

# PAS 1892:2023

Connected and automated plant (CAP) –  
Defining and specifying the use of CAP  
in construction and maintenance works  
for the purposes of procurement and  
deployment – Specification



Centre for Connected  
& Autonomous Vehicles



**bsi**  
Documents  
Document Sharing Hub

### **Publishing and copyright information**

The BSI copyright notice displayed in this document indicates when the document was last issued.

© The British Standards Institution 2023.

Published by BSI Standards Limited 2023.

**ISBN** 978 0 539 21904 3

**ICS** 13.110, 91.220

*No copying without BSI permission except as permitted by copyright law.*

### **Publication history**

First published July 2023

# Contents

|                                                                                                 |           |
|-------------------------------------------------------------------------------------------------|-----------|
| Foreword .....                                                                                  | iii       |
| Introduction.....                                                                               | v         |
| <b>1 Scope.....</b>                                                                             | <b>1</b>  |
| <b>2 Normative references .....</b>                                                             | <b>2</b>  |
| <b>3 Terms, definitions and abbreviations .....</b>                                             | <b>3</b>  |
| <b>4 Connected and automated plant (CAP) objectives.....</b>                                    | <b>5</b>  |
| <b>5 Technical requirements .....</b>                                                           | <b>10</b> |
| <b>6 CAP operational domain conditions (CAP ODC) .....</b>                                      | <b>11</b> |
| <b>7 CAP Operational design domain (CAP ODD) taxonomy .....</b>                                 | <b>13</b> |
| <b>8 Automation: capabilities, roles and responsibilities .....</b>                             | <b>17</b> |
| <b>9 Development of CAP operational safety case .....</b>                                       | <b>22</b> |
| <b>10 Security of the CAP .....</b>                                                             | <b>23</b> |
| <b>Annexes</b>                                                                                  |           |
| Annex A (informative) Examples of CAP strategic objectives .....                                | 26        |
| Annex B (informative) Example CAP ODC definitions .....                                         | 28        |
| Annex C (informative) Example of CAP ODD definitions .....                                      | 32        |
| Annex D (informative) Application of CAP capability levels to types of<br>plant: examples ..... | 35        |
| Bibliography .....                                                                              | 46        |
| <b>List of figures</b>                                                                          |           |
| Figure 1 – PAS 1892 strategic aims .....                                                        | vi        |
| Figure 2 – Responsibilities for the definition and specification of CAP.....                    | 6         |
| Figure 3 – CAP ODD taxonomy.....                                                                | 13        |
| Figure 4 – Operational safety case .....                                                        | 22        |
| Figure 5 – Holistic approach to security .....                                                  | 24        |

## List of tables

|                                                                                               |    |
|-----------------------------------------------------------------------------------------------|----|
| Table 1 – CAP level of automation to support strategic automation objectives .....            | 8  |
| Table 2 – Levels of automation and the responsibilities for observing attributes .....        | 18 |
| Table 3 – Levels of automation and the responsibilities for the understanding attributes..... | 19 |
| Table 4 – Levels of automation and the responsibilities for the deciding attributes .....     | 20 |
| Table 5 – Levels of automation and the responsibilities for the acting attributes .....       | 20 |
| Table 6 – Levels of automation and the responsibilities for the fallback attributes .....     | 21 |
| Table A.1 – Example strategic objectives .....                                                | 26 |
| Table B.1 – Example information to be provided in CAP ODC definition ....                     | 28 |
| Table C.1 – Example information to be provided in CAP ODD definition ....                     | 32 |
| Table D.1 – Examples of “observe” capabilities – compactor.....                               | 36 |
| Table D.2 – Examples of “understand” capabilities – compactor .....                           | 37 |
| Table D.3 – Examples of “decide” capabilities – compactor .....                               | 38 |
| Table D.4 – Examples of “act” capabilities – compactor .....                                  | 39 |
| Table D.5 – Examples of “fallback” capabilities – compactor .....                             | 40 |
| Table D.6 – Examples of “observe” capabilities – excavator .....                              | 41 |
| Table D.7 – Examples of “understand” capabilities – excavator .....                           | 42 |
| Table D.8 – Examples of “decide” capabilities – excavator .....                               | 43 |
| Table D.9 – Examples of “act” capabilities – excavator .....                                  | 44 |
| Table D.10 – Examples of “fallback” capabilities – excavator .....                            | 45 |

# Foreword

This PAS was sponsored by the Department for Transport (DfT) and the Centre for Connected and Autonomous Vehicles (CCAV). Its development was facilitated by BSI Standards Limited and it was published under licence from The British Standards Institution. It came into effect on 31 July 2023.

