Universidade do Minho
Escola de Engenharia

Frank Roberto Chuquín Montoya

Appointing parties and OpenBIM in the context of ISO 19650

BIM A+ European Master in Building Information Modelling

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Master Dissertation
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STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration.

I further declare that I have fully acknowledged the Code of Ethical Conduct of the University of Minho.

RESUMO

A indústria de arquitetura, engenharia, construção e operação (AECO) tem-se esforçado por adotar uma abordagem mais integrada em todo o ciclo de vida do projeto. Esta nova metodologia deve incluir tecnologias, processos e pessoas. A urgência para esta mudança vem do baixo nível de produtividade no sector AECO que tem impacto em diferentes fatores, tais como: tempo, custo, âmbito e qualidade.

O contratante é um dos atores ou partes interessadas dentro da cadeia de fornecimento da indústria AECO. Além disso, é o originador das metas, objetivos, propósitos e requisitos que o projeto deve cumprir para ser considerado bem-sucedido. Então, um contratante consciente sobre a necessidade de inovação e de transformação digital deve tomar a liderança, implementando o BIM. No entanto, não é um caminho fácil não só para as diferentes dimensões a considerar, tecnologias, processos e pessoas, mas também para os enormes guias, modelos, livros, artigos existentes que podem criar confusão num contratante para iniciar a sua viagem BIM.

Esta dissertação assume a perspetiva de um contratante que pretende criar um processo de fluxo alinhado não só com a série ISO 19650 mas também com critérios de interoperabilidade vindos do OpenBIM, e ainda por cima acrescentando algumas ferramentas de Construção Lean. A primeira abordagem discutida neste documento são os passos necessários que uma parte nomeada necessita para seguir a série ISO 19650. O resultado tangível disto é a geração de treze modelos diferentes, com um guia técnico que pretende apontar o caminho do contratante na sua viagem BIM. O segundo passo foi a incorporação nos documentos de práticas sobre interoperabilidade através de conceitos OpenBIM tais como IFC, MVD, BCF e IDS. Como terceiro passo, foram incluídas cinco ferramentas da comunidade de Construção Lean que pretendem impulsionar a sinergia entre Lean e BIM.

O processo de validação consistiu numa série de entrevistas e inquéritos semiestruturados a um painel de peritos da indústria. Este processo ajudou a refinar os modelos propostos e o guia técnico alinhado com a série ISO 19650, o OpenBIM e as ferramentas Lean Construction. Foram incluídas algumas alterações de acordo com as respostas e comentários dos peritos.

Os resultados ajudaram a melhorar e a considerar a perspetiva da indústria que o painel de peritos trouxe para esta investigação. Foi constatada a necessidade de melhorar os conhecimentos dos profissionais sobre OpenBIM e construção Lean nos aspetos mais práticos das ferramentas de cada domínio. Também foi salientada a conveniência de ter dois tipos complementares de documentos: modelos e guia técnico para ajudar a designar as partes na sua implementação do BIM. Além disso, foram encontradas dúvidas sobre a praticabilidade e adequação do quadro de informação ao nível do quadro de informação em relação a outra abordagem como LOD.

Palavras chave: Entidades Contratantes, BIM, ISO 19650, Lean, OpenBIM

ABSTRACT

The architecture, engineering, construction, and operation (AECO) industry strives for a more integrated approach in the entire project life cycle. This new methodology of doing must include technology, process, and people. The urgency of change comes from the low productivity level in the AECO sector which impacts in different factors such as: time, cost, scope, and quality.

The appointing party is one of the actors or stakeholders within the supply chain of the AECO industry. Also, it is the originator of the goals, objectives, purposes, and requirements that the project must fulfill to be considered successful. Then, a conscious appointing party about the necessity of innovation and a digital transformation can take the lead by implementing BIM. Nevertheless, it is not an easy path not only for the different dimensions to consider as it was mentioned technology, process and people, but also for the enormous guides, templates, books, papers existing that can create confusion in an appointing party for starting its BIM journey.

