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Entity Automation & Information Management Guideline

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1.0 PURPOSE

This document serves as a guideline for the Entities in developing an Automation and Information Management strategy for executing their projects and feeding into operations. The guideline is to help realize the full benefits of Automation and data utilization in Project Management and Operations. Automation and Information Management are a key part in achieving the desired state of “World Class-Best Practices tools and processes” stated in the strategic objectives of the NPMO Charter.

2.0 INTRODUCTION

This document is a guide to assist the Entity in their development of an automation strategy for new projects’ execution together with recommendations related to the automation of its operations. The imperative for the digitalization and then automation of the Entities is to enable the productivity and efficiency improvements required to be able to perform at the level of international best practice. To achieve this, Entities must ensure that their A/E’s, sub-contractors, and consultants are also using the latest digital technology which the entities can then leverage to the benefit of their projects.

Automation in the context of this document refers to digital work processes and software tools associated with the design through to the operation of a facility or building. It includes design and analysis software, procurement software, construction tracking and reporting, data repositories, etc. focusing mostly on Computer Aided Design (CAD), Building Information Modeling (BIM), Geographic Information Systems (GIS) along with associated Information management (IM) and associated productivity tools. For more information on these items, see Section 8 of this document.

2.1 Why Automation?

Digitalization of government services is critical to meeting the evolving expectations of the citizens and businesses of the Kingdom by improving services, processes, decision making and data sharing. A high degree of digital integration, where paper processes are replaced with data, is key to driving the efficiency and productivity of the Entity services and operations. In this digital environment, Automation delivers powerful workflows using data to handle the business processes more effectively and share data between different systems. Digitalization, in many cases, eliminates the need to recreate data across multiple systems and can allow immediate access, transparency and availability of data.

Significant opportunity exists to close the gap between the current productivity and quality, and the potential productivity and quality of Entity’s projects and operations. Underutilized, poorly utilized or the absence of automation solutions altogether can be a major barrier to realizing the full capability of the Entity. The more digitized, or “data-centric”, that information can become will allow for a higher degree of automation which will help close the “opportunity gap” that may exist in a partially digital environment.

By utilizing automation technologies like BIM and GIS, project teams are able to communicate better, allow all to visualize the project, make the design more transparent, and allow construction to develop effective work sequences. Thus it allows for quicker and more effective decision-making at every stage of the project. Without automation technologies, projects move at the pace of document transmittals. Previously, quality control was managed through multiple handoffs between functions and layers of management, this creates openings for errors and delays each step of the way. Systems such as BIM and GIS are based on a single source of information, with all involved in the design, procurement, and construction viewing the same database in a controlled environment.

While automation and information management starts with the A/E during the design, the benefits go far beyond the A/E into the project being more cost effective during procurement and construction. The follow-on effect is that the facility is more effective and efficient to operate supported by the electronic data that will provide rewards for years to come.

Ensure that Engineering is engaged at the earliest phase of a project and requirements are implemented by project Engineering

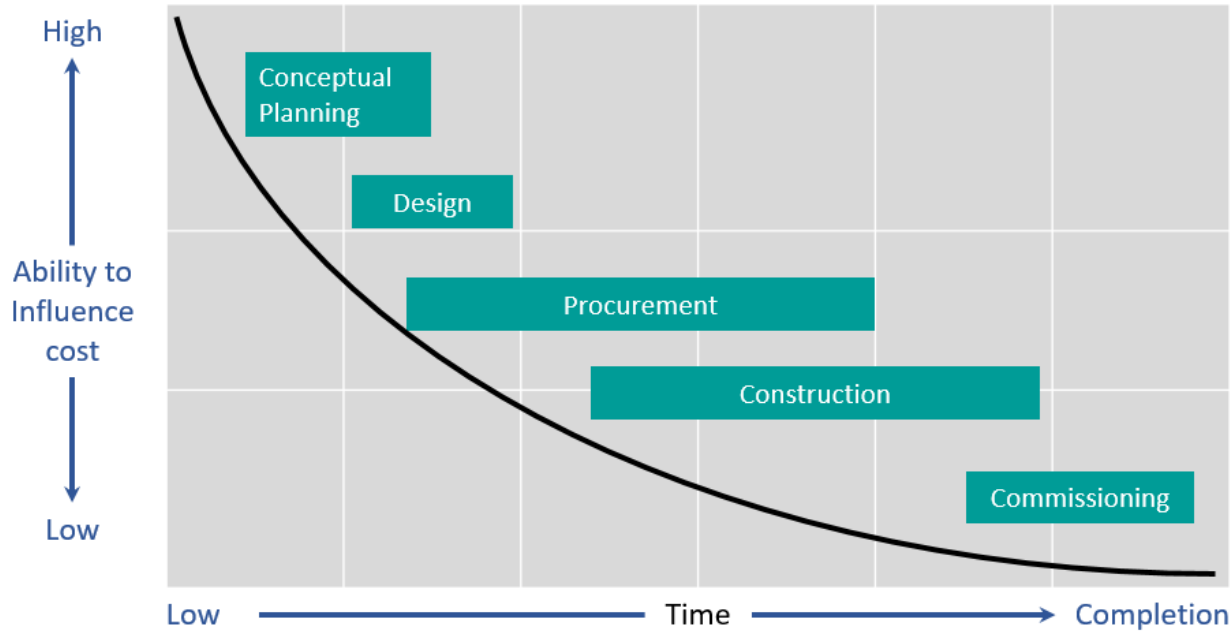

Figure 1: Cost influence curve

While Automation has allowed the AEC industry to become more productive, these gains have been in making the existing work processes incrementally more efficient rather than being transformative.

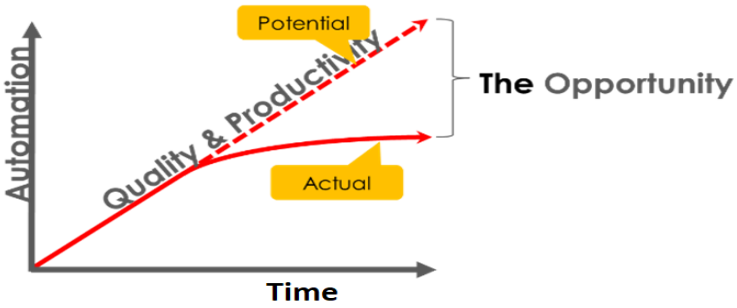

Figure 2: The opportunity gap

The transformation from a predominantly paper based project and operations environment to a predominantly data based environment is an evolutionary rather than a revolutionary process. Current services and operations need to be maintained, staff will need to be trained and/or new staff will need to be hired. The Entity will need to determine how to introduce new automation tools and techniques connected with new projects. This will require that existing assets or services become part of the “digital plant”.

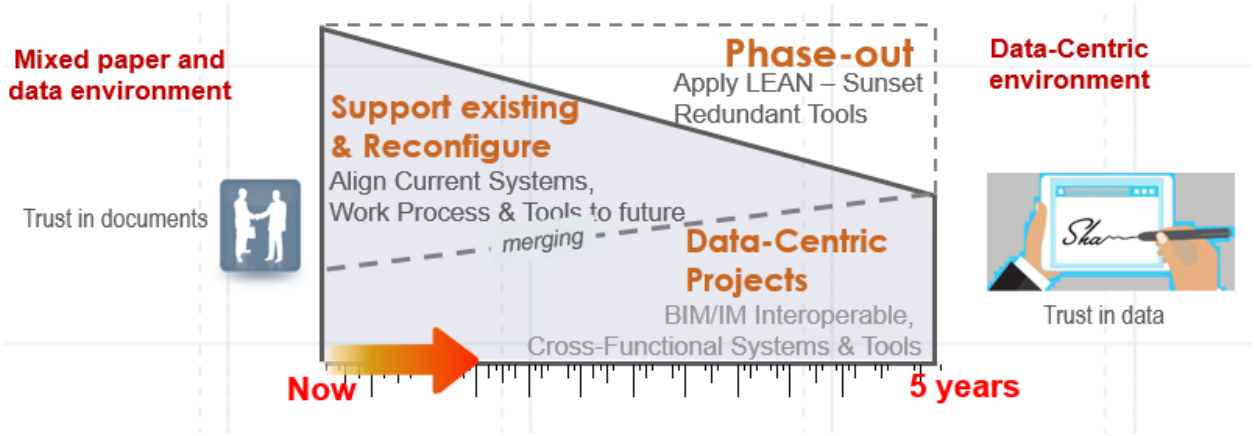

Figure 3: The evolutionary approach

Barriers to realizing the full potential of Automation may be technical, legal or human. To evolve as seamlessly as possible, the Entity must be cognizant of these factors creating an appropriate strategy to facilitate change.

