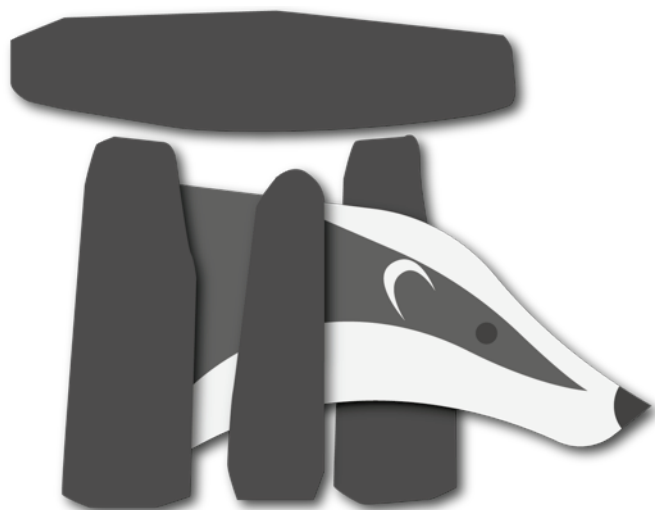




QS-14C

Outline Information Services Strategy

4. Your outline information services strategy shall provide the following information as a minimum:
- 4.1. the use of Project Data Analytics in relation to health, safety and wellbeing;
 - 4.2. the methodology for ensuring personal data captured on the Scheme is managed and disposed in accordance with GDPR;
 - 4.3. the methodology for capturing, managing and reporting data for Scheme Specific Performance Measure (SSPM) – “Safety of the Construction Workers” and one other SSPM of your choice;
 - 4.4. how the Data Hub will be used to manage data, including a high-level architecture diagram;
 - 4.5. how unauthorised and malicious access to data sources and systems will be prevented, including how those prevention methods will be tested;
 - 4.6. how network redundancy will be provided.



1. Outline Information Services Strategy

The purpose of this document is to describe BADGER's methods and procedures to deliver the Digital Construction Requirements, as per A303-Proc-PD-005-ITPD Vol. 0 ITPD App. D Part B, QS-14C. It defines the methodology for capturing, managing and reporting data, how information is integrated into the Data Hub and which measures are implemented to guarantee protection from unauthorised access.

4.1. The use of Project Data Analytics in relation to health, safety and wellbeing;

BADGER adopts digital processes for accessing the Data Hub and Project Data Analytics: Data Team develops a cloud-based system for collecting, processing and reporting data that allows the aggregation of information coming from design or construction and provides personalised access, through the Information Portal, to the various users.

BADGER processes data through the Data Hub for handling accidents consequences, reporting H&S performances and predicting likelihoods of health hazards occurrence. BADGER uses Highways England's Azure environment and continue to develop the current dashboard for risks, opportunities and issues management. Data is stored and updated in the Project CDE based on Business Collaborator server. Through BC Sync, information is exchanged every 24h from P-CDE and any other source with the Data Hub (**V2P5-1.4.6**). BC Sync connects Highways England and BADGER's Common Data Environments and automates the transmittal of agreed deliverables, significantly reducing manual administration errors and speeding up the process.

Project data is collected during design, construction and operational phase. Since the early design phase, BADGER evaluates all A303 potential H&S issues performing construction activities-based simulations and incorporates hazards identifiers into the PIM to improve communication and ensuring the adoption of risk mitigation measures. During the construction phase, data is collected not only

from safety reports but also from a set of multidisciplinary sources such as equipment performance data, vehicle telemetry, survey, human resources, near-miss events and training, as reported in the table below:

PROJECT DATA FOR ANALYTICS	
Created by works	- groundwater instrumentation and monitoring - construction plant and vehicle telemetry including GPS equipment - ground monitoring instrumentation, including tunnels progress - temporary traffic control instrumentation - other instrumentation and monitoring, including dust/air, materials, fire, incursions, shifting timelines due to COVID-19 challenges - surveys - site worker GPS equipment - service strikes - smart assets
Other Project data	- HR data - Weather - Stakeholder data - Project Control data, activities time schedules
HS&W data	- Reactive Indicators (AFR, Fatal Injuries, Lost Time Injuries, Near Miss, Lost Workdays, Medical treatments) - Proactive Indicators (OHS training, audits and internal inspections, emergency drills, OHS meetings) - BADGER's health and safety system for recording inspections, observations and incident events
Project Information Model	ADMM



As defined by the Digital Construction Requirements (**V2P5-3.8.10**), individuals for the roles of Data Engineer and Data Analyst with SQL and database management knowledge are included in the project team, under the direction of the Digital Lead.

