Lifecycle Approach to Data Creation and Management

Background

"Launched in October 2016, the Infrastructure Industry Innovation Platform (i3P) is an independent innovation community governed by representatives from its member organisations. Membership is open to clients (currently major infrastructure projects and construction programmes) and their supply chains (Tier 1 contractors and consultants) across the infrastructure industry.

As a primary driver for innovation in the UK infrastructure industry, i3P will help transform ideas into opportunities and practical solutions; providing a mechanism for strategically directing innovation to address the major challenges facing the infrastructure industry." –i3P

"i3P is connected to live projects and therefore potentially has access to a greater understanding of the practical application of research and theory. Bringing together i3P with these research and industry bodies therefore provides a powerful link with the realities of industry" – Mott Macdonald

Problem Statement

- We live in the digital age, where data is often considered king. How can the Construction and Infrastructure industry effectively create and manage data across the whole lifecycle of a built asset?
- How can information, best practice and standards of approach successfully flow between construction projects and construction companies, allowing the industry to move forward?

Observations

The digital age has brought about many technological advancements which aid all aspects of life, especially the ease in which we create, share and consume vast quantities of data. The 2016 Digital Construction Review points out: "the potential for digital technologies to improve productivity in the construction industry has been repeatedly highlighted by government officials and industry professionals alike over the past five years". It also points out that Building Information Modelling (BIM) would be the leading digital technology in the industry in the near future. BIM is centred on the creation, sharing and consumption of data, across disciplines, throughout the lifecycle of a building. It is therefore important that the potential pains associated with creating, managing, storing and accessing the correct data are considered and addressed.

The 2016 digital construction review also notes that: "the fragmented nature of the construction supply chain has historically acted as a barrier to achieving the widespread digitisation of working practices, compared with other large sectors such as manufacturing". This highlights the need for more efficient collaboration and transfer of information across the whole industry.

i3P Survey Results

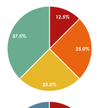
A survey was created and sent to the i3P consortium consisting of Construction and Infrastructure Companies and Clients (there were 8 respondents in total). The respondents were asked if they "strongly agree", "agree", were "neutral", "disagree" or "strongly disagree" with a range of statements. The statements spanned the 5 key topics:

- Change Management
- Data Creation, Sharing and Accessibility
- Data Longevity
- Transfer of Information
- Industry Collaboration

Some of the interesting responses are highlighted and analysed below.

Results Colour Key

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Topic	Statement	Result	Analysis
Change Management	"The change management procedures in place are both effective and efficient."		Overall the feeling is quite neutral about whether current change management procedures are effective and efficient. This result could hint at the need for better education about best practises for change management which could make the neutral opinion more positive. Also a review could be required which explores whether the current change management procedures could be improved (through reform or added governance) or whether making changes to construction data is just inherently difficult to manage.
Data Creation, Sharing and Accessibility	"Accessing the required data about an infrastructure asset is quick and easy."		Half of the respondents stated that they strongly disagree or disagree with the statement. This highlights that there should be improvements made which are centred around the ease at which data is accessed. With all respondents also stating that they use a common data environment (CDE) to share and access data, steps may be required to either ensure these systems are quick and easy to use or ensure these systems are always the single point of reference for data.
Data Longevity	"Certain data must survive throughout the life cycle of the built asset."		The majority of respondents strongly agreed with the statement. This result tells us that it is very important that data (about a built asset) is made accessible throughout the entire built asset lifecycle. This can be 100+ years. With digital data only being widely created for the past 30-40 years, careful considerations need to be made to ensure data created today will last the next 100+ years.
Transfer of Information	"Best practice, knowledge and innovation is successfully transferred from one project to another."		No respondents strongly agreed with the statement and only 37.5% of respondents agreed. This suggests that a better mechanism for transferring best practice, knowledge, and innovation from one project to another should be a priority. This may spawn from the uniqueness of each project, which could itself be viewed as an issue to tackle.
Industry Collaboration	"Collaboration with competitors and other companies leads to shared risk and shared benefits."		This result clearly shows that there is still a mixed view of collaboration within the construction industry. Half of respondents were positive about the outcomes of collaboration. More importantly, half of respondents were neutral or negative about the outcomes of collaboration hinting that perhaps information needs to be spread detailing the virtues and the best way to conduct industry collaboration.