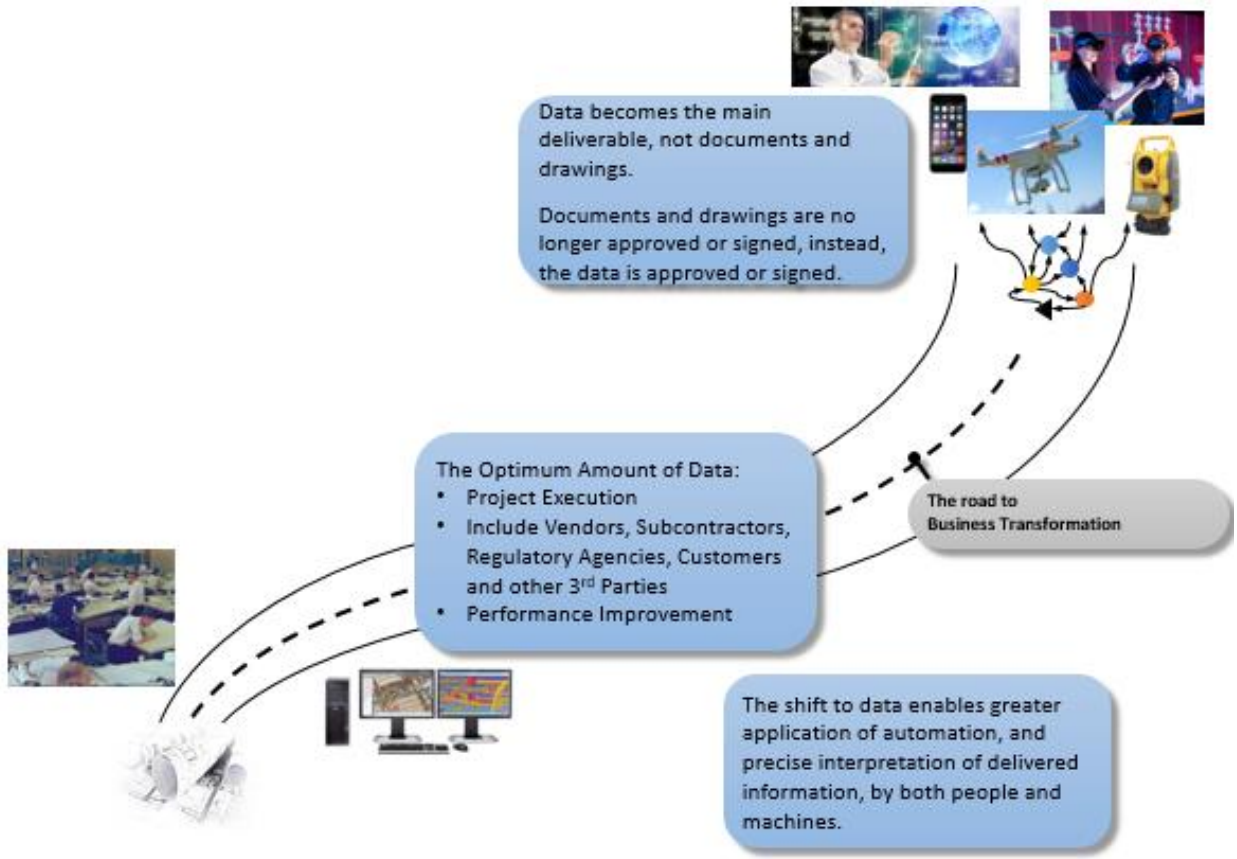

Figure 4: The road to business transformation

2.2 Benefits of the data-centric approach

A data-centric approach provides the following advantages:

1. Improved ability to sustain information accuracy and reduced information loss
2. Data is easier to manage and easier to access compared to paper
3. Critical information is easier to access for the right person at the right time, leading to better designs and decision making
4. New work process opportunities will emerge from digital solutions that create value over the paper based processes

5. Improved collaboration with A/E's, 3rd parties and construction is possible, using advanced planning and visualization tools
6. Entity adoption becomes a catalyst for change by the A/E facilitating the use of practices only permissible in a digital environment.

These benefits all contribute to reducing costs in operations and total installed costs of projects if utilized by A/Es as recommended in this guideline.

2.3 The Information Model

In order to represent the relationships, constraints, rules, and operations of data obtained during design and operations the overall information model for the Entity should be considered as consisting of 2 separate but compatible data models: a Project Information Model (PIM) and an Asset Information Model (AIM). The use of the data gathered and how it grows with a project is shown in Figure 5.

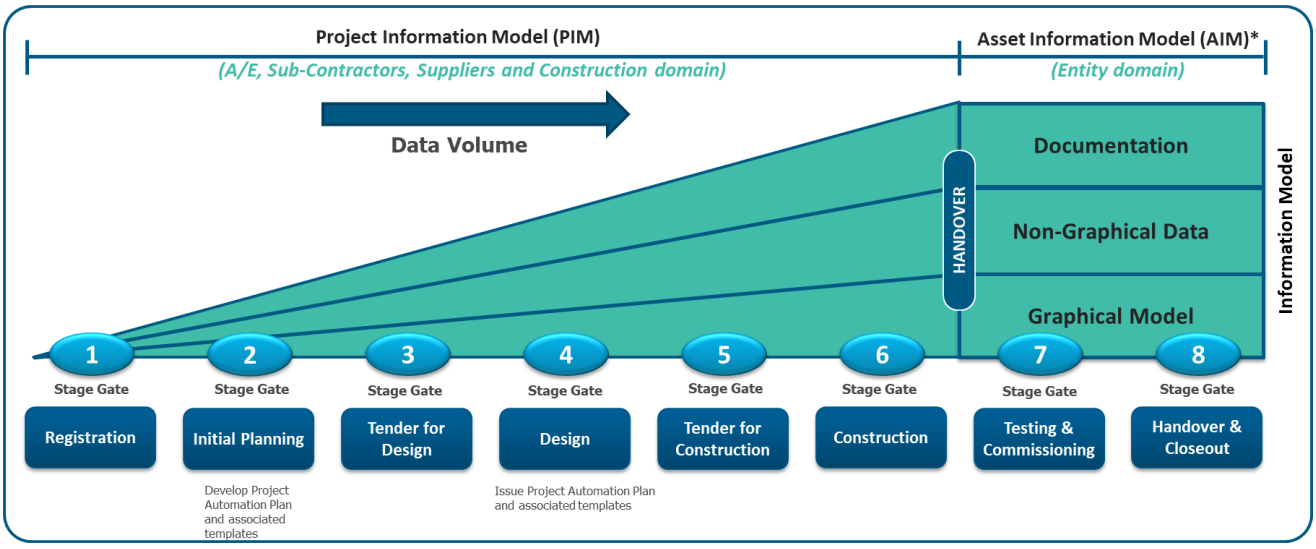

Figure 5: Entity Information Model (projects)

- The **PIM** is a suite of software, databases and associated work processes that forms the information and graphical environment developed during the design and construction phase of the project. This environment is the interface with the A/E on projects and is designed to receive and process their deliverables. It may consist of CAD, BIM and model viewing software, databases and tools to manage data from the A/E. The main purpose of the PIM environment is to manage and control the data that will be turned over to Operations and Maintenance (O&M) department for loading into their software

- The **AIM** is a suite of software, databases and associated work processes that is used by operations to operate and maintain the Entity assets. Files and databases from the PIM are used together with operations and maintenance software systems such as Computer-aided Facility Management (CAFM), Computerized Maintenance Management System (CMMS), Enterprise Content Management System Software (ECMS) and Enterprise Resource Planning (ERP) to form the AIM.

Typically, without an AIM, information about the plant often exists in:

- Non-digital form e.g. manuals
- File cabinets
- Unstructured electronic files e.g. PDFs, spreadsheets, MSWord files
- Scattered storage devices or servers e.g. files

By the Entity prescribing the form and content of the data that it requires from the A/E, it will be able to:

- standardize project progress reporting
- visualization of their projects
- utilize A/E design data to seed their O&M databases
- develop the "single source of truth" concept in a Common Data Environment (CDE) -see section 8.4

3.0 SCOPE

The scope of this guideline pertains to the development of the PIM environment discussed above for new projects and for existing projects where possible. It is recommended that the Entity also develop the AIM in order to be able to benefit from the data-rich project environment that will develop and grow in the future. The Entity is encouraged to modernize its existing operations where practical to obtain benefits of scale, standardization and centralization of O&M. However, the full scope of work will need to be determined once an assessment of the current state of digitalization and automation has been made by the Entity.