This dissertation takes the perspective of an appointing party that intends to create a flow process aligned not only with ISO 19650 series but also with interoperability criteria coming from OpenBIM, and on top of that by adding some Lean Construction tools. Then, the first approach discussed in this document is the necessary steps that an appointing party needs to follow ISO 19650 series. The tangible result of this is the generation of thirteen different templates with alongside a technical guide that intends to pave the path of the appointing party in its BIM journey. The second step was the incorporation in the document of practical's about interoperability through OpenBIM concepts such as IFC, MVD, BCF and IDS. As a third step it was included five tools from the Lean Construction community that pretend to boost the synergy between Lean and BIM.

The validation process consisted of a series of semi-structured interviews and surveys to a panel of experts from the industry. This process helped to refine the proposed templates and technical guide aligned to ISO 19650 series, OpenBIM and Lean Construction tools. Some changes were included according to the answers and comments of the experts.

The findings helped to improve and to consider the perspective of the industry that the expert panel brought to this research. It was found that necessity to improve the knowledge of practitioners about OpenBIM and Lean construction in the most practical aspects of the tools of each domain. Also, it was highlighted the convenience of having two complementary types of documents: templates and technical guide for helping appointing parties in its BIM implementation. Moreover, there was found doubts about the practicality and suitability of the level of information framework over other approach as LOD.

Keywords: Appointing parties, BIM, ISO 19650, Lean, OpenBIM

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1. INTRODUCTION

BIM is not any more an option since the market for public and private projects in many countries is asking for more integrated projects in the Architectural, Engineering and Construction (AEC) sector. Companies/owners or also called appointing parties need to address how to begin their BIM journey which means how to start the planning process and eventually the execution part of their projects using an information management approach.

Besides, the construction industry is searching for different technologies and methodologies for improving the productivity and to keep track of different dimensions or factors of success such as time, cost, scope, and quality. Some of the innovational trends that we can find in the AEC sector are building information modelling, lean construction, digital twins and OpenBIM.

Considering BIM as the digitalization of the built environment or BIM as an enabler of information management, we can find an enormous literature about standards, guides, templates, and approaches for implementing BIM. This Information is scattered, and this creates confusion for an appointing party who wants to start with BIM. Then, this is a cumbersome situation that prevents owners/companies to begin using an information management approach for delivering projects.

Therefore, the motivation for this dissertation is to bring light and make clear what should be the path to follow for those appointing parties that need to start this BIM process. This is made by presenting proper and specific templates and technical guidance to be implemented in the delivering phase of a project in accordance with OpenBIM standards. It is considered that if best practices are compiled and explained in a such a manner that is considered the perspective and the responsibilities of an appointing party, by doing this the path is paved and people involved are going to be less reluctant to start this BIM process including ISO 19650 series and OpenBIM.

The main objectives of this work are:

- To compile some of the best practices and examples of BIM developments for owners;
- Propose a simplified BIM process ready to be applied by intermediate maturity level companies;
- Promote the use of OpenBIM in BIM contracts.

To accomplish these goals, it is expected that one´s may achieve the following outcomes:

- Creation of templates aligned with the ISO 19650 series for the use of an appointing party. These templates will collect different standards and approaches as best practices. It will be created considering the perspective of a specific company as the appointing party.
- Creation of a technical guide that alongside the templates will accelerate the implementation of BIM. This technical guidance should be specific and bring light to stakeholders.
- Those technical guide and templates must address the use of open standards. It will be included the use of IFC as a medium to exchange of information and specifically MVD. Also, the use of BCF as a manner to communicate issues between different parties. Moreover, it will be exploring the novel use of Information Delivery Standards (IDS).

This research started defining the scope of work by explaining the problem and the objectives of the dissertation. Then, a literature review was made considering different resources such as standards, guides, templates, books, and master thesis from a variety of countries. Then, a structured framework was chosen for presenting the material which comprises thirteen topics. Each one is described in the sub-sections of literature review.

Then, a series of exploratory interviews are made. These interviews are the first approach for getting an overview about the level of knowledge of ISO 19650 series, OpenBIM and Lean in the industry environment. In a semi-structured interview that starts with a round of five questions three persons that work in the role of BIM managers in a governmental institution in charge of public works that worth 100 million euros each, are part of these interviews. Once the responses were collected, they serve as an input to take into account in the development and elaboration of the templates and the technical guide.