Acknowledgement is given to Gavin Summerson, of Connected Places Catapult, as the technical author, and the following organizations that were involved in the development of this PAS as members of the steering group:

- Association of Directors of Environment, Economy, Planning and Transport (ADEPT)
- Blackwell Earthmoving Ltd
- Burges Salmon LLP
- Centre for Connected and Autonomous Vehicles (CCAV)
- Connected Places Catapult
- Costain
- Department for Transport
- Edinburgh University
- Flannery Plant
- Health and Safety Executive (HSE)
- Infrastructure and Projects Authority (IPA)
- J C Bamford Excavators Ltd
- National Highways
- National Protective Security Authority (NPSA)
- Network Rail
- TRL
- WSP
- Zenzic

Acknowledgement is also given to the members of a wider review panel who were consulted in the development of this PAS.

The British Standards Institution retains ownership and copyright of this PAS. BSI Standards Limited as the publisher of the PAS reserves the right to withdraw or amend this PAS on receipt of authoritative advice that it is appropriate to do so. This PAS will be reviewed at intervals not exceeding two years.

This PAS is not to be regarded as a British Standard. It will be withdrawn in the event it is superseded by a British Standard.

The PAS process enables a specification to be rapidly developed in order to fulfil an immediate need in industry. A PAS can be considered for further development as a British Standard, or constitute part of the UK input into the development of a European or International Standard.

## Information about this document

**Product certification/inspection/testing.** Users of this PAS are advised to consider the desirability of third-party certification/inspection/testing of product conformity to this PAS. Users seeking assistance in identifying appropriate conformity assessment bodies or schemes may ask BSI to forward their enquiries to the relevant association.

This publication can be withdrawn, revised, partially superseded or superseded. Information regarding the status of this publication can be found in the Standards Catalogue on the BSI website at [bsigroup.com/standards](https://bsigroup.com/standards), or by contacting the Customer Services team.

Where websites and webpages have been cited, they are provided for ease of reference and are correct at the time of publication. The location of a webpage or website, or its contents, cannot be guaranteed.

The diagram in Figure 5 of this PAS has been supplied by Bodvoc Limited.

## Use of this document

It has been assumed in the preparation of this PAS that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

## Presentational conventions

The provisions of this PAS are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is “shall”.

*Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.*

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. “organization” rather than “organisation”).

## Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient’s own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

### **Compliance with a PAS cannot confer immunity from legal obligations.**

In particular, attention is drawn to the following specific Acts and regulations, although this list is not intended to be exhaustive:

- Health and Safety at Work etc Act 1974 [1], the regulations made under it and associated HSE guidance and Approved Codes of Practice, such as:
  - The Construction (Design & Management) Regulations 2015 [2];
  - The Provision and Use of Work Equipment Regulations 1998 [3];
  - The Management of Health and Safety at Work Regulations 1999 [4];
  - Lifting Operations and Lifting Equipment Regulations 1998 [5];
- The Environment Act 2021 [6];
- Automated and Electric Vehicles Act 2018 [7].

# Introduction

**0.1** The construction industry faces challenges on a number of fronts including decarbonization and labour shortages, as well as the need to find ways of improving safety, health and wellbeing and overall quality of activities across the workforce. These challenges cannot be solved by existing solutions on their own.

**0.2** Until the early 20th Century, construction equipment was largely powered by humans or animals. Since then, there have been major technological advancements with the internal combustion engine, hydraulics, electrification, advances in computing and robotics and an increase in the adoption of digital technologies.

**0.3** The UK Government *Construction Playbook* [8] is driving contracting authorities to adopt modern methods of construction and for the supply chain to adopt digital, automated processes. The UK Government *Consultancy Playbook* [9] also advocates the move to more outcome-based specifications in order to give suppliers the flexibility to propose innovative solutions. Automation in construction through the use of connected and automated plant (CAP) provides opportunities to improve productivity, efficiency, and quality of construction, whilst improving the safety and welfare of construction workers. The industry is developing a strong understanding of the potential presented by CAP, with exciting examples of new technology being applied in practice.