3.1 Documentation

In creating the overall Automation/Information Management (IM) environment, these documents will need to be developed by the Entity:

1. **Digital Transformation Strategy Document:** a clear strategy document needs to be created that presents the goals for CAD/BIM/GIS and IM discussed in this document. While these technologies will result in productivity and efficiency gains on their own it should be explained that these are also prerequisite technologies for employing new technologies such as the Internet of Things (IoT), drones, sensors, Augmented Reality/Virtual Reality (AR/VR), mobile productivity tools, big data and analytics, and other innovations. This document should present the goals, schedule, cost and resources required in sufficient detail for obtaining management approval

2. **Entity Automation and Information Management Plan:** This will describe the PIM, in the context of the planned AIM environment, by defining a software portfolio of suitable commercial software, together with work processes, staffing, and IT infrastructure requirements to engage with the A/Es in order to provide the digital deliverables to Entity O&M departments. This will be an internally developed document based on the Digital Transformation Strategy Document for the Entity to follow.

3. **Project Automation Requirements and Deliverables Plan:** This document will be developed for each project by the Entity from the guideline and issued to the A/E. It will describe the project specific automation requirements including any mandated software tools or work processes to be followed by the A/E, 3rd party consultants and contractors in order to create the required project deliverables. Refer to EXPRO guideline document: **Project Automation Requirements and Deliverables Guideline** (NPM-KE0-GL-000020). Attachments to this document include the BIM Execution Plan (BEP) template.

Automation Documentation Schema

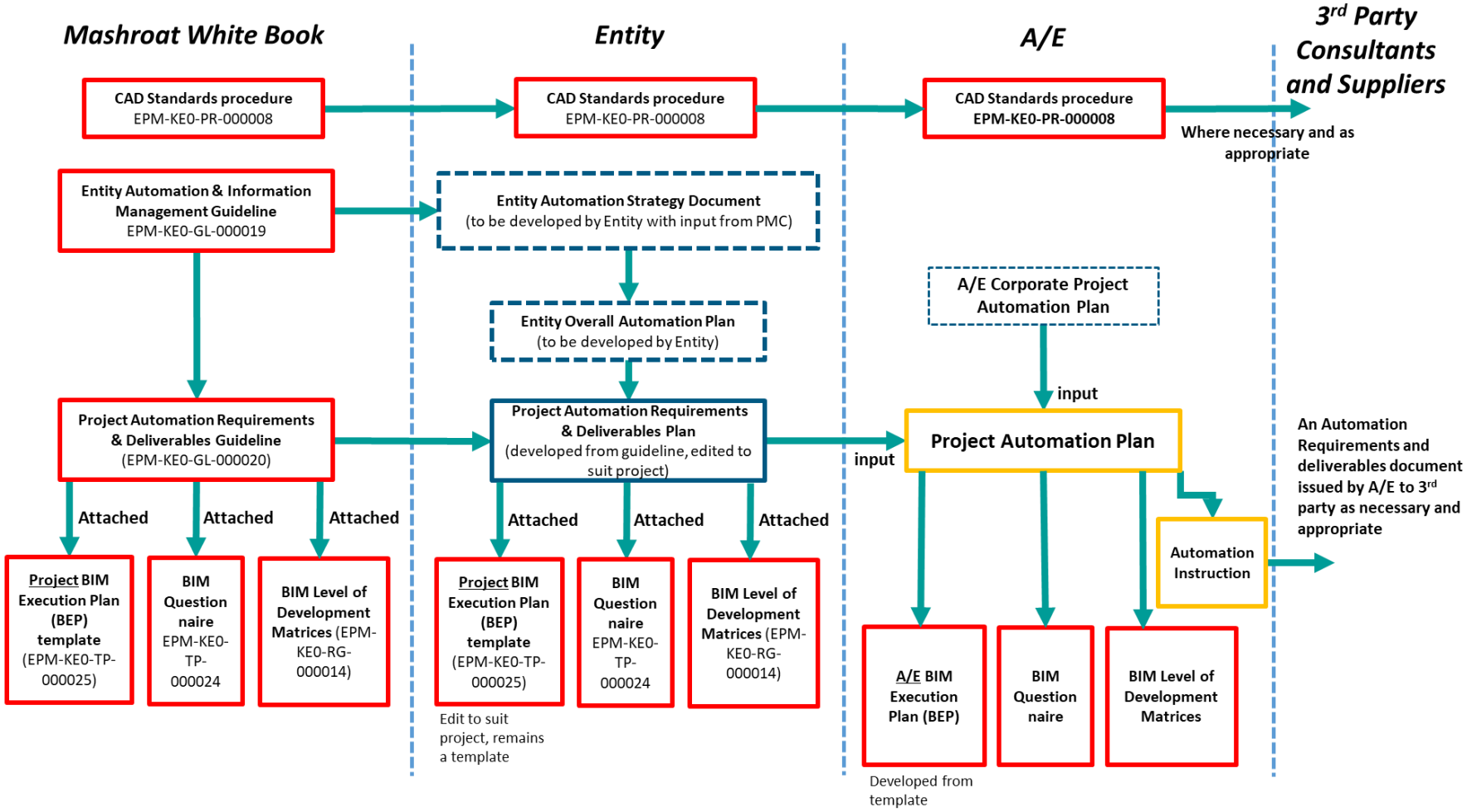

Figure 6: Automation documentation schema

These documents should be reviewed and updated annually as a minimum to reflect changes and lessons learned from projects in progress, completed projects, and feedback from O&M.

Automation/digitalization is a key part of the Entity organization-wide IT strategy and should not be viewed in isolation. Implementation of the Automation plan must take into account location, interconnectivity of projects/facilities, percentage network up time, back-ups, staff capability, etc.

The scope to be covered by these documents is the Automation and Information Management related to the execution of projects by the Entity resulting in physical assets, the digital representation of these, together with associated data. These deliverables may or may not be immediately utilized in Operations but may be required in the future as part of any modernization of Entity O&M systems.

Together, these documents need to cover the following broad tasks and activities:

- Assess the current Automation system being currently used in the Entity (if any) as it relates to Project Delivery and Operations
- Determine the digital requirements that the Entity's O&M requires from the project. The needs should be based on operations, maintenance, and training. The Entity should consider what information might be helpful in the future even though there may not be an immediate need for it today
- Establish the Automation environment for the management of projects undertaken by the Entity for managing the electronic deliverables from the A/E to the Entity
- Determine the process for delivering the project model and data deliverables to the Entity's internal O&M customers
- Develop a list of documentation required. This could include procedures, instructions, process diagrams, lists, tables, etc.
- Provide a training plan for the resulting work processes and software

3.2 Plan Execution

The Entity, in developing the **Entity Automation and Information Management Plan**, will be required to develop an activities list, schedule, budget, and staffing plans etc. in order to implement the plan.

3.3 Excluded from scope

Although project related Automation may impact or be impacted by the areas below, they are excluded from the scope of this document:

- Document or Content Management Systems (EDMS or ECMS). Integration of these systems with Automation discussed here may be required depending on Entity strategic plan
- Information and Communications Technology (ICT) infrastructure
- Office Automation software
- Enterprise Resource Planning (ERP) systems
- Facilities Management & O&M systems

4.0 DEFINITIONS

Definitions	Description
A/E	Architectural/Engineering
AIM	Asset Information Model
AR/VR	Augmented Reality/Virtual Reality
Automation	Field of specialized software tools and associated work processes involved with the creation of A/E project deliverables. Focus is on CAD/BIM/GIS and IM
BEP	BIM Execution Plan

BIM	Building Information Model(ing) VERB: A cross-functional collaborative process of creating, collecting & managing information to virtually design, procure, schedule, construct, commission, start-up and operate a facility. BIM therefore develops a digital representation of the physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward NOUN: The collection of files and databases used in building the information model of the facility
CAD	Computer Aided Design
CAFM	Computer-Aided Facility Management
CDE/ Data Warehouse	Common Data Environment: Large store of linked Data and trusted source of truth of the assets
CIO	Chief Information Officer
CMMS	Computerized Maintenance Management System
COBie	Construction Operations Building Information Exchange (**COBie**) is a non-proprietary data format for the publication of a subset of Building Information Models (BIM) focused on delivering asset data as distinct from geometric information
Digital Asset	3D models, databases and other digital media that represent the plant in the form of digital graphics and data
DOR	Division of Responsibility
ECMS	Enterprise Content Management System (software)
EDMS	Enterprise Document Management System (software)
ER	Exchange Requirements: Defines the information that will be required by the Entity from the A/E, suppliers, and consultants for the operation and maintenance of the completed built asset
EPC	Engineering, Procurement and Construction
EPMO	Entity Project Management Organization: This is an integrated team that comprises the Entity and its PMC responsible for managing all of the Entity's projects
ERP	Enterprise Resource Planning (software)
FTP	File Transfer Protocol
GIS	Geographic Information System
HAZOPS	Hazard and Operability Study
ICT	Information & Communications Technology
IFC	Industry Foundation Class file type
IM	Information Management
IoT	Internet of Things
IT	Information Technology
LiDAR	Light detection and Ranging (laser scanning)
LOD	Level of Development
MTO	Material Take-Off
NavisWorks	3D Model Review software
NGIS	National GIS Committee (a body of the General Commission of Survey (GCS))
O&M	Operations and Maintenance
OS	Network Operating System
PMC	Project Management Company: An external consultant engaged by the Entity to deliver capital expenditure infrastructure projects
PIM	Project Information Model
Raster	Image consisting of a grid of points of color (pixels)
SASO	Saudi Arabian Standards Organization
SME	Subject Matter Expert
Super User	Subject matter expert who will define how the software will be used, support software implementation, and drive its implementation on the project
TIC	Total Installed Cost
TCO	Total Cost of Ownership