The team implements Azure analytics capabilities with new solutions based on knowledge mining (**TQ5C2.1**, led by the Project Director). Starting from the available libraries on Azure Architecture Centre, the Team uses a combination of services (including AI, statistical analysis and Business Intelligence tools) to process the vast amounts of data coming from worksites. This allows BADGER to explore and understand information, uncover hidden insights or emerging phenomena and identify relevant variables among data.

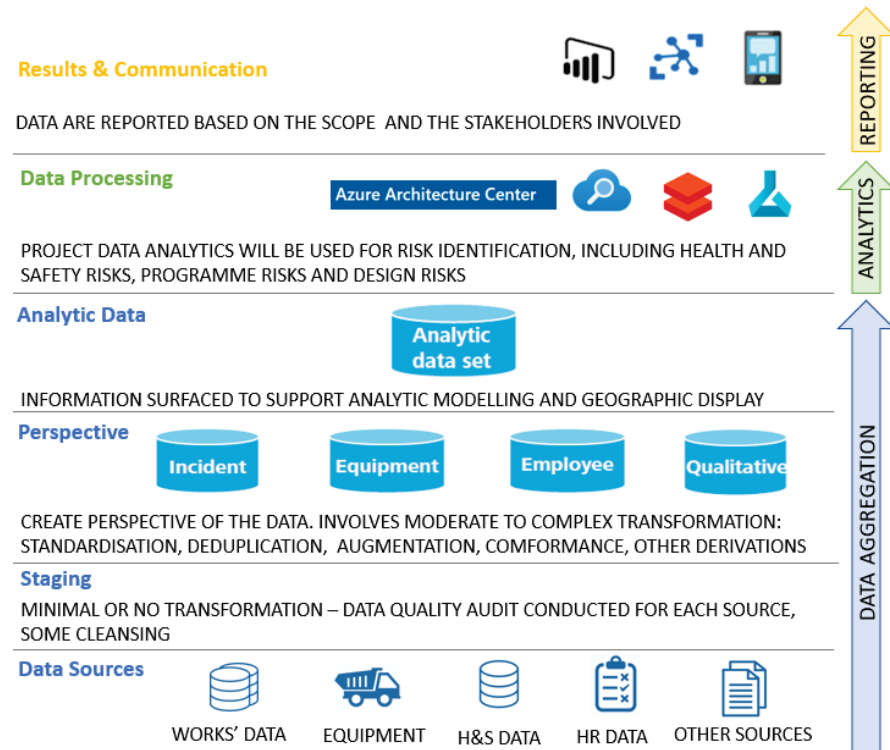


Figure 1: Sample of analytics data aggregation methodology

Within Microsoft Azure platform, data sources are filtered and fused into structured dataset for simultaneous analysis of all factors potentially contributing to workplace incidents, enriching the content with AI capabilities that will let extraction of real-time data-driven insights for informed strategic decision making. The use of Power BI for reporting (**V2P5-3.8.9**) simplify the reporting process and automates the information workflow, enabling stakeholders to utilise time more effectively. Reports are customised according to purposes and data is shared in different formats, including dashboard or sheets/graphs, based on the stakeholders involved.

Azure insights are integrated into the iTwin viewer, improving the digital twins of the Scheme. The iTwin Services federate digital models with other data sources, such as works' schedules, enabling 4D visualisation of the project. The use of smart assets and activity monitoring applications provides real-time data of the works' status.

With automated workflows, embedded links and dedicated APIs, third party data is integrated within the P-CDE. Sensors data coming from operations is synchronised to Azure Hub and time series insights are generated. Then, the iTwin viewer provides a single view for all this information: the BIM models coming from engineering, the live data analysis and the information coming from site surveys. These support workers to gain a deeper understanding of the condition of the Scheme, providing real-time 3D/4D visibility of risks and give teams the information needed to improve quality and safety. It allows taking preventive actions to reduce risk, such as adjustments to equipment maintenance schedules, placement of machines and vehicles or tasks re-scheduling.