In the elaboration of the templates and technical guide, it was considered at any moment what is required to do by the appointing party, also what is specified in the ISO 19650 series and what is the manner that OpenBIM deals with information management, those are the three pillars for the preparation of those templates. Equally, it was considered some tools coming from Lean Construction, which were included in the templates. Apart from that, online resources, international standards, books, papers were considered for the elaboration of the templates. The analysis of sections that are repeated in different resources and the cross reference between them were made.

Besides, there is a close connection between the templates and the technical guide. This is shown in the manner that this technical guide was written pretending to help with some considerations and recommendations in the moment of filling the templates.

Once the templates and technical guide were finished, it is time to put them in consideration of those experts. This is made through a customized survey that translates what is proposed in the templates and technical guide and a semi-structured interview.

This survey contains 29 questions which address the content of relevant sections of those templates and technical guide. Following the survey, a semi-structure interview is made, and six (6) questions are presented to the interviewees.

Once collected those responses, they are used as a basis for adjustment and changes in the templates and technical guide proposed. Therefore, by doing this validation is expected to refine the proposal considering an industrial point of view.

Finally, as a result of this dissertation some conclusions and recommendations are delivered. Those come from analyzing the process of elaboration of the templates and technical guide, the adjustment and refinement made after the validation and finally is described future steps in the topic researched. The following figure 1 – Research methodology summarized the process.

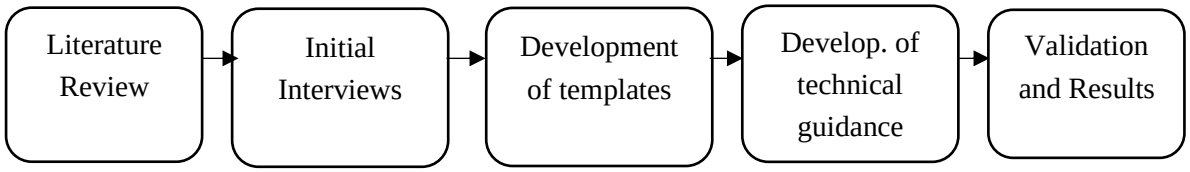

Figure 1 – Research methodology

It must be said that this dissertation considers precedence works made by former students of the BIM A+. The work of Mirniazmandan (2021) named "Proposal of a company BIM guide in alignment with ISO 19650", the BIM guide created in this dissertation was divided in four sections: policy, people, process and technology which is a compiling effort of different standard and guides. Also, the work of Terrosi (2020) "guidelines for BIM information management at design stage" was considered for this dissertation because it contains a series of documents such as: matrix BIM competencies (for assessing desirable role competency), matrix project team members maturity level assessment (appraise people competency), template of exchange information requirement (EIR), template of BIM execution plan (BEP), matrix CDE comparison analysis and a workflow for the design stage. Besides, Fontana (2020) presented the master thesis named: "Information management workflow for the construction and operation phases on a BIM process". This work presents an information requirement template containing four sections: technical, management, commercial, and legal. Also, contains a process map for the construction and operation phase taken into account BIM uses, CDE, interoperability and quality control.

This thesis is divided into five chapters that contains the following information:

Chapter 1 it is about the introduction of the work and explain the problem, gives a hypothesis, points out the objectives and outcomes, explains the research methodology, an assessment of past studies and summarizes the chapters.

Chapter 2 it is the literature review that shows the most important standards, guides, online resources, templates and master thesis that cover the topics of this dissertation. This literature review is structured considering the most relevant topics for this dissertation.

Chapter 3 presents templates and a technical guide that intent to be descriptive and instructional, both documents are part of this framework proposal by the author of the thesis. These resources work closely with the process framework proposal. This proposal intends to be simple and straightforward considering the pains and gains of an appointing party for starting its BIM journey.

Chapter 4 here is presented the validation of the deliverables (templates and technical guide) in an industrial/professional environment through surveys and interviews to a panel of experts. This helps to change or make some adjustments to those resources.