5.0 REFERENCES

Reference	Description
NPM-KE0-PR-000008	CAD Standards Procedure
NPM-KE0-RG-000009	List of Commonly Used Design and Engineering Software
NPM-IT0-PL-000001	Project Information & Communications Technology Plan
NPM-KE0-GL-000020	Project Automation Requirements and Deliverables Guideline
NPM-KE0-TP-000025	Project Building Information Modeling Execution Plan (BEP) template
NPM-KE0-TP-000024	BIM Questionnaire Template
NPM-KE0-RG-000014	BIM Level of Development Matrices
NPM-KE0-TP-000012	Tagging Procedure – Template
NXP-DP0-GA-000002	Industry Available Project Management Tools
NPM-KE0-TP-000032	Automation Survey Template
NBIMS https://www.nationalbimstandard.org/	National BIM Standard – United States website

6.0 IMPLEMENTATION REQUIREMENTS AND BASELINE ASSUMPTIONS

Automation implementation, especially BIM and GIS are highly recommended across all Entity projects. EXPRO recommends that at a minimum the Entity shall design all projects to 3D BIM.

The following are major factors in implementing BIM/GIS on a project:

- **Complexity**
  Based on the project design's size, technical complexity and degree of cross-discipline coordination required. The need for implementation should be specifically assessed and decided at Initial Planning Stage, as part of the Project Execution Plan, prior to progressing through Stage Gate 2

- **O&M and Facilities Management**
  6D BIM (see section 8.2.1 of this document) should be implemented where O&M and Facilities Management is part of the project scope or deemed a highly probable requirement in the near future

- **Phased Project Delivery**
  Should the project be part of a phased project or deemed a phase of a wider development, BIM and/or GIS is recommended in order to facilitate the design and construction of future phases

Decision-making in regards to Automation implementation incorporates the following high-level implementation factors:

1. **Policies & strategies:** The approach by the Entity in adopting Automation to meet project and operational needs must align with the overall goals and objectives in the National Manual for Project Management(NMPM).

2. **Change management:** A new automation plan will require change management to manage the people side of the change to achieve the desired business outcome. This will be done by program coordination, knowledge transfer, performance management, education, and training.

3. **Standards and processes:** to be developed by the Entity must include provisions for future value to be created from the data.

4. **Integrated Automation technology:** Project Automation processes and model management tools must be designed to deliver information in a collaborative environment across the Entity's organization as well as with external organizations (other Entities and contractors)

5. **Centralization:** The Entity must determine how much of the information, control, analysis, etc. is to be centralized and how much data and control will remain at a local office/plant.

7.0 ASSESSMENT OF CURRENT AUTOMATION

As part of developing the Entity Automation and Information Management strategy to develop the PIM environment and future AIM environment, an assessment must first be made of the current automation status of O&M and Project Delivery Divisions of the Entity. As part of this assessment the Entity shall create a tailored survey document with questions that will help in determining the current status.

Refer to document number NPM-KE0-TP-000032 – Automation Survey Template (Attachment 1) for a sample questionnaire. Add/Delete/Modify the sample questions to suit the project.

8.0 FOCUS OF AUTOMATION

EXPRO promotes the use of major modern technologies by the Entities and in turn by the A/Es designing and building projects for the Entities. The software used for this will vary depending on the type of project.

In determining whether to adopt the software on a project, the Entity will need to determine whether the projects have the size and/or complexity that warrant the deployment of the more advanced software tools on a project. Generally, once an organization has made the investment in Automation, smaller projects are included in the interests of completeness and standardization.

Research should be conducted to determine the world class/ best practice implementations of Automation and Information Management software applications at similar Entities around the world. Cost vs benefit analysis must be made for each proposed software application as part of the business case. A proposed software application is one that has a perceived value in terms of cost-saving, ease of use, customer experience, speed, efficiency or other positive attribute that will improve the business of the Entity. The Entity must assess if it has the capability to implement the software application and what it will take to do it and what the cost will be.

Each software application proposed will require:

- A business case - outlines the project and includes its background, benefits, scope and risk assessment
- A statement of requirement - outlines the necessary resources (time, people and cost)
- A project development plan - includes the project schedule and risk management plan
- A launch plan - details the project rollout

Software applications will be approved by the Automation sponsor (discussed in Section 12 titled Senior Sponsorship) upon final recommendation from the Automation Manager after thorough consultation with the heads of department and Subject Matter Experts (SMEs). An applications portfolio document will be developed listing the approved suite of software approved by the Entity. Project Delivery related software applications generally fall into the broad technology categories below but not limited to these:

8.1 Computer-Aided Design (CAD)

CAD is the use of computers to create drawings and diagrams. CAD should be used for conceptual design drawings, schematic and standard drawings. Design of buildings and facilities should performed using 3D modeling software (3D BIM) with models loaded with data per the Entity Exchange Requirements.

8.2 Building Information Model or Modeling (BIM)

BIM is a cross-functional collaborative process which can include creating, collecting & managing information to virtually design, procure, schedule, construct, commission, start-up and operate a facility. BIM therefore develops a digital representation of the physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis

for decisions during its lifecycle from inception to decommissioning. With BIM, think 'model' - not 'drawing'. CAD is no longer a standalone activity but part of a holistic process of building the information model. BIM therefore encourages a Total Installed Cost (TIC) or Total Cost of Ownership (TCO) approach to decision-making rather than a compartmentalized one.

There are levels of development (LOD) and BIM dimensions that define its various facets. The 3D model, while only one component of the BIM, is at the core of BIM.

8.2.1 BIM Dimensions

3D – Object based 3D design model that is clash-free and the model elements are labeled or tagged.

3D modeling software is currently the best way to communicate design intent with design partners, procurement, and construction teams as well as interface with contractors. 3D modeling is a mature practice and has expanded include features such as;

- Real-time global work sharing amongst project participants
- Integration of 3rd party models
- Real time reporting of model Material Take-Off (MTO) quantities
- Automated drawing production
- Integration of laser scans in the model
- Augmented Reality/Virtual Reality (AR/VR) for 3D model reviews, safety in design, construction reviews etc.

3D software can expand to include customer operations readiness, start-up systems planning and progress, safety in design and more.

4D (3D plus time) – This is integration of the project schedule (construction or other) together with the 3D model. 4D efforts can vary from weekly 4D storyboards, images showing each milestone, animations of a construction simulation showing progress, or a detailed 4D implementation plan for the project life cycle over time.

Detailed 4D planning and visualization typically leverages off a work packaging or sequencing strategy. The work package number is associated with model elements and can be linked to events in the planning software. 4D efforts often focus on complex parts of a facility where access and constructability issues may arise to clarify and optimize the sequence of construction. More advanced uses are to display construction status and supply chain status information graphically providing a valuable tool for construction and workforce planning

5D (3D plus cost) – Use of the 3D model for performing quantity takeoffs & monitor material quantities, deliveries, subcontracts, and construction resources such as labor and equipment. It may or may not include the project schedule

6D – Information needed for commissioning, start-up, turnover, facility operation and management is called 6D. Developing a Common Data Environment (CDE) or “data warehouse” for the project is a key element of the data-centric approach, which can be utilized for data handover to seed operations. Data from the A/E delivers benefits to the Entity O&M organization, which can include:

- Harvesting data to seed the customer’s systems is cheaper, can be done earlier and is typically more complete
- Providing a single source of up-to-date information about the plant
- Delivering accurate and fast access to data
- Integrating with Electronic Document Management Systems (EDMS), Enterprise Resource Planning (ERP) and Computerized Maintenance Management Software (CMMS) systems
- Turns stand-alone data into information by building relationships of tagged items with drawings, datasheets, drawings etc.

7D/8D – Tracking commercial, physical, and safety risk, including mapping potential construction safety issues, Hazard and Operability Studies (HAZOPS) and critical path / long lead-time items. These BIM dimensions are not as well defined and are not often employed to date.