Case Study: Data Sharing and Interoperability

buildingSMART International formerly IAI and buildingSMART – openBIM**

Vision - Realisation of the full societal, environmental and economic benefits of open sharable civil infrastructure and building asset information into commercial and institutional processes worldwide.

Mission - Proactively facilitate with key leaders the active use and promulgation of open data standards enabling civil infrastructure and building asset data and life-cycle processes to be seamlessly integrated, improving the value achieved from investments in the built environment and enhancing opportunities for growth.

Strategic Goals:

- Provide openBIM standards of tangible value to society and bring measurable benefits to users.
- Provide the leading neutral international forum for consensus building supporting the creation, adoption and use of openBIM standards.
- Lead globally in the timely development of relevant value-enabling openBIM standards.
- Provide timely and thorough software certification and people compliance testing services to accelerate adoption of openBIM standards.
- Become a trusted resource and partner for governments and industry leaders desiring adoption of openBIM standards worldwide.

Source: https://www.buildingsmart.org/about/vision-and-mission/

Case Study: Industry Collaboration and Lesson Learned Best Practice

CII Construction Industry Institute

Construction Industry Institute (CII)**

The mission of CII is to inspire owners, service providers, and academia to collaborate through research to produce best practices and implementation resources, creating innovative solutions that tangibly improve safety and capital efficiency.

Source: https://www.construction-institute.org/about-cii/cii-vision-and-mission

Lessons Learned - Best Practice

The CII carried out research into lessons learned programmes within the construction industry. The research found that "lessons learned programmes are essential to the construction industry" and "despite the fact that many engineering and construction organisations recognise the importance of lessons learned programmes, few have been successful in systematically identifying and transferring knowledge from current projects to future projects". The key findings of this report are used to inform a best practice resource called "Effective Management Practices and Technologies for Lessons Learned Programs". This resource is freely available on the CII website's "knowledge base" (link below).

Source: https://www.construction-institute.org/resources/knowledgebase/best-practices/lessons-learned/topics/rt-230

Case Study: Long Term Storage

society of American Archivists

CAD/BIM Taskforce - Society of American Archivists**

"The issues of preservation and curation of architectural records have been further exacerbated by the technological advancements of architects' tools, namely Computer-Aided-Design (CAD) and Building-Information Modelling (BIM) software programs. The mammoth size of the issue of saving CAD/BIM files requires a multi-step plan that effectively, but gradually, addresses the layers of complications this effort will unfurl. The first step is to create an inclusive bibliography of past, current and scheduled future projects that address the legal, technical and curatorial complexities of CAD/BIM files. Recognizing the complexity and wide-reaching nature of born-digital architectural records, the Society of American Archivists (SAA) Design Records Section created a CAD/BIM Taskforce in August 2012, at the SAA's Annual Conference.

After the 2015 SAA Annual Meeting the CAD/BIM Taskforce refocused its efforts moving from research mode to proactive actions."

Source: https://www2.archivists.org/groups/design-records-section/cadbim-taskforce

Case Study: Digital Thread

wyre council — BIM+

Modernising Data Management - Costal Defences, North West**

Software that makes it easier for facilities managers to locate information about their assets has been adopted by Wyre Council for a coastal defence project in North West England. 3D modelling and digital information management has been applied to aid the future operation and maintenance of the 6km stretch of costal defence.

A project of such huge scale generates a huge volume of information. Left unmanaged could quickly give rise to a future inability to find critical information when required. At the same time, there was recognition that capturing the right information, not just all information, would be a critical success factor. The programme leader explains: "We looked at our requirements during the pre-design, design, construction and operational phases and decided on the data we would need to capture at each stage to meet these and optimise asset management and minimise maintenance costs throughout the lifecycle of the project.

Source: http://www.bimplus.co.uk/projects/software-facilitates-lifetime-asset-management/

** The above studies were found through independent research

Data Security

- "Implementing BIM inevitably creates a complex collaborative environment, with a diverse range of organisations sharing information and models electronically. From a cyber security perspective, the situation will be complicated by the fact that organisations have differing levels of security awareness and discipline in place.

