailed Safety Analysis** needed.<br>Relatively mature AV operated in an environment which is only partially controlled. | CPC |
| Trials Plan – Testing in a Car Park | | | X | | Plan showing detailed test cases and test aims | Parkopedia |
| Briefing/checklist | | x | X | x | Checklist for actions to be performed before trials | Parkopedia/CPC |
| Test Report – (Testing in Secure Area of Car Park) | | | | x | Report showing that test cases were carried out and no safety issues were identified | Parkopedia |

| | Activity (required evidence must be in place BEFORE this activity commences) | | | | | |
|---|---|---|---|---|---|---|
| **Evidence** | **Manual driving: Data gathering** | **Automated: Testing in a controlled environment** | **Automated: AVP testing in car parks** | **Automated: Demonstration** | **Description** | **Responsible** |
| RAMS 4 | | | | X | **Detailed Safety Analysis** needed.<br>Relatively mature AV operated in an environment which is only partially controlled. | CPC |
| Trial Plan – Demo | | | | x | Plan showing detailed test cases and test aims | Parkopedia |
| Requirements Review | X | X | X | X | **Confirm all requirements applicable to the forthcoming stage of testing have been signed off in the requirement spreadsheet** | CPC, Parkopedia |
| Failure Modes and Effect Analysis (FMEA) | | | X | X | To generate safety goals | CPC |
| System Safety Argument (HARA) | | | X | X | To generate safety goals, identify hazards and rate the risk | CPC |
| Verification and Validation of Requirements | | | X | X | To verify and validate all requirements have been met and tested | CPC, Parkopedia |
| StreetDrone Safety Document | X | X | X | X | Reference document | StreetDrone |
| Incident Reporting Spreadsheet | | X | X | X | To be kept up to date on a rolling basis, if and when incidents occur | Parkopedia |

*Table 1 Testing and Trials Activities and Evidence*

# 4. Sign-Off of Safety Case

The below sign-off table is for stakeholders to indicate agreement that the evidence required by the safety plan for this phase of testing has been collected to the satisfaction of the AVP consortium. One this sign-off is completed, it is then permissible for testing in a Controlled Environment to proceed, provided that the testing is in accordance with the Safety Plan and the RAMS 3 document.

| Name | Company | Date | I confirm my approval of the Safety Case for this stage of testing (Y/ N) |
|---|---|---|---|
| Maysun Hassanaly | CPC | 18/112019 | Y |
| Lovedeep Brar | CPC | 04/12/2019 | Y |
| Brian Holt | Parkopedia | 10/12/2019 | Y |

*Table 2 Sign-Off*

# 5. References

| Document Name | Owner | Date of release and version |
|---|---|---|
| RAMS 3 | CPC | 18/11/19 v1.0 |
| Safety Plan | CPC | 18/11/19 v2.0 |
| FMEA | CPC | 18/11/19 v1.0 |
| HARA | CPC | 18/11/19 v1.0 |
| Requirements | CPC | 18/11/19 v2.0 |
| Test Report – Testing in a Controlled Environment | Parkopedia | 18/11/19 v1.0 |
| StreetDrone User Manual | StreetDrone | N/A |
| Trials Plan | Parkopedia | 18/11/19 v1.0 |
| Incident Reporting Spreadsheet | Parkopedia | N/A |

*Table 3 References*

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