The Entity will promote the 3D BIM as a minimum requirement. Entities that require data from projects for utilization in O&M should be utilizing 6D BIM. The Entity may request as much BIM data from the A/E as the Entity thinks is appropriate for the project. For planning and visualization, the A/E may employ 4D BIM or other dimensions during the design of projects depending on the A/E capabilities and desires.

8.2.2 BIM Level of Development (LOD)

The level of development defines the content and reliability of BIM elements in the model: The BIMForum's interpretation of the LOD definitions are as follows:

LOD 100 - elements are not geometric presentations. They may be symbols or other generic representations of information that can be derived from other model elements. Any information derived from LOD 100 elements must be considered approximate

LOD 200 - elements are represented graphically but are generic placeholders, e.g., volume, quantity, location, or orientation. Any information derived from LOD 200 elements must be considered approximate

LOD 300 - elements are graphically represented as specific systems, objects, or assemblies from which quantity, shape, size, location, and orientation can be measured directly, without having to refer to non-modeled information such as notes or dimension call-outs

LOD 350 - elements are enhanced beyond LOD 300 by the addition of information regarding interfaces with other building systems. For example, an LOD 350 masonry wall element would include jamb conditions, bond beams, grouted cells, dowel locations, and joints – information that enables the model user to coordinate the wall element with other systems in the structure

LOD 400 - elements are modeled at sufficient detail and accuracy for fabrication of the represented component.

LOD 500 - facilities management - This level will have suitable geometry and information to support operations and maintenance. Geometry and data should be as built and field verified

In the project development phase, the Entity will generally leave the milestone LOD requirements to be determined by the A/E according to its needs. The LOD that the Entity expects to be delivered in the final model handover will depend on the type of project. Generally, if the end requirements are for visualization purposes only, an LOD of 300 will be sufficient for simple projects. For facilities with significant operational plant and equipment, tagged objects will require LOD 500 while the remaining object may be LOD 300.

A/E's firms designing plant and buildings shall utilize 3D BIM starting at a level of development (LOD) determined by the Entity. Generally, a goal of LOD 350 is the expected standard as part of the Entity's 5-year plan. In projects where the Entity has defined data Exchange Requirements, a LOD 500 is expected.

8.3 Geographic Information System (GIS)

A geographic information system (GIS) is a system designed to capture, store, integrate, manipulate, analyze, manage, and present spatial or geographic data. The key word to this technology is Geography – this means that some portion of the data is spatial. In other words, data that is in some way referenced to locations on earth. Coupled with this data is usually tabular data known as attribute data. Attribute data can be generally defined as additional information about each of the spatial features. For example, schools, the actual location of the schools is spatial data. Additional data in the GIS system would be the school name, level of education taught, student capacity; all of these could make up the attribute data.

There are GIS applications one can purchase (ArcGIS, for example) or those that can be obtained for free (QGIS, for example). The GIS applications are software tools for users to create interactive queries,

analyze spatial information, edit data, and display the data. The GIS data can be stored as a graphic, as a raster document, a photo, as well as other digital data.

GIS has numerous applications and today is an indispensable part of the planning process. The Entity will need to determine what software is most suitable for its operations in terms of what GIS maps it will create, utilize, share, and what is being used by the A/E and 3rd parties.

A National GIS Committee (NGIS) has been formed by the General Commission of Survey (GCS) to establish a national GIS database according to the latest national and international standards and specifications. The NGIS is to establish regulatory and organizational rules needed to establish the vision, mission, goal, detailed tasks, organizational structure needed for the national GIS infrastructure program. It is the Entities responsibility to provide the data and input required by the NGIS. Entities that develop GIS databases should be consistent with the NGIS requirements per Council of Ministers' Resolution # 388: 3.7. These are:

1. World Geodetic System 1984 (WGS84) and subsequently developed offshoots thereof such as the international Terrestrial Reference Frame 2000 (ITRF2000) and subsequent versions to date.
2. Vertical reference of the Saudi Geodetic Network, namely Jeddah 1969 Mean Sean Level (SAVD71) or any later version of that reference developed as a result of increased measurements and observations.
3. Universal Transverse Mercator (UTM)

Work shall be carried out in full coordination with the e-Government program (Yesser) in order to make sure that redundancy is avoided. For more information see:

http://en.nsdi.gov.sa/Add-Content/Home_Files/More.aspx

8.4 Common Data Environment (CDE)

Developing a client CDE or data warehouse should be considered by the Entity as part of its operations to take full advantage of executing projects in a data-centric way since productivity and efficiency savings are mostly realized in Operations. The key to well-structured data is a Common Data Environment (CDE). A CDE can take many forms from a single repository like an ECMS (Electronic Content Management System) - more suitable for an Owner/Operator, to various configurations of a staged process (WIP/Shared/Published/Archived) that uses multiple databases. The CDE is the single source (not necessarily a single application) of information where graphical and non-graphical data for the asset is collected, managed, and shared. Depending on the size or type of project, it could be a project server, an extranet or a cloud-based system.

Creating this single source of information facilitates collaboration between project stakeholders and helps avoid errors and duplication of data. The CDE acts as the "trusted source of truth" for the plant populated with information from the A/E, Procurement and Contractors collected via the data Exchange Requirements (ER).
Information in the CDE is used to seed data for assets in Computer Aided Facilities Management (CAFM) and/or Computerized Maintenance Management System (CMMS) software by Operations. The CDE can also be linked to the Enterprise Resource Planning (ERP) system for the management of spares for example.

The Benefits of a Common Data Environment are:

- Reducing the time and effort required to find information about an asset together with information about other associated assets in the same system
- Visually navigate through the data representations where an asset's 3D model view, data sheet information, P&IDs, orthographic drawings and other connected information are easily viewed
- Maintenance activities, including shutdowns, can be planned based on accurate information
- Extracting the latest approved data from one central database location
- Remote access allows remote planning and monitoring
- Fulfill any regulatory requirements for records keeping

The use of a tool such as CDE/data warehouse, combined with the use of BIM on projects, can provide, if properly managed, large cost savings by the Entity. On large projects, the CDE is a key tool for managing data by the A/E since it facilitates quick turnover of data to the Entity. The Entity benefits from a CDE by maintaining a centralized database of all information about the assets.

The adoption of a CDE overcomes geographical barriers and allows, for example, the creation of an extended team in other locations. A shared technology platform can create new business opportunities reducing costs of managing the Entity assets.

8.5 Laser scanning

Laser scanning or LiDAR is a remote sensing technology, which uses the pulse from a laser to collect measurements, which can then be used to create 3D models and maps of objects and environments. By combining multiple surface models from different angles, a 3D model is able to be produced. The 3D model can then be used for analysis, re-design of the objects/space, etc. These images can be incorporated into a 3D model as either raster or vectored graphics. The results of this can benefit a project by:

- Reducing the risk by determining existing conditions
- Reduced Rework
- Decreased Project Costs and schedule
- Capture Existing Conditions in High Resolution
- Fewer Physical Site Visits (safety benefits)
- Better Information Management During a Project

8.6 AR/VR

Augmented reality adds digital elements against a live view. Virtual Reality (VR) is an immersion experience in a completely digital environment. These technologies can add significant value by way of visualization for planning and permitting, demonstrations, 3D model reviews, and the training of operators.

The benefits of these technologies are:

- Reducing Rework
- Improving Safety
- Lowering Labor Costs
- Meeting Timelines
- Resolving Issues Faster
- Increasing Quality
- Allows the client to walk through the final project

8.7 Advanced Work Packaging (AWP)

During engineering, the construction team is brought in early to divide the project into construction volumes, like LEGO™ blocks. These divisions are based on construction experience and installation sequencing. As the design matures, the A/E works with Construction to develop the work packages visually and then sequences the installation of the individual packages - usually a combination of area and commodity. The sequence of installation affects the construction as well as the design schedule, purchase of equipment and material schedule, resulting in a synchronized overall project schedule. This process improves cost, schedule, safety, and quality performance, which delivers better project outcomes. AWP can be an integral part of 4D scheduling. If AWP is adopted on projects, this methodology must be supported by the automation tools to be successful.

8.8 Mobile Devices

Digitalization permit the use of mobile devices that can deliver information to stakeholders via mobile devices such as smartphones and tablets. The Entity should encourage exploration of these software

applications by its operations and on projects by the A/E and construction contractors. Mobile devices can bring visualization and data entry into the field.