Results from Project Data Analytics is used also to improve H&S training programmes and make them more effective (**TQ5C2.1**, led by the Project Director). Periodic inspections and audit activities are carried out, evaluating the effectiveness of adopted H&S measures. The results, reported in the P-CDE, allow canvassing of the views of employees on some key aspects of health and safety within the organisation.



Information taken from DISC assessment, objectives set as part of the wellbeing records, is collected in a dedicated area of P-CDE and exchanged automatically with the Data Hub providing dashboards and ensuring there are adequate controls and mitigation actions in place (QS-18B describes Improvement and Innovation processes).

4.2 The methodology for ensuring personal data captured on the Scheme is managed & disposed in accordance with GDPR;

BADGER's parent companies have strict protocols regarding processing of personal data based on legality, loyalty and transparency; limitation of purpose; data minimisation; accuracy; limitation of the conservation period; integrity, confidentiality, demonstration of consent for processing personal data.

An organisational structure of Privacy for each of the areas will be implemented consisting of a Working Group to which the Information Services (IS) Lead will report. A Government Model on Privacy will have to be formally designed, with Highways England and BADGER adhering to this agreed model. Based on the principles of Proactive Responsibility and for possible inspections or audits, all aspects concerning the processing of personal data, the correct compliance with the regulations, as well as the corrective measures that are applied must be evidenced. Records of treatment activities will include, at a minimum, the information collected in art. 30 GDPR, which will be reviewed and updated accordingly.

In the event that it is necessary to contract an application and / or Services to an external Entity or to any other Entity of BADGER or its Parent Companies by virtue of which, the latter may / should access / process Personal Data, BADGER shall choose a Provider that offers sufficient guarantees to apply appropriate technical and organisational measures, so that the treatment is in accordance with the requirements of the Regulation. They will sign, prior to access / management of any data, a Service Delivery Contract in which the minimum content that art. 28 GDPR, and the requirements that may be established by the applicable Data Protection regulations.

Other Technical Aspects that will be considered in the Information Management / IT Management Plan:

- Inventory of information systems
- Risk analysis and assessment of privacy impact, including pseudonymisation and encryption of personal data (in some cases); the ability to restore availability and access to personal data quickly in the event of a physical or technical incident; and a process of regular verification, evaluation and assessment of the effectiveness of technical and organisational measures to ensure the safety of the treatment.
- Audits to verify compliance
- Notifications of security violations related to personal data

Brexit and GDPR

UK government has established a new regime, UK GDPR, in use since 1 January 2021. Although there is not much difference between UE GDPR and the proposed UK GDPR, BADGER will adapt its procedures to the new regulation if necessary. Furthermore, BADGER's parent companies are working on a BCR (Binding Corporate Rules) project in order to protect the transfer of personal data from the European Economic Areas (EEA) to third countries and international organisations.

4.3 The methodology for capturing, managing and reporting data for Scheme Specific Performance Measure (SSPM) – “Safety of the Construction Workers” and one other SSPM of your choice;

BADGER develops processes and methodology for capturing, managing and reporting data for SSPMs, able to guarantee information security, data integration and a collaborative workflow.

The SSPMs examined in detail in this section are:

- SSPM 1.1 Safety – Health, Safety & Wellbeing, Safety of the construction workers;
- SSPM 3.1 Deliver the RIS – Delivery, Employment and skills development.



BADGER will undertake a self-assessment of the SSPMs and will submit to the *Project Manager* at the end of each quarter from the date of the notice to proceed, up to the completion of section 3, as per **Performance Manual S3.4**.

4.3.1 SSPM 1.1 - Safety of the Construction Workers

An HS&W management system complying with ISO45001 is adopted for the project. BADGER agrees the specifics and a template of reportable KPI's with Highways England to ensure the fulfilment of corporate and Highways England requirements.

BADGER measures and populates HSW databases and generates HSW performance reports one month in arrears, using both leading and lagging indicators to provide a balanced performance picture.