**0.4** In response to this increasing interest, National Highways (formerly Highways England) commissioned the development of an industry-wide *CAP Roadmap* [10] for the adoption of connected and automated plant (CAP) as business-as-usual by 2035. The *CAP Roadmap* [10] was jointly launched by National Highways, the Infrastructure Industry Innovation Partnership (i3P) and TRL in June 2020. The *CAP Roadmap* [10] identifies potential barriers to the adoption of CAP and proposes nine parallel workstreams to achieve the vision of CAP as standard business practice. The *CAP Roadmap* [10] identifies a need to initiate work to establish the legal and standards frameworks that will enable CAP to thrive, as well as a need to develop procurement processes that support automation in construction.

**0.5** This PAS uses the term “automated” rather than adopting the term “autonomous” to provide consistency with existing legislation, such as the Automated and Electric Vehicles Act 2018 (EAVA) [7]. This is also consistent with the PAS 188X series of standards for connected and automated vehicles.

**NOTE** *The avoidance of the term “autonomous” is consistent with the fact the term is recognized in law as bestowing its possessor with the fundamental building blocks for human rights, which is inappropriate for a machine.*

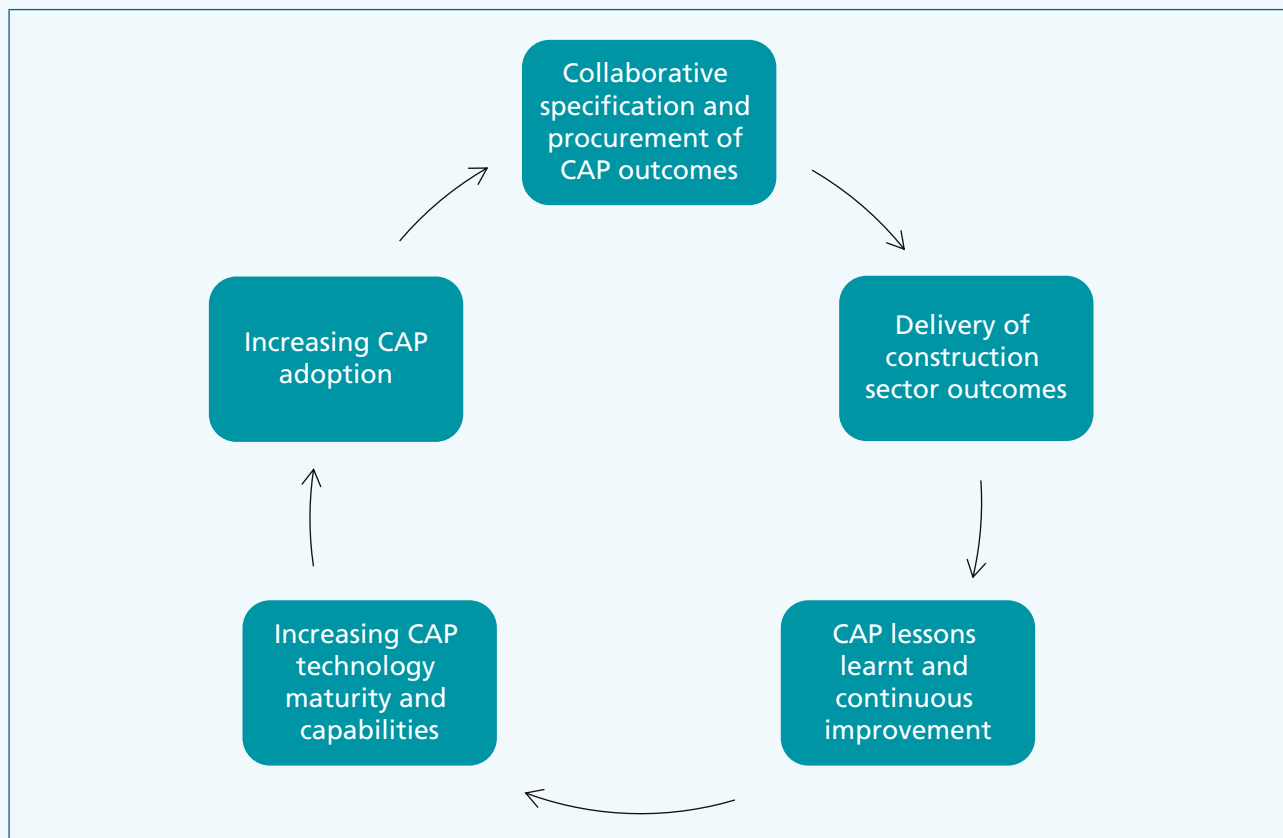
**0.6** This PAS provides a framework to enable appointing and lead appointed parties to create a common CAP specification that they can provide to appointed parties which facilitates the ability of organizations to:

- a) understand and define needs for CAP in construction and maintenance works based upon a set of strategic and technical objectives;
- b) define the required capabilities for CAP based upon these needs;
- c) utilize a common language for defining CAP capabilities; and
- d) have a clear approach for defining responsibilities for the safe operation of CAP.

**0.7** This PAS, as well as providing a framework for common CAP specifications, has a number of other strategic aims (see Figure 1) including:

- a) increasing adoption of CAP;
- b) supply chain collaboration in the specification of CAP;
- c) encouraging an outcomes-focused approach to the specification of CAP;
- d) creating a culture of sharing lessons learnt and continuous improvement in the use of CAP systems; and
- e) increasing technology maturity and capabilities of CAP systems.

Figure 1 – PAS 1892 strategic aims



# 1 Scope

This PAS provides requirements and a common framework for defining and specifying connected and automated plant (CAP) and their associated systems and connectivity for the purpose of procurement and deployment.

This PAS covers the specification for the purposes of procurement of CAP within a controlled work site boundary for the purpose of construction and maintenance works.

It does not cover CAP operations outside of the controlled site boundary or CAP that is being utilized as part of offsite processes. This PAS does not apply to CAP operating within the public realm, for example deliveries, transits on public highways or other uncontrolled environments.

It provides a taxonomy for defining and specifying performance requirements for CAP.

The PAS covers:

- a) setting objectives including consideration of specific outcomes to be achieved through the deployment of CAP, including safety, quality and operational efficiency;
- b) establishing requirements for capabilities of CAP and associated systems including levels of performance;
- c) a taxonomy for describing levels of automation, including the division of roles between system and human; and
- d) development of the safety case and security minded approach to deployment.

This PAS is intended for the appointing, lead appointed and appointed parties specifying CAP systems in construction and maintenance works.

Organizations including manufacturers, designers and researchers might also be interested in this PAS.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions, or limits the application, of this document<sup>1)</sup>. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

PAS 1885, *The fundamental principles of automotive cyber security – Specification*

BS ISO 17757, *Earth-moving machinery and mining – Autonomous and semi-autonomous machine system safety*

BS EN ISO 12100, *Safety of Machinery – General principles of design – Risk assessment and risk reduction*

<sup>1)</sup> Documents that are referred to solely in an informative manner are listed in the Bibliography.

## 3 Terms, definitions and abbreviations

### 3.1 Terms and definitions

For the purpose of this PAS the following terms and definitions apply.

**3.1.1 automated or semi-automated machine system**  
machine and its supporting systems and infrastructure that enable the machine to provide automated operations

[SOURCE: BS ISO 17757:2019, modified]

#### 3.1.2 appointed party

provider of goods or services via an appointment or work instruction

**NOTE 1** This term is used whether or not there is a formal appointment between the parties.

**NOTE 2** Appointed parties in the case of CAP are typically organizations contracted by a lead appointed party to provide CAP and associated systems.

#### 3.1.3 appointing party

person or organization making an appointment or issuing a work instruction

**NOTE 1** The appointing party might be termed “client”, “owner” or “employer” but the appointing party is not limited to these functions. In some cases, the appointing party can be the same person or organization as the lead appointed party, for example, where a house builder is acting as both the appointing party (client) and lead appointed party (main contractor).

**NOTE 2** This term is used whether or not there is a formal appointment between the parties.

[SOURCE: BS EN ISO 19650-1, modified]

#### 3.1.4 attribute

characteristic of an object or entity

[SOURCE: BS ISO 15143-1:2010]

**NOTE** The use of this term aligns with its use in PAS 1883.

#### 3.1.5 CAP operational design domain (ODD)

operating conditions under which a given automated or semi-automated machine system is specifically designed to function

**NOTE 1** Operating conditions includes, but is not limited to, environmental, geographical, and/or the requisite presence or absence of certain site characteristics.