9.0 SOFTWARE AND REFERENCE LIBRARIES

The Entity's software selection plan will be based on several major factors that must first be considered as part of the Entity digitalization strategy:

- The extent and the nature of the digitalization plans of Entity Operations
- The requirements for the running of the modern Project Delivery division
- Any project work that is planned to be self-performed

9.1 Software considerations

Specific software selection shall follow the following guidelines:

- Suitability – fit for purpose and best of class
- Functionality (ease of use)
- Estimated life of software and track record of vendor support
- Compatibility – with Entity network operating system (OS) and database types if required
- Industry trends
- Internal interoperability – maximize seamlessness of integration with other software in the portfolio
- Alignment with other Entities – where possible and appropriate to use the same software as other Entities to allow for maximum interoperability between the Entities
- Scalability – the PIM(s) or AIM(s) systems must be scalable to incorporate future project/assets or for phased implementations
- Cost – part of the Cost vs Benefit analysis

9.2 Software Applications Portfolio

9.2.1 General

The diagram below shows the Project Management Features and Tools relating to the National Manual for Project Management volumes. The software tools shown can be used as a starting point for identifying suitable software solutions and is provided here for the convenience of the Entity to edit and issue their own diagram. Software solutions shown on this diagram is not an endorsement or recommendation for these tools.

Major software applications will be agreed to by the Entity Chief Information Officer (CIO) after recommendations from the Automation Manager.

9.2.2 Engineering Software

The Project Delivery division will be more focused on the engineering tools. See NPM-KE0-RG-000009 - List of Commonly Used Design and Engineering Software for a menu of commonly used software in the industry.

This list contains the responsible discipline, application name, program description and name of the software developer. It is expected that the Entity will be more focused on the review, collaboration tools and consistency of the final product than in the design authoring tools unless self-performing the design of its future facilities.

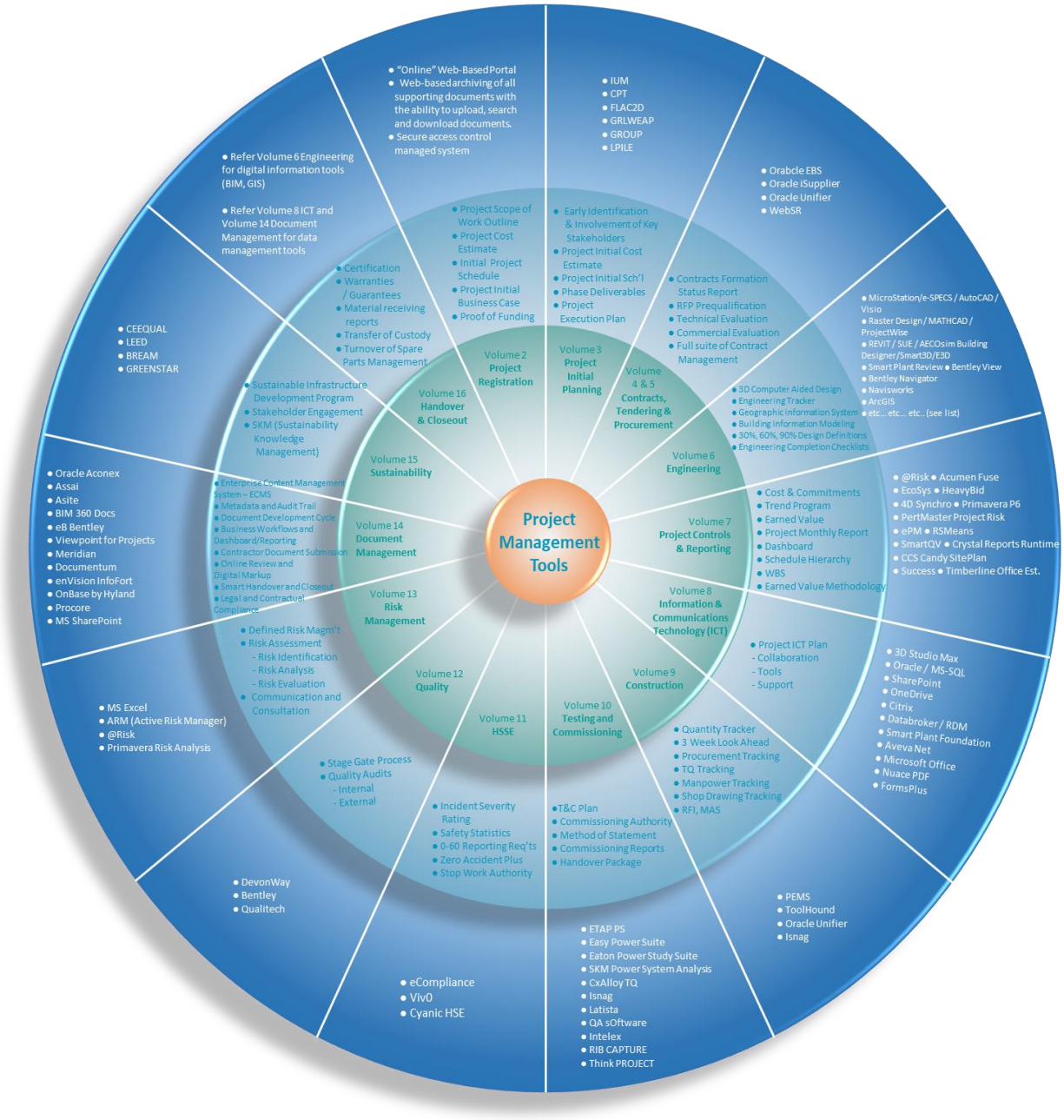

Figure 7: Industry available Project Management tools - refer to NPM-DP0-GA-000001

9.3 Data Integration

Data Integration is the process of exchanging data between databases for the purpose of consolidating information for tagged objects from discrete data sources. Each tag type for an asset needs to be defined by the Entity operations based on their asset types, operational, and maintenance requirements. This requires the development of a master data database that defines the tagged types, their respective properties, and a Division of Responsibility (DOR) for all of the data fields required. Data required externally will need to be defined in an Exchange Requirements (ER) document (see section 20.2 – Exchange requirements).

The following table broadly shows the ER DOR for the various data functions:

Function	Entity		A/E		Construction (including procurement)	Third parties and vendors
	Project Delivery Group Automation	Operations	Plant Delivery Group	Functions & Disciplines		
Define data requirements		R		R (including future procurement & construction)		
Collate & document	R		R			
Create data		R		R		C
Data Consumer		R		R	R	
	Enforces tagging requirements and defines methodology	Uses the data for Maintenance planning and in Operations	Enforces tagging requirements Ensures quality and performs handover	Creates most of the tags and other data and populates their properties	Uses the data for work package planning and progress tracking. Also new productivity technology	Provide data as a project deliverable

Figure 8: Exchange Requirements DOR

9.4 File Transfers and Electronic Collaboration Media

The Entity shall adopt standard methods of file transfer capable of transferring large data sets such as native CAD files, model review files and other project files between the Entity and external parties such as the A/E and third parties such as consultants/vendors. Typically file transfer software such as OneDrive, Dropbox, File Transfer Protocol (FTP) etc. is used.

Requirements for electronic collaboration such as live video conferencing, live model reviews, CAD file management applications (eg. ProjectWise, BIM360 etc.) or other live collaboration methods must be communicated to Entity IT and established early in the project.

Should a project have specific requirements for file transfer or electronic collaboration above the established standard, these should be clearly identified and concurred with the Entity IT department.

9.5 Support and Training

Identify support and training resources:

- So that users will get IT and applications support
- So that users will get training on computers in the use of software applications
- To assign who is responsible to provide technical support to the A/E, construction, or the Entity

10.0 IMPLEMENTATION SCHEDULE

Below is a recommended timeframe for implementation of Automation on projects unless technologies such as BIM or GIS are imposed on the projects by the Entity. Entities already more advanced in Automation should start at a suitable plan-year level depending on their current automation maturity level. Entities are encouraged to mandate 3D CAD implementation as a minimum in the first year.

5 year plan:	**Assess** Determine the current state of automation	**Define** Determine software applications & make a plan	**Implement** 3D BIM Rollout & Flow down to A/Es	**Populate** import data and models	**Consume** Use models and data	**Enhance/expand** expand 3D to 4D, 5D and 6D as applicable
Year 1	x	x	x			
Year 2		x	x	x	x	
Year 3				x	x	x
Year 4				x	x	x
Year 5				x	x	x
(and beyond)						x

10.1 Implementation Priorities

Priorities should be determined after an assessment of the current state of automation has been completed and evaluated. In circumstances where projects are imminent, an early documentation and implementation effort should be made to capture future electronic deliverables in the short term from the A/E. This also applies on current projects where possible. Automation should be prioritized in areas where the Entity's O&M will benefit the most.