The monitoring and reporting process is based on the collection of:

- a. Numeric data, identified to monitor statistically the OHS performances, which consist of two groups:
 - Proactive Indicators
 - Reactive Indicators
- b. Descriptive Information through periodic safety reports.

Examples of Reactive indicators	Examples of Proactive Indicators
Accident Frequency Rate	Training in OHS issues
Fatal Injuries Lost Time Injuries & commuting accidents	OHS Audits and Internal Inspections
Medical Treatments (MTC)	Safety Management Walkabout
Work Restricted Case (WRC)	Emergency Drills
Near Miss	Meetings on OHS issues
First Aid Cases (FAC)	TBT / pre-job meetings / JSA
Lost Work Days (LWD)	Safety culture and engagement, Behaviour, Attitude/Maturity surveys, Observations
Worker compensation costs	
Complaints of unsafe or unhealthy conditions	
Property/Material damage	

Reactive Indicators represents incidental events already occurred, include accidents, injuries and Near Miss. Proactive Indicators, otherwise, include all the activities carried out to strengthen awareness reducing the number of injuries occurring in the area of responsibility, both in direct and indirect personnel.

In accordance with **V2P5-S1.4**, BADGER uses the Dalux as the health and safety platform for data collection and management, together with Airsweb2 that is used for Health & Safety Incident Reporting as per **V2P5-3.6**. **QS-16A** describes BADGER Health & Safety management system in further details.

Data collection will take place through the compilation of special cards managed with the help of BADGER Information Portal (BIP) App and Dalux Field, the BIP APP is a bespoke mobile app giving access to real time project information. It is led and managed by the Digital Lead, supported by the Leadership Team. **(TQ5D.1.3. TQ5C2.1 & TQ5C4.2)**

Regarding AFR assessment, hours-worked data, daily captured with access control systems (e.g., badge reader / biometrics), is collected into the P-CDE and exchanged as per **V2P5-1.4.6**. This data is then combined with the number of incidents occurred for AFR score calculation following the **Performance Manual – Appendix B**.

QHSE data reports are available and accessible to different users through apposite area of the Information Portal. Depending on the purposes, the user may have a panoramic view of the situation across the Scheme. Dashboards can be easily exported as excel files, elaborated to perform different kind analysis and are useful to rapidly understand where the project is improving and where to proactively intervene. We improve the Information Portal also to store processes, procedures and systems, enabling quick accessibility of information to the Leadership team and workforce at any time, much of this accessible via the BIP App.

The collection and periodic evaluation of HSW data allows regular monitoring of the safety of construction workers, as well as the



effectiveness of the management system, the implementation of the programs and the achievement of the planned objectives. Once uploaded on the P-CDE, HSW management system data is automatically exchanged every 24 hours to the Data Hub. This is guaranteed using BC Sync, a tool that connects the P-CDE and E-CDE server, both based on Business Collaborator.

BC Sync automates the transfer of files and their metadata, helping support information management processes as per ISO 19650, removing the need to handle and transform data and reducing risk or inefficiencies in handover. Sync allows users to visually define the transfer rules between the servers using an ETL (Extract, Transform and Load) process for direct server to server transfer, settled on routine basis. The transfer between servers is fully captured in perpetuity within the audit trail.

4.3.2 SSPM 3.1 – Employment and skills development

The information portal, based on Business Collaborator, provides access to project information for all the stakeholders involved, including Client, Project Teams, Suppliers, and all employees/workforce or apprentices.

The integration of Microsoft Dynamics apps within the BC portal though embedded links and APIs provides a common access to all significant workforce data and improves employment communications, skills tracking, training and apprentice satisfaction assessment as per **V2P1 – General Requirements**.

The integration of MS Dynamics HR (**TQ5B3.1**, led by the HR Manager), or a similar application, allows:

- promote employee connections with the development of customisable employee profiles that include career;
- accomplishments, skills, certifications, and interests;
- enable self-service access to let employees handle profile updates, training, performance-tracking, and time-off requests;
- provide reports of team performance data, including working days, surveys results, workshops and all evidence required to demonstrate the achievement of employment & skills objectives;

- make managers and Employment & Skill lead able to identify all apprentices individually appointed under the contract;
- help employees grow with training and certification tracking;
- visualise the Defined Cost of Staff calculated, including supply chain, in accordance with the Schedule of Cost Components;
- set alert messages that advise every time that the SSPM indicators are under the required thresholds;
- improve workforce planning via Microsoft Power BI dashboards, helping to analyse & visualise all human resources data.