**NOTE 2** The term “CAP ODD” is used to describe the operating conditions within which any given CAP system is designed to function. The purpose of this is to ensure that suitable CAP systems are selected, based upon the operating conditions of the construction work site as described in the CAP operational domain conditions (CAP ODC).

#### 3.1.6 CAP operational domain conditions (CAP ODC)

operating conditions of a construction work site within which automated or semi-automated machine systems are required to function

**NOTE 1** Operating conditions includes, but is not limited to, environmental, geographical, time of day restrictions, and the presence of any other specific site operations that might impact upon the required machine system functions.

**NOTE 2** The term “CAP ODC” is used to describe the conditions that CAP systems are required to function within. The purpose is to help describe the site operating conditions so that suitable CAP systems can be specified that can operate within these conditions. For example the geography such as type of terrain and gradient of the site might be described in the ODC. CAP systems would describe the conditions they can operate within in the ODD, allowing appointing parties to specify CAP systems with ODD that are compatible with the ODC.

#### 3.1.7 CAP task delivery plan

documented plan that describes the general tasks to be fulfilled by CAP and the objectives to be met for these tasks

#### 3.1.8 connected and automated plant (CAP)

construction plant and related control systems that provide levels of automation for aspects of the vehicle’s operation

**3.1.9 controlled construction work site**

place where construction works or routine maintenance is performed where general public access is not permitted, including any land immediately adjacent specifically used for the purposes of the works

**NOTE** *These are sites to which access to the site is only permitted for persons that have been authorized.*

**3.1.10 construction works**

everything that is constructed or results from construction operations

**NOTE** *Construction works include building and civil engineering works and this includes inspection or routine maintenance of a built asset.*

[SOURCE: BS ISO 6707-1:2004, 3.1.1; ISO 15392:2008, 3.8]

**3.1.11 information services**

services that transform, manages, exchanges or presents information to users and between systems

**NOTE** *Information services include defined file types and formats as well as IT infrastructure.*

[SOURCE: BS EN ISO 19101-1:2014, 4.1.19, modified]

**3.1.12 lead appointed party**

appointed party appointed or instructed directly by an appointing party

**NOTE** *The lead appointed party might often also be described as the “main contractor”, “principal contractor” or a consultant directly appointed by the appointing party, whose scope might include CAP.*

**3.1.13 operator**

person operating CAP and related control systems

**NOTE** *Control systems include systems that enable remote operations.*

**3.1.14 system**

combination of interacting elements organized to achieve one or more stated purposes

**NOTE** *A system is sometimes considered as a product or as the services it provides.*

[SOURCE: BS ISO/IEC/IEEE 15288:2015, 3.38]

**3.2 Abbreviations**

|      |                                    |
|------|------------------------------------|
| API  | application programme interface    |
| CAP  | connected and automated plant      |
| EM   | electromagnetic                    |
| GNSS | Global Navigation Satellite System |
| ODD  | operational design domain          |
| ODC  | operational domain conditions      |
| OEM  | original equipment manufacturer    |