Considerations for determining priorities of Automation:

- Current solutions deployed or in progress
- Project locations
- Scope of the Project (e.g. EPC)
- Stakeholders (Partners / Other agencies) requirements
- A/E, Sub-Contractors and consultant requirements and capabilities
- Information and Communications Technology deliverables
- Project staffing by location
- Applicable regulations
- Intellectual Property / Ownership requirements
- Turnover requirements either to the operator or to another Entity
- Operations and maintenance requirements
- Staff experience

11.0 AUTOMATION WORKING GROUP

Establishing an automation-working group sponsored by a senior director is recommended for the Entity. This group will "brain-storm" automation opportunities in the Entity. Members should comprise of the Automation Manager, key Entity stakeholders, PMO parent company automation specialists and A/E firms. The Entity should consider participation from local universities as a way of promoting innovation in the Kingdom. This working group should be tasked with developing an Automation Strategy for the Entity that will help obtain management approval and funding.

12.0 POLICY ADOPTION AND SENIOR SPONSORSHIP

A senior director should be appointed the Automation Sponsor for the Entity. This individual would promote the adoption of digital technology by the Entity internally and externally with A/E's and 3rd party consultants. The main responsibility of this role is to facilitate the successful implementation of Automation by removing barriers - be they financial, organizational, or human.

13.0 STAFFING

Entities should appoint an Automation Manager to manage the automation assessment, software application analysis, documentation, and establishment or enhance the Automation environment. Duties will include identifying and appointing software "Super Users" and work with the departments to identify their SMEs for their respective work processes and associated software.

The Automation manager or designee will be the point of contact between the various Entity departments implementing and using Automation tools and the IT department. The Automation manager will also be the first point of contact between the Entity and the A/E for automation related issues.

Staffing requirements may also include:

- Data Integration/IM specialist
- Applications administrators
- Database administrators

- Licensing administrator
- Application Super-Users
- Programmers

Suggested Automation Responsibility Matrix

	Automation Working group	Director	Automation Manager	IT Manager	Dept. Manager	SME	Application Super-User
Automation sponsorship		**A**					
Automation assessment	**C**	**A**	**R**		**R**	**R**	**R**
Use-Case implementation	**I**	**A**	**R, C**	**C**	**R**	**R**	**R**
Work process ownership	**I**	**I**	**C**		**A**	**R**	**C,R**
Software custodianship			**A**	**R**	**C**	**C**	**C**
Work process training			**C**		**A**	**R**	**R**
Software applications training	**I**		**C**	**C**	**A**	**C**	**R**
Software Licensing Requirements		**I**	**R**	**C**	**A**	**C**	**C**
Software Licensing implementation			**A**	**R**	**C**	**I**	**C**
IT requirements & support		**I**	**C**	**A,R**	**C**	**C**	**C**
Work process ownership			**C**		**A**	**R**	**C**
Software support & development	**I**		**C,R**	**A,C**	**A**	**C,R**	**R**

R: Responsible	**A: Accountable**	**C: Consult**	**I: Inform**
This individual or group actually completes the task or activity and is responsible for action and/or implementation. Responsibility is often shared. Each individual's degree of responsibility is determined by the individual with accountability	This is the individual who carries "yes" or "no" authority and has full veto power for an activity. Only one "A" can be assigned to a task or activity and authority must accompany accountability	These are the individuals or groups who must be consulted prior to a final decision or action. "Consult" implies two-way communication in which stakeholders are identified and their agreement sought	These individuals or groups must be informed after a decision or action is taken because they may take action or make a decision based on the result. "Inform" is FYI and implies a one-way communication

14.0 TRAINING

The Automation manager will be the custodian of the Automation Training Plan. A training program will be created to ensure sufficient trained staff (included backup) exist to support the Automation related software and associated work process. The Automation manager shall liaise with other department managers to facilitate the training of their staff in the use of their software by providing a suitable IT and software training environment. Department managers will be responsible for nominating suitable staff for training and ensure that staffs are made available.

15.0 INNOVATION CENTER

Software applications may require testing and/or piloting before implementation therefore an "innovation center" should be considered. An "innovation center" is a hardware/software/network environment that will support the evaluation of the software applications and demonstrate their effectiveness. Typically conducted in a parallel environment with the operation activities so as not to alter the operations current processes.

16.0 CODES AND STANDARDS

Unless a national Asset Registry has been established at the time of implementing this guideline, Industry Classification Code type Uniformat II shall be assigned to all 3D model elements. These codes are required by engineering for developing specifications for objects placed in the model that make up the design. Where a 3D model is not utilized, elements must be associated with a classification code manually to conform with the project specific Exchange Requirements and the National Asset Registry.

17.0 DATA QUALITY AND COMPLETENESS

Data quality is defined as the fitness of the data provide for its intended use. Entity shall establish tools and procedures to monitor data quality and completeness of the data supplied as per the Exchange Requirements together with a work process for accepting/rejecting data received from the A/E and acceptance into the O&M databases in the plant.

Data quality requirements will follow the data quality dimensions of completeness, uniqueness, maturity, validity, accuracy, and consistency.

Data Quality Dimensions:

Dimension	Consideration
Completeness	Does the field have a value for this stage of the project?
Uniqueness	Should this item be tagged uniquely? If so, check for duplicates
Maturity	Is this a preliminary value, design or final value as appropriate for project stage
Validity	Correctly formatted tag Correctly formatted values (including date format) Padding and trailing zeroes 1 vs l vs i etc. Correct case Within the permissible range of values Unit of measure (UOM) Truncations Integers vs characters
Accuracy	Is the value correct?
Consistency	Same formatting used organization wide

18.0 IT INFRASTRUCTURE

The Automation Manager will work with the Entity IT manager to establish the necessary IT infrastructure required to support the Automation systems. Implementation of any “Cloud Services” must abide by the Communications and Information Technology Commission (CITC) rules. This must be included in the Entity IT documentation.

19.0 REPORTING

In addition to regular project reporting the Automation manager will work with Entity Project Managers and A/E representatives to facilitate reporting to monthly update of the EXPRO Dashboard or other reporting as required.

20.0 PROJECT EXECUTION

20.1 A/E BIM/Automation Execution Plan

The Entity will issue a project specific “Project Automation Requirements and Deliverables Plan” to the A/E. This document will be developed from the EXPRO “Project Automation Requirements and Deliverables Guideline” (NPM-KE0-GL-000020) already discussed. This document is to be customized by the Entity for each project as required and issued to the A/E to help form the basis of their Project Automation and BIM Plans mentioned above.

The A/E’s Project Automation Plan and BIM Execution Plan documents will outline the “how”, “what” and “when” of executing a project from an automation perspective. It should state the processes and standards required to create the deliverables to the Entity’s requirements. It should maximize the utilization of

Automation on projects. The Entity Automation Manager will assess and approve the A/E's Automation and BIM Execution Plans.

The document shall describe typical meeting agenda items, roles and responsibilities, project location, LOD, model review requirements, clash detection, as-built models, object naming conventions, work breakdown numbering convention, etc.

For non-linear projects (buildings and process plants), project data and drawings must be generated from the 3D model, with the exception of standard drawings, diagrams, and schematics.

Typical table of contents in the Entity's project specific "**Entity Automation & Information Management Guideline**" document are:

- Project introduction
- Roles and responsibilities
- Kickoff meeting together with topic list
- Collaboration methods
- Software used
- Clash detection requirements (in BIM Execution Plan)
- LOD/model development matrix (in BIM Execution Plan)
- Exchange Requirements
- Naming and Numbering conventions
- Submittal requirements and schedule
- Closeout meeting

20.2 Exchange Requirements (ER)

The Entity Exchange Requirements (ER) defines the information that will be required by the Entity from all project participants for the development of the project and for the operation of the completed facility. ER defined in the Project Automation Requirements and Deliverables Plan (developed from NPM-KE0-GL-000020 - Project Automation Requirements and Deliverables Guideline) must be flowed down by the A/E to sub-contractors and suppliers as appropriate.

The Entity must define which components require tagging as part of the ER and to be added by the A/E contractor in developing their own Project Automation Plan. The Entity should list the asset types, grouped by Masterformat code (e.g. equipment number, line number, instrument number etc.) that require tagging and also refer to the Entity Tagging Procedure for how these tags are defined, how the tags will be used (e.g., on design documents, for material receipt at a project site, for asset management throughout the life off the building or facility, etc.).

A well-defined, unambiguous tagging scheme must ensure uniqueness of tags, sorts sensibly in lists and can be parsed easily, as well as making sense to the user. Data integration relies on the uniqueness of tags since the tag is normally the unique key in discrete database tables that enable a comparison to be made between matching objects. The Entity will develop its own Tagging Procedure from the Tagging Procedure Template - NPM-KE0-TP-000012 and issue this to the A/E.

For more information, see the section called "Asset and Component Tagging Requirements" in document number NPM-KE0-GL-000020 - Project Automation Requirements & Deliverables Guideline.

The Entity Automation Manager will facilitate the process of defining the data requirements with project stakeholders to determine the inputs from each department to create a consolidated ER document. Each Operations stakeholders will need to define their respective data. E.g. chief electrical maintenance engineer will be responsible for defining the attributes associated with the cable number tag.