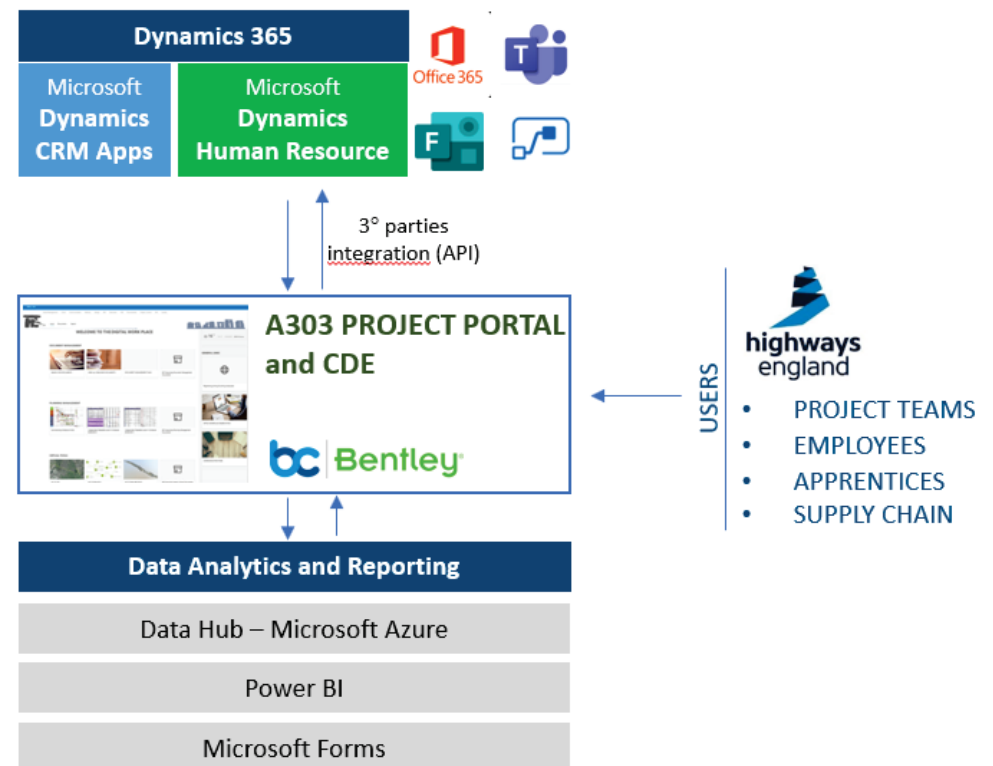


Figure 2: Integration of MS Dynamics within BC (Information Portal)



To evaluate the Apprentice Satisfaction Score, BADGER provides anonymous online surveys to all apprentices through Microsoft Forms (MS Office 365 platform), using the BIP App. Survey questions are compliant with **Appendix B of Performance Manual**. Forms submission timing and processes, including results reporting, will be assessed in the Employment and Skills Plan, submitted within three months of the notice to proceed. Results will be collected into Business Collaborator CDE and exchanged to the Data Hub where customizable dashboards provide response summary information and individual outcomes.

The integration and the management of SSPM 3.1 data within Business Collaborator will be further detailed in the Employment and Skill plan, ensuring the fulfilment of **V2-P1** requirements.

4.4 How the Data Hub will be used to manage data, including a high-level architecture diagram

Data Hub will provide intelligence to the raw data collected from multiple sources including physical environment, equipment, staff and assets throughout the construction site. Overcoming the silos-based traditional concept, BADGER adheres to Highways England's aims of deploying a seamless digital environment where data is collected, exchanged and cross related, providing effective decision-making tool to different agents throughout the life cycle.