## 4 Connected and automated plant (CAP) objectives

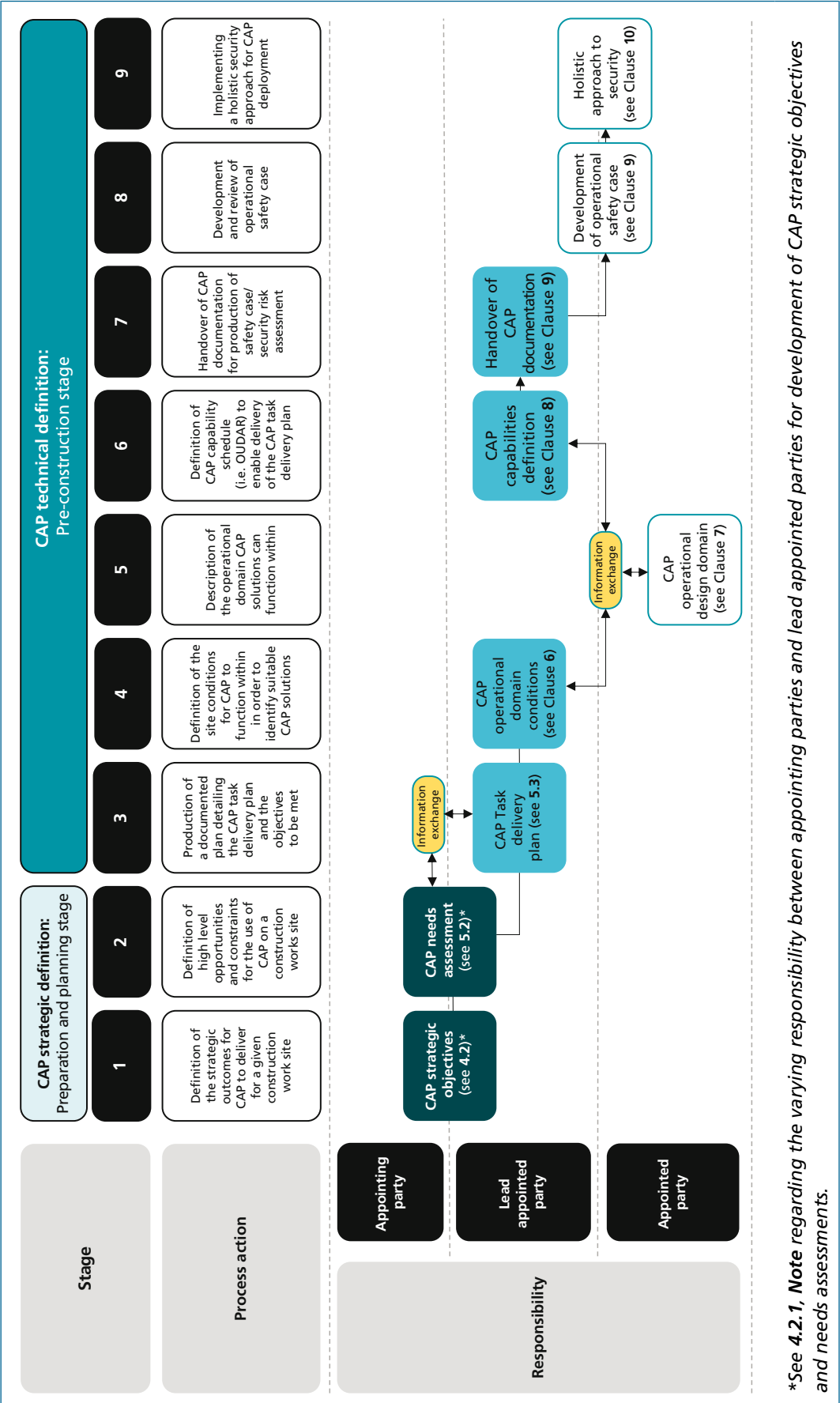
### 4.1 General

The responsibilities for the definition and specification of connected and automated plant (CAP) shall be assigned by the appointing party based upon the method of contracting to be implemented in accordance with Figure 2.

**NOTE 1** *Depending on the contracting process, the appointing party might also take the role of lead appointed party (e.g. a housebuilder also acting as main contractor). There might also be cases where an appointing party wants the lead appointed party to act on their behalf in defining CAP strategic objectives (see 4.2 and 4.3).*

**NOTE 2** *In order to maximize opportunities for CAP, the CAP strategic definition should be completed at the preparation and planning stage as described in the UK Construction Playbook [8].*

Figure 2 – Responsibilities for the definition and specification of CAP



## 4.2 CAP strategic objectives

**4.2.1** The appointing party or lead appointed party (see Note) shall develop strategic objectives in order to define the outcomes to be achieved in the adoption of CAP (see Annex A). The appointing party or lead appointed party shall set strategic objectives that are intended to optimize the use of CAP in construction works and to inform decisions on the adoption of CAP by weighing up the wider impacts and outcomes to be achieved.

**NOTE** Responsibilities for defining CAP strategic objectives as specified in 4.2 might differ based upon the contracting mechanism and which party has the strategic impetus for the deployment of CAP systems. There might be instances where the appointed party is leading the definition of CAP objectives however in other cases, the responsibility might be handed over to the lead appointed party. There might be other instances where the appointed party has not specified CAP. However, the lead appointed party aims to set CAP objectives as part of their own strategic objectives. Overall the responsibility for CAP objectives should be agreed between the appointed party and lead appointed party from an early stage, such as during prior mobilization or the procurement of appointed parties.