Data should be exchanged in Construction Operations Building Information Exchange (COBie) data format using the Industry Foundation Class (IFC) file format. For more details, refer to NPM-KE0-GL-000020 - **Project Automation Requirements and Deliverables Guideline** developed for Entity use.

20.2.1 Milestones and Data Drops

At various project milestones, the Entity may require files and data. The file and data is a key part of the information exchanges and file transfers that will occur on the project.

Sample Model Delivery Schedule of Information Exchange for Submission and Approval:

INFORMATION EXCHANGE	FILE SENDER	FILE RECEIVER	ONE-TIME or FREQUENCY	DUE DATE or START DATE	MODEL FILE	MODEL SOFTWARE	NATIVE FILE TYPE	FILE EXCHANGE TYPE
Review Models	Design Coordinator	ProjectWise	WEEKLY	[DATE]	STRUCT	DESIGN APP	.XYZ	.XYZ .ABC
Tagged items	Design Coordinator	Data Warehouse	60-90-100%	[DATE]	All Disciplines	DESIGN APP	.XYZ	.XYZ .ABC
Design Models	Design Coordinator	ProjectWise	60-90-100%	All Disciplines	DESIGN APP	.XYZ	.XYZ .ABC	All Disciplines

20.3 Licensing

The Automation Manager will work with the IT manager to establish software-licensing requirements and maintain a method of tracking license usage. These will be documented in the **Entity Automation and Information Management Plan**. The Automation Manager will make himself aware of details of the software usage agreement, enforce this on projects throughout the Entity, and insist that the A/E use legal software copies and abide by the terms of the software agreement.

21.0 MAINTENANCE OF THE DIGITAL ASSET

The long-term maintenance of the digital asset must be addressed in the **Entity Automation and Information Management Plan**. Future modifications to the plant must be updated so as to maintain an accurate representation of the assets in terms of data, graphics and associated drawings, and other documents. Models, drawings and databases must be aligned between these representations. The Entity needs to be cognizant of changes to software versions and their continued compatibility with former versions and interoperability with other software and update the plan accordingly.

22.0 GOVERNANCE

EXPRO will provide guidance to the Automation approach to the Entity by reviewing the **Entity Automation Plan** and also the project specific document **Automation and Deliverables Plan** for each project.

EXPRO Automation staff will be available for consultation and advice regarding Automation strategy and project execution.

23.0 PROJECT AUTOMATION RISKS

The challenges faced by organizations in the digital transformation are generally:

- Integration across complex digital ecosystems where various platforms may exist
- Non-standard processes and systems require standardization across sites
- Lack of IT expertise
- Lack of senior implementation leaders familiar with automation capabilities and issues
- Apprehension and resistance to change by the staff
- Difficulty in measuring and communicating the benefits from significant investments in automation

Risks related to Automation implementation and how they may be mitigated or the risk limited are.

RISK	MITIGATION
Difficulty in assessing the business case for possible solutions. This may result in	Consult expertise from the EPMO, PMC parent company, EXPRO, and consider external consultants

overspend on Automation or unneeded Automation	
Change causing disruption to existing work processes due to lack of training or unforeseen issues	"Leading Change" workshops delivered by EXPRO and/or EPMO together with resources available on the EXPRO portal. Robust training required.
Finding trained staff for key positions	Internal training programs and hiring of experienced outside consultants
IT connectivity and infrastructure limitations limiting the effectiveness of leverage or centralization	Rollout of Automation must be done with close consultation with IT. Connectivity issues may reduce the ability to centralize systems and thus need to be more localized
Resistance to change may result in poor or failed implementation	Training on the benefits of Automation coupled with strong leadership by senior staff
Interoperability issues may limit the benefits of Automation	Considerable effort must be spent in formulating the software suite to be used by the Entity taking into consideration software versions interoperability and compatibility between new and existing software
Cyberattack	Deploy the latest Cyber-security technologies. Critical infrastructure may need to be air-gapped or not automated if it is key national security related. Regular backups are an essential part of disaster recovery in the event of a successful cyber attack
Software version issues	Actively manage the software suit

24.0 BIG DATA AND ANALYTICS

A developing field is that of Big Data - the practice of collecting and storing large data sets of historical and current projects along with operational data for analysis. Big data can be used for predicting trends based on history and user behavior analytics. Insights into stored and transactional data can be drawn by Big Data so as to improve processes and decision making resulting in improved efficiency and productivity of the Entity. Consolidating years of data from many projects together with machine learning can also be used to reduce cost of future projects. The move towards the data-centric project execution discussed in this document is a prerequisite for the wider use of Big Data technology however; this does not preclude the use of Big-Data for discrete purposes by the Entity.

25.0 BACKUP AND STORAGE

Backups and storage of project related data from new models and data must follow Entity backup and storage procedures. The Entity Automation Manager is to identify project related Automation files and databases that require backup and storage to the IT department and inform them of any requirements that are in addition to standard procedure outlined in the Entity backup policy.

Best practice must also apply to A/Es project data backups, restoration and disaster recovery solutions.

26.0 INTELLECTUAL PROPERTY

To maximize the value of information re-using models and data, the Entity shall include in their contracts wording to obtain agreement from the A/E expressly agreeing to transfer ownership and custody of all Project CAD/BIM files to the Entity. The A/E is required to flow down this requirement to their sub-contractors and consultants. This will include things such as the native 3D model files, model review files (e.g. NavisWorks files) and data contained in the model objects and associated databases or files to the First Party (Entity) upon completion of the Design model and again upon completion and handover of the As-Built model. Such ownership and custody shall be vested in the Entity upon transfer.

The Entity may transfer these files at its sole discretion to other parties as required. Second Party shall include all reference data and other essential files required to successfully recreate the CAD/BIM environment in the Entity's or other party's domain.

27.0 CYBER-SECURITY

The Automation Manager is required to follow Entity IT processes and practices designed to protect networks, computers, programs and data from attack. Any vulnerabilities caused by the implementation of new solutions must be identified and mitigated. Refer to the appropriate Entity IT documentation.

28.0 ATTACHMENTS

1. NPM-KE0-TP-000032 - Automation Survey Template

Attachment 1 - EPM-KE0-TP-000032 - Automation Survey Template

EXPRO	Automation Survey This survey is to help understand the the Entity's current use of software used for CAD/BIM/GIS/IM Instructions: Check the appropriate box (one only) and add details					ENTITY NAME: DATE: PREPARER:

Technology	No, not at all currently	A little	Some times	yes, but only in some locations	Yes, mostly	Details
CAD and BIM	*1*	*2*	*3*	*4*	*5*	
Does the Entity have a dedicated Project Delivery Organisation?	☐	☐	☐	☐	☐	
Is the Entity mostly a digital organization in terms of records of equipment. Ie. Does it maintain "as-built" CAD files or 3D BIM models of its plant and equipment?	☐	☐	☐	☐	☐	
Are electronic deliverables (CAD drawings and 3D models) currently deliverables from A/Es and Consultants?	☐	☐	☐	☐	☐	
Do the A/E's generally use BIM on the projects but do not hand over the BIM files?	☐	☐	☐	☐	☐	
Does the Entity have its own CAD standards that the A/Es follow?	☐	☐	☐	☐	☐	
Are these deliverables utilized by the Entity Operations or others in the organization?	☐	☐	☐	☐	☐	
Does the Entity use CAD authoring or viewing software internally to view CAD files?	☐	☐	☐	☐	☐	
Does the Entity have trained people in the use of CAD/BIM tools?	☐	☐	☐	☐	☐	
GIS						
Does the Entity maintain its own GIS database?	☐	☐	☐	☐	☐	
Does the Entity use GIS data?	☐	☐	☐	☐	☐	
Does the Entity create GIS data?	☐	☐	☐	☐	☐	
Does the Entity share GIS data with other government entities?	☐	☐	☐	☐	☐	
Operations						
Does Operations use a CMMS system like SAP or Maximo?	☐	☐	☐	☐	☐	
Does the Entity utilize information in the form of data coming from building projects ie. Spreadsheet data or BIM data from the A/E?	☐	☐	☐	☐	☐	
Does the Entity O&M own a data warehouse type of database used as a "single source of truth" for its assets ?	☐	☐	☐	☐	☐	
Does the Entity have a standard asset coding/tagging system?	☐	☐	☐	☐	☐	
IT Infrastructure						
Is the Entity IT infrastructure a modern, high speed one (GB/s) fiber or less?	☐	☐	☐	☐	☐	
Generally, are Entity offices connected with other Entity offices externally with fiber, copper, or Satellite?	☐	☐	☐	☐	☐	
Does the Entity use cloud-based applications?	☐	☐	☐	☐	☐	