Digital projects confront an extremely high velocity of information production with very slow information processing, relying heavily on human knowledge and experience, an approach however with plenty of associated risks. BADGER will adopt an integral strategy putting information in the centre, minimising the need for time consuming meetings and peer-to-peer discussions. Valuable information will be collected and accessed through the MS Azure Data Hub (**V2P5 – section 1.4.6**), including:

- Construction site information - tunnelling equipment & monitoring, surveying equipment, ground works, water monitoring, plant & equipment, construction workers, TM, etc. Data is gathered from sensors, equipment, site reports, etc.

- Project data (HR, HSEQ, Project Controls, etc.)
- PIM and geospatial databases, delivered through the P-CDE (ProjectWise cloud along with iTwin services)

BADGER's Data Hub gathers all the information from the different databases and authorised information sources of the project. Under the premises of SSOT philosophy, data will be stored, cleaned, structured, and enriched, for the correct visualisation on demand.

Visualisation and Communication	Reporting to different stakeholders in the project
Processing	Project data analytics to support different processes
Analytic	Data set configuration to support analytical modeling and geographical display
Perspective	Enriching Data: Add necessary extra data Structuring Data: Clustering data
Staging	Cleansing Data: Unify types, identify missing data & remove doubles Importing Data: Versioning & Validating Identification of the DDBB "silos"
Source	Data Matrix configuration: Analysing data sources and consumers

BADGER will work with the MS Azure Platform, owned by Highways England. Different insights and analytics will be provided, once agreed with the *Project Manager*. Data is considered to be live, but unique throughout the different systems.

BADGER's Information Portal, based in Business Collaborator (BC), will provide access to the Project Team and Highways England to relevant information of the PIM (including GIS) embedding the P-CDE. It will serve as well as the Document Management System (DMS) of the Project (ISO 19650 compliant). Information will be exchanged automatically from Teams Shared status in P-CDE to Client Shared status/Published in E-CDE, taking advantages of sharing both systems the same BC technology (BC Sync).



BADGER's Information Portal will serve also as collaboration tool for the different teams. Each team (HSW, Quality, Project Controls, Design/Delivery, Traffic Management, Communications, Asset Management, etc.) will have a dedicated part where information will be managed in a collaborative manner, and later automatically integrated in dashboards. iTwin Services (Design Review, Synchronizer and Viewer) integration in the Information Portal will support visualisation and insights to the different teams.

On top of that, the BIP App will provide access in mobility and desktop, granting accessibility to engage and align team members with the project culture. The App will be a mirror of the Information Portal, able to integrate 3rd parties' systems with embedded links or APIs. A high-level map depicting our proposal is depicted below:

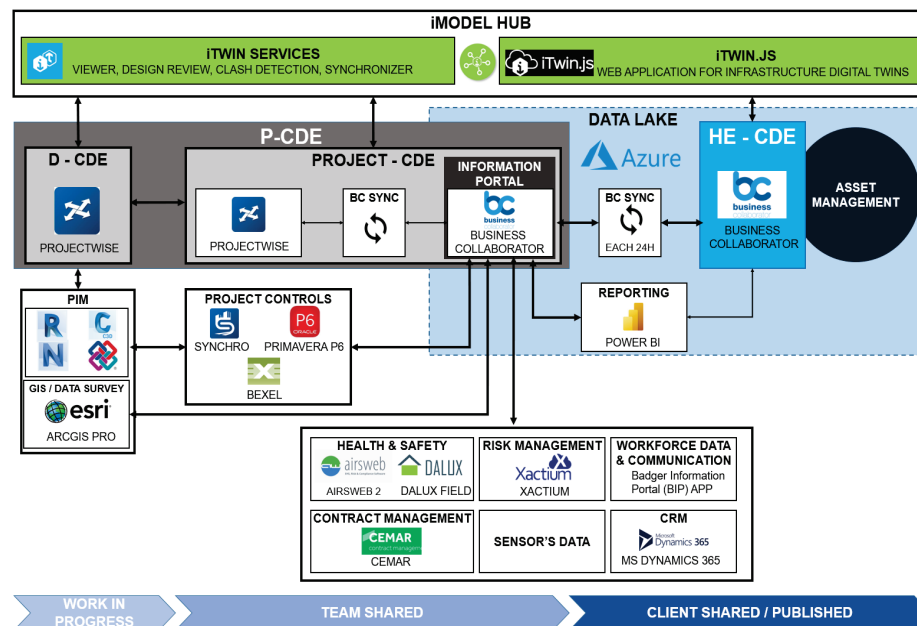


Figure 3: High level map

4.5 How unauthorised and malicious access to data sources and systems will be prevented, including how those prevention methods will be tested