**4.2.2** The strategic objectives shall cover the following:

- a) delivery objectives: including efficiency;
- b) safety objectives: including safety and the provision of a healthy environment;
- c) security objectives: including a holistic approach to security of the CAP, the environment within which it is deployed and any data/information it creates, processes, updates or communicates;
- d) environmental objectives: including resource consumption and preservation of the environment;
- e) human objectives: including the experience and impact upon stakeholders;

**NOTE** Human objectives can take into account implications on human factors, operator satisfaction and wider stakeholder implications. This might include impacts on improving accessibility to those with accessibility needs, or impacts on specific stakeholder, for example, road user customer satisfaction, where CAP is being utilized in a controlled construction work site on the highway. Human objectives might also cover impacts of humans on the performance and safety of CAP.

- f) quality objectives: including the minimization and resolution of defects;
- g) appointing or lead appointed party objectives: including contribution towards appointing and lead appointed parties' organizational objectives;

- h) continuous improvement objectives: dissemination in the wider industry; and
- i) other objectives; including those that do not fall within those listed in 4.2.2 a) to 4.2.2 g), defined by the appointed party or lead appointed party.

**NOTE 1** The provisions relating to objectives as provided in 4.2 and 4.3 should be carried out with participation with market actors in order to review the delivery of objectives. Market actors might include lead appointed parties, appointed parties such as CAP suppliers, operators and original equipment manufacturers (OEMs).

**NOTE 2** Where strategic objectives have not been defined by the appointing party at the stage where they have entered into contract, objectives might be defined by the lead appointed party in collaboration with the appointing party.

**NOTE 3** A weighting can be applied to consider the relative importance of strategic objectives, depending on the objectives of the project, specific site context, organizational objectives and management system requirements.

**NOTE 4** Strategic objectives can be developed by following the process defined in BSI Flex 390, Built Environment – Value Based Decision Making – Specification. This is to support the specification of CAP that aligns with the principles of value-based decision-making.

**4.2.3** Objectives shall be specific, measurable, achievable, realistic and time-bound with a set of CAP performance metrics developed to measure progress.

**NOTE** Appointing or lead appointed parties should assess whether the requirements of 4.2.3 can be applied to all objectives and how they might be applied. For example, human objectives (4.2.2 e)) might only be able to be measured qualitatively.

**4.2.4** The appointing party or lead appointed party shall define information requirements to support the collection of data for the analysis of CAP performance metrics.

**NOTE** The use of previous project performance data from tasks delivered using traditional methods (i.e. not utilizing CAP) can be used to benchmark CAP performance.

**4.2.5** The appointing party or lead appointed party shall define a process for monitoring and analysing the delivery of objectives at defined project stages, including a process for continuous improvement in the delivery of objectives and for taking actions to mitigate any risks or to respond to any lessons learnt, and dissemination in the wider industry.

**4.2.6** The appointing party or lead appointed party shall incorporate CAP strategic objectives, performance metrics and delivery processes that are to be followed into the tender documentation, for appointed parties to define how these requirements are to be fulfilled as part of their proposals.

## 4.3 Level of automation

**4.3.1** Appointing parties or lead appointed parties shall define their strategic objectives for CAP level of automation in controlled construction work sites based upon the levels provided in Table 1.

**Table 1** – CAP level of automation to support strategic automation objectives

| Level of automation                             | Responsibility                                                                                     | Description                                                                                                                                                                                                                                                                           |
|-------------------------------------------------|----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Level 0: no automation</b>                   | Operator only.                                                                                     | Construction functions are delivered conventionally with operators taking responsibility for delivery of intended outcomes.                                                                                                                                                           |
| <b>Level 1: operator/system co-operation</b>    | Operator with system assistance.                                                                   | Construction functions are carried out by the operator with systems providing assistance to the operator in delivery of intended outcomes.                                                                                                                                            |
| <b>Level 2: semi-automated</b>                  | System with human supervision.                                                                     | Construction functions are carried out by systems with human monitoring and intervention initiated either by the operator, or at the request of the system in order to deliver the intended outcomes.                                                                                 |
| <b>Level 3: highly automated</b>                | System only.                                                                                       | Construction functions are carried out by systems with operators providing the required minimum design and oversight of the system to ensure delivery of the intended outcomes.                                                                                                       |
| <b>Level 4: highly automated – co-operative</b> | Individual items of equipment: system only.<br>Co-ordinating automated systems: human supervision. | Construction functions are carried out by multiple co-operatively, networked, automated machines with minimal oversight of individual operations. Operators provide minimum design and oversight to and through the co-ordinating system to ensure delivery of the intended outcomes. |