  Control and protection of information will become more complex as the length of the supply chains grows during development of the design, construction, and then through outsourcing of operational services or support once in use. In addition to the changing user access across the lifecycle, there will also be changes to the sources of data, and during the operations phase the need to accommodate feeds of asset use, maintenance and energy consumption data." [1]
- "PAS 1192-5 details the approach to applying appropriate and proportionate measures to manage the security risks that affect a built asset, in whole or in part, asset data and information." [2]

Data Ownership and Legal Considerations

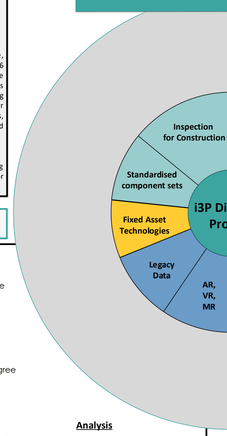
- "An intermediate conclusion might be that construction companies follow the same direction as early PLM. Standardising the data (model) to have a common understanding between stakeholders. Construction companies might not want to implement a PLM system as ownership of data is unclear as compared to manufacturing companies, every discipline or department in PLM might be another company in the construction industry." - beyondplm.com
- "In addition to the traditional information security triad (confidentiality – integrity – availability), there are some security-related legal issues that should be considered:
  - Protection of intellectual property and intellectual property rights;
  - Information Management responsibilities, including handling of cyber security incidents;
  - Resolving BIM technology disputes." [1]
- The NEC4 X10 clause states that the client owns the Information Model unless Information Model Requirements say otherwise. [3]

Documentation

[1] The Institution of Engineering and Technology (IET) – Building Information Modelling: Addressing the Cyber Security Issues.

[2] PAS 1192-5: Specification for security-minded building information modelling, digital built environments and smart asset management.

[3] NEC4 Suite of Contracts - Clause X10: Information Modelling.



Life Cycle Approach to Data Creation and Management

Scoring Criteria:

- Excellent
- Above average
- Average
- Below average
- Poor

Breakdown | Problem/ Opportunity Scale | Best Practice Industry | Breakdown of Solutions | Examples | Benefits/Limitations | Covering Standards | Ease of Integration | Impact | Short-term Risk | Long-term Risk | Maturity

Standards

PAS 1192-3: Specification for information management for the operational phase of assets using building information modelling

PAS 1192-2: Specification for information management for the capital/delivery phase of construction projects using building information modelling

PAS 1192

PAS:1192-4 Collaborative production of information. Fulfilling employer's information exchange requirements using COBie

PAS:1192-5: Specification for security-minded building information modelling, digital built environments and smart asset management

ISO/DIS 19650-1: Organisation of information about construction works – Information management using building information modelling – Part 1: Concepts and principles

ISO/DIS 19650-2: Organisation of information about construction works – Information management using building information modelling – Part 2: Delivery phase of assets

ISO 29481-1: Building Information Models - Information delivery manual - Part 1 Methodology and format

ISO 29481-2: Building Information Models - Information delivery manual - Part 2 Interaction framework

ISO 16739: Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries

ISO 55002: Asset Management – Management systems – Guidelines for the application of ISO 55001

ISO 55001: Asset Management – Management systems – Requirements

ISO 55000: Asset Management

Data Creation, Sharing and Accessibility

How you ensure that data is created and used in a way which meets the wants, needs and expectations of all stakeholders within a construction project.

Approximately **40% of all construction projects experience more than 10% change**. Productivity exceeds planned rates on 60% of projects when change is limited to 5%, but never reaches planned rates once change exceeded 20%.

"Effective change management is critical to mitigating project risk. Project teams should agree up front on standard processes for communicating changes and variations and managing their impact on workflows."

"By using comprehensive modelling and common data environments, Beijing Institute of Architectural Design **reduced design time by 60%** on the Olympic Stadium in Hangzhou."

"BIM is all about structured information that flows through the construction process from brief through to facility management. For this to work successfully, **interoperability is critical**."

- 61% reduced project error;
- 55% reduced communication time;
- 52% increase in client satisfaction.

However, for data collaboration between stakeholders in construction projects to happen **efficiently**, it is important that standards, guidelines and contracts are followed.

PAS 1192:2 defines a CDE as a "single source of information for any given project, used to collect, manage and disseminate all relevant approved project documents for multi-disciplinary teams in a managed process." It suggests that all data should be shared using the CDE.

The CDE is widely used as a "single source of truth" for data. A more powerful but complex concept is "single version of the truth".

Following documents such as the **CIC BIM Protocol, CIC Information Management** guidelines, and **NEC4 X10 Clause** ensures that the information requirements and procedures are understood by all stakeholders.

See also: Data Security and Data Ownership and Legal Considerations

Data Longevity

A building/infrastructure asset could have a life span of over 100 years - consideration needs to be taken as to what data must survive the lifecycle and how this data is stored.