An Information Security Management Plan (ISMP, **V2P5-2.1.10**) will be defined in order to prevent unauthorised and malicious access to data sources and systems. The ISMP and the ISMS (Information Management Security System) shall comply with the requirements of BS ISO/IEC 27001 and BS EN ISO/IEC 27002. One of BADGER's JV partners is certified in BS EN ISO 27001 by EU full member accredited body. In case HE deems it necessary, the scope of this certificate will be widened and certified by UKAS/IQNet within 6 months of the Contract Date, guaranteeing compliance with clause **V2P5 2.1.8**.

A Security Lead will lead, manage and assume responsibility of the ISMP, being responsible for implementing the strategy for deploying the infrastructure, including its protection, the networks and data handling protocols, prevention of breaches and reaction to attacks.

The ISMP will meet also with the guidance and recommendations contained in BS EN ISO 19650-5:2020 and will be agreed with the Information Services Lead (**V2P5-4.1.1**)

The expertise, leadership and business knowledge will be crucial to develop the ISMP. A PDCA (Plan, Do, Check, Act) approach with continuous evaluation and improvement will be chosen for its development.

The steps to implement an adequate ISMS will include:

- conducting an information security risk assessment,
- establishing the risk management process,
- implementing the risk treatment plan,
- measuring, monitoring and reviewing the processes,
- following principles specified in ISO 19650-5:2020 – Security-minded approach to information management, by adopting ISO 27001 certified systems and software.



To ensure compliance of security policy and to reduce the risks to an acceptable level, security audits (internal and external) will be conducted periodically. In addition to manual security audits, automatic analyses will be carried out such as vulnerability analysis and ethical hacking. Red team and blue team techniques will be also considered. All the reports generated by these activities will be provided to the *Project Manager*.

Unauthorized and malicious access to data sources and systems will be prevented by implementing the following measures:

Prevention of unauthorized access to systems

- Management of roles and permissions
- Management of privileged accounts (administrator accounts)
- Hardening of systems (disable unnecessary and / or vulnerable services) **V2P5-2.5.3**
- Monitoring of access through a SIEM to detect these unauthorized access in real time.

Prevention of unauthorized access to information

- Permission management, aided by CASB (Cloud Access Security Broker), for Cloud SaaS environments
- DLP (Data Loss Prevention) to ensure that end users do not leak sensitive information out of the company
- Document encryption with IRM (Information Rights Management) or AIP (Azure Information Protection)
- Monitoring of the accesses through a SIEM to detect these unauthorized accesses in real time.

Prevention of malicious access to systems and information

- Management of roles and permissions
- Management of privileged accounts
- Antivirus / antimalware / EDR (Endpoint Detection and Response) platforms
- Comprehensive vulnerability management (vulnerability analysis and patching)
- Hardening of systems

- Monitoring of accesses through a SIEM to detect these malicious accesses in real time.

Monitoring and audits

- Vulnerability analysis
- Red Team / Blue Team for the detection and resolution of security problems
- Periodical Security audits.

Security Operation Centre (SOC)

BADGER digital team will assist the Project through its Security Operation Centre (SOC). The main services offered by SOC are DLP (Data Loss Prevention), SIEM (Security Information and Event Management), Sandboxing, Forensic Analysis, Incident management and Vulnerability Analysis.

Digital Signatures

BADGER uses Adobe Sign for the purpose of Digital Signatures. Signed versions will be stored in the CDE as a new revision or rendition. Our chosen CDE has integrated fully with Adobe sign to streamline the process. This option will present HE with minimal overhead and will retain a full audit trail and ensure only those with permissions to execute documents (with digital signatures) will be able to upload these to the system.

4.6 How network redundancy will be provided

As recommended for Fully Redundant Multiple Switches, Network redundancy will be provided through two Internet connections. Over these connections, two Meraki firewalls (MX84) will be installed. Each firewall will be connected to both Internet routers. Finally, there will be two switches connected between them and each of them connected to both Meraki firewalls.