**NOTE** The CAP levels of automation provided in Table 1 provide appointing and lead appointed parties with a method of describing their high-level objectives for automation in controlled construction work sites. The levels of automation are not intended as a means of prescribing specific technical capabilities of CAP. The specific technical capabilities of CAP are defined by the lead appointed party using the capability levels defined in Clause 8, considering the needs of the site environment as defined by the ODC (Clause 6).

**4.3.2** Appointing parties or lead appointed parties shall define whether they want to specify co-operative systems and their objectives for co-operation.

***NOTE 1** Objectives for co-operation should be informed through engagement with the lead appointed party and appointed parties to consider feasibility and availability of solutions.*

***NOTE 2** Co-operation can be between the same type of CAP systems (e.g. excavators) or between different CAP systems (e.g. excavators and dumpers).*

**4.3.3** The threat assessment and security measures implemented in the CAP and its operation shall be commensurate with the level of automation defined and cognizant of the impact of any loss of connectivity.

***NOTE** Further information on CAP security is provided in Clause 10.*

## 5 Technical requirements

### 5.1 CAP needs analysis

**5.1.1** The appointing party shall produce a documented CAP needs analysis that identifies where CAP might be utilized in the delivery of construction works.

**NOTE 1** *The CAP needs analysis should be conducted at the planning and preparation stage prior to the commencement of construction works in order to optimize opportunities for CAP. For example, prior to publication for tender, as defined in the UK Government Construction Playbook [8].*

**NOTE 2** *Depending on the project delivery route and contracting mechanism, responsibility for the CAP needs analysis can be handed by the appointing party to a lead appointed party. For example, in the case of design and build projects, the lead appointed party might be the main contractor.*

**5.1.2** The CAP needs analysis shall include:

- a) the general tasks which might be delivered to identify opportunities for CAP;
- b) opportunities for CAP to improve delivery, based upon existing processes;
- c) identification of the role of CAP in the delivery of strategic objectives for these general tasks; and
- d) the appointing party's site-specific considerations and constraints.

**NOTE 1** *Site-specific considerations should include site layout, ground conditions, topography and any specific hazards and access related issues as identified in the pre-construction information and construction phase plan as appropriate.*

**NOTE 2** *The CAP needs analysis can be broken down into the broad type of tasks (e.g. excavating, grading, compacting). The CAP needs analysis should consider opportunities for CAP to undertake multiple tasks, e.g. through use of different attachments. The CAP needs analysis should also consider needs for co-operation between machines. When defining the CAP needs analysis, the appointing party might engage with the supply chain, including lead appointed and appointed parties, as part of a pre-commercial procurement engagement activity in order to identify opportunities for use of CAP.*

### 5.2 CAP task delivery plan

The lead appointed party shall agree with the appointing party a documented CAP task delivery plan defining the tasks to be fulfilled by appointed parties through the use of CAP and the objectives to be met for these tasks, including:

- a) task description and objectives;
- b) task quantification and production requirements (e.g. quantity, weights, dimensions);
- c) access/egress from site;
- d) CAP limitations (e.g. time, equipment and operational constraints) (see 6.7);
- e) scale of CAP deployment (e.g. considering size of site, stage of construction); and
- f) co-operation between machines;
- g) safe and secure operations including CAP-specific risk and treatment information relevant to the pre-construction information and the construction phase plan.

**NOTE 1** *The CAP delivery plan can be part of the bill of quantities and activity schedule.*

**NOTE 2** *Documented CAP Delivery Plans should be provided in a format as agreed between the lead appointed and appointing party and could be provided in different formats as is required including, maps and other digital formats and representations.*

**NOTE 3** *Risk assessment and treatment form a holistic approach to security, i.e. covering the goals in BS ISO 19650-5 and the physical, personnel, process and technical security domains.*