The long term retention of data means that, "The **costly and time-consuming** phase of as-built asset data capture at the start of a maintenance contract **can be largely eliminated**."

"Operations and maintenance service providers have their part to play in maintaining the BIM model through subsequent configuration changes to **maximise the value** of an up-to-date **'virtual' asset** that always accurately mirrors the physical prototype."

- Institution of Civil Engineers

Data Change Management

How you implement a change to building or asset data whilst ensuring compliance with current standards, governance and constraints.

Change management governance ensures that a consistent and effective approach is deployed and followed when dealing with technical change across the lifecycle of a built asset.

Software solutions that aid change management are available with advanced BIM platforms. Change visualisation allows design changes to be quickly understood and analysed.

Including the following features:

- Visually compare how the model progresses with every version.
- Comment and mark-up files to analyse and review changes.
- Manage user permissions.

Throughout the lifecycle of a built asset, past data needs to be utilised and new data is created. It is important to understand which data needs archiving, as it is passed down the lifecycle and which data becomes redundant.

Important data must survive throughout the lifecycle of the built asset. Also, BIM methodologies suggests all data should be digital. It is therefore important to consider how this digital data is stored/accessed over long periods of time.

Options include:

- Cloud Storage
- Local Storage
- Archival Storage

Interoperability within construction projects is possible in two different ways:

- Interoperability between software from the same vendor.
- Interoperability through open data standards.

Change Authority

Deciding who can and should make/review changes to valuable building data.

Version Control

PAS 1192:2 states: "Revision numbering and version control shall be kept in step between any model and its related information, whenever either the model or the information is changed."

Version control can include meta data such as change descriptions, time stamps and state attributes.

Change Procedure

A change procedure (or process) should outline what steps need to be taken before a change is implemented. This can include how to submit a change request, how changes get reviewed (e.g. cost-benefit analysis) and how changes get approved.

Data Maintenance

It can be critical to update and maintain digital data throughout the asset lifecycle. The amount of building data (and meta data) that should progress thorough the lifecycle stages should be considered. It should be clear who is responsible for ensuring this data is maintained and accessible.

Forward Compatibility

Forward compatibility of data formats must be considered to ensure that the correct data is accessible in the future.

Cloud storage

Data being stored and served by a cloud storage provider. The data is the easily accessed via the internet.

Local storage

Data being stored and served locally. This is merely on site hard drives which store the data and servers which deliver the data when required.

Archival Storage

Involves saving data to a physical storage which is not 'online' therefore you cannot instantaneously export the data or import new data.

Benefits:

- Reduced risk of making changes which include incorrect, incomplete or unwanted/ unneeded information.
- Reduced time/monetary cost of using incorrect data/ information – this can be very high in construction.
- Stakeholders can be confident they are not viewing/using obsolete data.

Limitations:

- Lots of time spent checking.
- Delays in implementing and sharing data changes.
- Difficult to define which changes need to follow the procedure i.e. deciding if a change is significant or not is a subjective matter.

Benefits:

- More efficient change control.
- Reduced time spent implementing, reviewing and suggesting changes.
- Easily understand the impact of changes.

Limitations:

- Benefits only those who have competencies on BIM platforms/with 3D modelling.
- Potential training requirement/learning curve.

Benefits:

- Time/cost saving in maintenance/decommissioning work.
- Up to date digital assets could have a monetary value.
- An effort to make data forward compatible means data is more likely to be accessible and useful in the future.

Limitations:

- Cost of long-term maintenance of data/ information.
- Ownership of data could be disputed for built assets.
- Non-compatibility issues sometimes unavoidable due to technological advances.

Benefits:

- Easy to access data.
- Stored on neutral ground if ownership is an issue.

Limitations:

- Expensive in long term.
- What if the cloud storage provider shuts down?

Benefits:

- Can be sure that data is secure as it is local.
- Data can be made readily available if needed.

Limitations:

- Investment in data storage and serving hardware.
- Who stores the data locally?

Benefits:

- Cheapest storage method
- Can be either local or not (amazon glacier).

Limitations:

- Longer data retrieval times.
- Will the storage technology expire?

Industry Collaboration

How companies can collaboratively work together to ensure that industry can be moved forward as a whole.

Transfer of Information

How valuable information can successfully flow between a programme of projects within a company.

Companies | Programmes | Projects

According to the 'Connecting Teams' report, the benefits of successful project collaboration include:

- 61% reduced project error;
- 55% reduced communication time;
- 52% increase in client satisfaction.

"Companies can **save money** by not reinventing the wheel every time a new project is started."

"**Reduce project costs** by learning from past projects and implementing past successes while avoiding past failures."

"45% of BIM users use a BIM object library - 66% create objects as needed and a similar number create objects in-house and re-use them across multiple projects."

Graham Watts, chief executive of the Construction Industry Council explains: "A particular project may see some **innovation that is a better way of working that could benefit the whole industry**, but that team disintegrates at the end of the project and that innovation is lost."

Interoperability

Computing and IT | Automotive | Public-Sector Bodies | Aerospace

Benefits:

- Easy to understand the implications of data.
- Can be easily understood by non-technical audiences.

Limitations:

- Lots of training required.
- Certain stakeholders may have a platform preference and be unwilling to work with others.

Benefits:

- Platforms are reliable and secure.
- Customisable interfaces for bespoke accessibility.
- Ease of acquisition and use.

Limitations:

- Some of these platforms are not necessarily PAS 1192:2 compliant.
- Not specifically designed for construction i.e. model files must be downloaded instead of viewed in online.
- No version control aid.

Benefits:

- Functionality developed with the construction industry in mind e.g. design review, change visualisation, model aggregation.
- PAS:1192:2 compliant and some platforms align to "BIM level 3".

Limitations:

- IFC files don't always contain all the functionality of native files.
- Data exchange format is not the same as an open format.

Benefits:

- Fully integrated and compatible data.
- Reduction in cost due to features like clash detection.

Limitations:

- Training requirement
- Certain stakeholders may have a platform preference and be unwilling to work with others.

Benefits:

- Included in official ISO Standards.
- Interoperability across software providers allowing stakeholders to use their preferred software.

Benefits:

- Targets and milestones to work towards.
- Greater likelihood of timely delivery.
- Fewer costly disagreements – they can be settled in the briefing phase.

Limitations:

- May be difficult to get all stakeholders to agree.

Benefits:

- Clear guidelines which reduce misunderstandings and incorrect information.
- Standard approaches make it easier to interpret information.

Limitations:

- Defining specific software requirements can limit options (i.e. different architects use different software)

Benefits:

- Someone to oversee data creation therefore increase in compliance.
- Smoother delivery of data/ information.
- Lower risk of data protection non-conformity.

Limitations:

- Governance does not guarantee compliance with procedures.
- Cost of employing an information manager.

Benefits:

- Less duplication of information can save both time and money.
- Reusing information can help insure consistent delivery/quality.

Limitations:

- Sharing data outside of a given project can cause legal issues – IP, data ownership, data protection.
- Information that is reused might be obsolete.

Benefits:

- Fewer mistakes made.
- More efficient processes – faster, cheaper.
- Reduced project risk.
- Better internal communication.

Limitations:

- Solutions to some problems may be unknown/some mistakes are unavoidable.
- Captured lessons are often not utilised.
- Unwillingness to admit mistakes/ failures can make it a difficult process.

Benefits:

- More efficient ways of working.
- Cross-discipline growth, for example, construction contractors sharing best practice with asset management organisations (and vice versa).
- Technological advancements.
- Less duplication of R&D work.

Limitations:

- Cultural differences between companies means that best practice might not be transferable.
- Current industry behaviours show some resistance to collaboration.
- Not increasing competitive edge as competition also benefits from innovation.
- Less valuable intellectual property.

Benefits:

- Potential for lower design and materials cost and faster high quality project delivery.
- Standardised parts means consistent quality and better understood integration.
- Easier maintenance/repair/renovation due to greater visibility and knowledge on the standard build approach.

Limitations:

- Definition of standard approaches takes a lot of time, money and can be very difficult (can lead to disputes on what is the right way).
- Not increasing competitive edge as others use the same approach.
- Potentially less design freedom/ creativity.

Industry Standardisation

Collaborating within an industry to develop an agreed standardised way of doing something such as standardised components.

Shared risk, shared benefit.

Sharing Innovation and Best Practice

Collaborating within an industry to share and develop innovative solutions or industry best practices.

Capturing Lessons Learned

Capturing lessons learned from one project and filtering this into future projects.

Ensure that mistakes are not repeated and missed opportunities are explored in future projects.

Recycling Information

Can information from one project be used directly in future projects to avoid the needless duplication of this information?

Information Requirements

- Information structure e.g. software platform appropriate to meet Employer information requirements.
- File formats and naming conventions.
- Units, dimensions, abbreviations, symbols used in development.

Responsibility Matrix

This is a key document as it both allocates responsibility for preparation of the Models and identifies the Level of Detail ("LOD") that Models need to meet at the project stages or data drops stated in the table.

Appointment of an Information Manager

- Managing the processes and procedures for information exchange.
- Initiating and implementing the Project Information Plan and Asset Information Plan.
- Assisting in the preparation of Project Outputs, such as data drops.
- Implementation of the BIM Protocol, including the updating of the MPDT.

Modular Standardised components

Using standardised components in projects allows the design and effects of these components to be better understood.

The data associated with these components (specifications, designs, tests performed, etc.) which may come in the form of a BIM object, can then be reused or extended without starting from scratch.

A Lessons-Learned-System (LLS)

A comprehensive LLS is a business tool that gives a company the power to learn and plan from past mistakes or achievements.

Research highlights "Recording good or bad practices at different stages of projects is not common in the construction industry."

NASA's Lessons Learned Information System

The NASA LLS is a database of lessons learned from contributors across NASA and other organisations. It contains the official, reviewed learned lessons from NASA programs and projects.

Open Source Software Projects

- GPL - GNU Public Licencing can be used but contributions have to be released back into the community.
- Creative Commons Mandatory attribution with use restrictions.

By sharing knowledge and experience of infrastructure development a standard framework as been developed. Companies can cooperate on larger scale solutions. Far greater than what each company could achieve alone.

- 92076 – Community Members
- 184 - Countries
- 673 Supporting Companies
- 20M+ - Lines of Code

"BMW and Toyota have collaborated in the area of sharing costs and knowledge for electric car battery research, despite the fact that both compete in the luxury car segment."

"Porsche is collaborating with Audi to develop "new vehicle architectures for future mobility," including autonomous, digital and electronic cars."

Data Being Used

Some vital data might not be required for decades...

Development Strategy

Strand 1: Change Management

The process involved with making changes to the data of a building or infrastructure asset and how this process is managed. Changes will always be required to be made to data, especially in a lifecycle data approach. As a building or infrastructure asset passes through the lifecycle stages, the data associated with it (maybe stored within a BIM model) will change also. If these changes are not managed sufficiently, it may lead to wrong, inaccurate or obsolete data.

Next steps:

1.1 The i3P consortium should collaborate with the Centre for Digital Built Britain's research into best practices for digital specifications. Better digital specifications will help construction companies better define the difference between design development and technical change.

1.2 The i3P consortium should review current methods to connect micro and macro changes to better understand the dependencies on a project level. This is needed to ensure that changes (no matter how big) are efficiently assessed for full through-life impact before they are implemented.

1.3 The i3P consortium should consider the development of a common format for communicating changes as current change descriptions are often open to interpretation leading to ambiguity in change classification.

Strand 2: Data Longevity

The longevity of data is all about the approach to keeping, maintaining and using data for long periods of time. A lifecycle data approach will of course need some consideration for data longevity. Buildings can survive for over 100 years – how do we ensure that data can be utilised throughout this lifespan, whilst technological advancements bring new software, hardware and storage.

Next steps:

2.1 The i3P consortium should collaborate with the Centre for Digital Built Britain's research into the data requirements of the latter lifecycle stages (e.g. operation and maintenance). This should include consideration for the best methods of capturing and maintaining as built data.

2.2 The i3P consortium should begin thinking about how data should be stored and maintained to ensure that it can be accessed and utilised throughout the lifecycle stages (e.g. tackling forward compatibility concerns).

Strand 3: Data Creation, Sharing and Accessibility

Data creation, sharing and accessibility are at the heart of the digital approach to building design, construction and facility management. The easier it is for data to be created, shared and accessed, the easier it is for construction and infrastructure industry companies to operate.

Next steps:

3.1 Open data standards are the preferred solution for interoperability therefore the i3P consortium should support efforts to develop these standards (with for example; buildingSMART, Centre for Digital Built Britain and the Alan Turing Institute).

3.2 The i3P consortium should review the pains associated with the current use of common data environments (CDE) and provide an i3P wide collection of recommendations for their development (e.g. development of better connected CDE's). This has the potential to offer significant and directly measurable value to current projects.

3.3 The i3P consortium should consider how the roles of "document management", "design/model management" and "project controls" can align to move towards a more complete information governance.

Strand 4: Transfer of Information

How can valuable information, knowledge and data flow between construction projects to ensure that the practices of construction industry companies improve over time? Transfer of information can include, reusing information from previous projects (designs, specifications, tests), applying lessons learned from previous projects.

Next steps:

4.1 The i3P consortium should review the current level of information recycling between construction projects and how this can be maximised. This review should consider the impact that using a standardised component/modular approach could have on recycling information and the opportunity to build component catalogues at a project or client level.

4.2 The i3P consortium should share current lessons learned systems/processes to discover:

- What systems/processes are used?
- Are these systems/processes effective and efficient?
- What is the best way for the construction industry to capture and apply lessons learned? (This can be enabled by the i3P sharing portal)

Strand 5: Industry Collaboration

Industry collaboration is all about construction and infrastructure companies working together to come up with innovative solutions, standardised approaches and best practices. The goal of this collaboration should be to move the whole industry forwards by pioneering new ways of working.

Next steps:

5.1 The i3P consortium should share the successes of collaboration within the construction and infrastructure industry. This can help to tackle current industry behaviours which show resistance to collaboration.

5.2 Full engagement from i3P members in collaborative projects to innovate within the construction and infrastructure industry. These collaborative, innovative projects can be realised from other discovery posters (e.g. standardised component sets discovery poster).

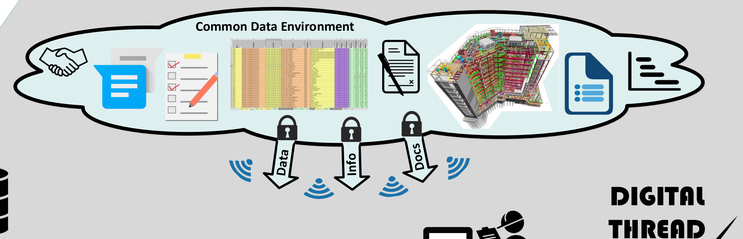
Other

6.1 The i3P consortium should explore the option of deploying a New Product Introduction (NPI) process for construction. This could be adopted as a standard approach that aids collaboration at the correct points in projects.

Example NPI Process

Source: https://www.almengineeringsolutions.co.uk/alm-because/npi-process/

Production Concept



Key Case Study: Crossrail

"Information Management within Crossrail is focused on the creation, management and ultimate handover of large volumes of information and data generated by the project. This information is either required by Crossrail directly for the design and construction of the railway, or by the Infrastructure Managers for its future operation and maintenance. Crossrail generates large numbers of drawings (500,000), documents (5,000,000), and e-mails with multiple versions arising throughout the lifecycle of the project. Effectively managing project documentation also has significant commercial and contractual implications."

"The creation and management of information within Crossrail is enabled by a number of specialist teams. Normally the project management of different forms of information (e.g. CAD, documentation, asset information, GIS) are kept very separate, but at Crossrail these have been brought into one department. The benefit from this is the overall coordination and consistency, particularly in respect of complexity integrating information from 31 advanced works contracts, 24 consultancy framework contracts and over 60 main construction contracts as well as a uniform information handover strategy to the future Infrastructure Managers."

"Crossrail is the first major project to have used the concept of a Common Data Environment (CDE) and Master Data Management (MDM) for managing project information. The CDE comprises two parts – a set of linked databases in which most of the information is stored (eg, documentation and records, CAD models and the GIS) and other stand-alone applications for helping build the railway (eg, scheduling, risk, cost control and H&S).

"The Information Management learning legacy brings together lessons learned and good practice from the planning and implementation of information management applications and tools."

The Crossrail project took great consideration as to how data was archived so that it could best be utilised by Transport for London (TfL) who will be operating and maintaining the railway. Details of this are found at: https://learninglegacy.crossrail.co.uk/documents/archiving-crossrails-data/

Main Source:

https://learninglegacy.crossrail.co.uk/learning-legacy-themes/information-management-and-technology/

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ADDITIONAL PROJECT INFO:

All i3P discovery phase 2 projects are match funded by the i3P and the MTC. Each discovery project is carried out over a timescale of 6-8 weeks, which makes use of input provided by the i3P within this timescale to support the projects. A review of industry best practices / technologies for each discovery project has been down selected according to criteria agreed with each discovery project sponsor.