Chapter 5 points out conclusions and recommendations considering the work done in this dissertation and it states some areas for future research.

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2. LITERATURE REVIEW

Through an extensive literature review of different documents (i.e., standards, guides, templates. manuals, books) a selection of relevant topics aligned to this dissertation was made. In the reference section it can be found the list of the material revised. From them, stand out the international standard ISO 19650 series (2018), the UKBIM Framework (2022), International BIM toolkit (2020), and the open standards from BuildingSmart International (2022a). The topics listed as relevant were thirteen: standards, guidance, OpenBIM, CDE, BEP pre and post appointment, level of information need, federation strategy and information container, information requirements, information protocol, information standard, information methods and procedures, and Lean-BIM. Each topic is discussed in the following sub-sections.

2.1. Standards ISO 19650 series

ISO 19650-1 (2018) defines what is fundamental for the information delivery which is the Exchange Information Requirements (EIR). It is pointed out in ISO 19650-1 (2018) that an appointing party is responsible for formulating the information requirements. Those requirements help to define what information is needed, when and who is responsible for producing. This information requirements must use the concept of level of information need.

Also, for the appointing party is pivotal to establish the information standard, production methods and procedures and the common data environment (CDE).

The ISO 19650-2 (2018) specifies the information management process that starts with assessment and need until project close-out. In this dissertation is important to map each of the process in order to determine the level of involvement of the appointing party. The following is the list of activities that ISO 19650- 2 considers as part of the information management process: assessment and need, invitation to tender, tender response, appointment, mobilization, collaborative production of information, information model delivery and project close-out. Then, each process is composed by different activities.

For assessment and need the activities are: appoint individuals to undertake the information management function, establish the project´s information requirements, establish the project´s information delivery milestone, establish the project´s information standard, establish the project´s information production methods and procedures, establish the project´s reference information and shared resources, establish the project´s common data environment, establish the project´s information protocol. All those activities are part of the responsibility of the appointing party according to ISO 19650-2 (2018).

In the process named “invitation to tender” the activities are the following: establish the appointing party´s exchange information requirements, assemble reference information and shared resources, establish tender response requirements and evaluation criteria and compile invitation to tender information.

For “tender response” the activities are: nominate individuals to undertake the information management function, establish the delivery team´s (pre-appointment) BIM execution plan, assess each task team capability and capacity, establish the delivery team´s capability and capacity, establish the delivery

team´s mobilization plan, establish the delivery team´s risk register and compile the delivery team´s tender response. All those activities are part of the responsibility of a prospective lead appointed party.

The process named "appointment" has the following activities: confirm the delivery team´s BIM execution plan, establish the delivery team´s detailed responsibility matrix, establish the lead appointed party´s exchange information requirements, establish the task information delivery plan (s), establish the master information delivery plan, complete lead appointed party´s appointment documents and complete appointed party´s appointment documents.

The fifth process is "mobilization" and the activities are: mobilize resources, mobilize information technology and test the project´s information production methods and procedures. Most of these activities are responsibility of the lead appointed party.

For "collaborative production of information", the activities are: check availability of reference information and shared resources, generate information, undertake quality assurance check, review information and approve for sharing and information model review.

The process of "information model delivery" is composed by: submit information model for lead appointed party authorization, review and authorize the information model, submit information model for appointing party acceptance, review and accept the information model. Here, the review and acceptance steps are considered responsibility of the appointing party.

For "project close-out" the activities are: archive the project information model and capture lessons learned for future projects. Those are responsibilities of the appointing party.

The ISO 19650-2 (2018) also shows an information management assignment matrix that propose a match between each process and activity with different stakeholders (appointing party, third party, lead appointed party and appointed party). This matrix helps to understand how it should be a proper assignment and what to expect from others. Nevertheless, for an appointing party who wants to initiate its journey in BIM thought the ISO 19650 is not enough this assignment matrix because it is no stated explicitly who is responsible for each activity. Certainly, this can vary from project to project, but a clear indication of responsibilities will help the appointing party.

Finally, the standard ISO 19650 series (2018) defines fundamental concepts that needs to be addressed by the appointing party. The ones detected are the following: common data environment, level of information need, information requirement as a specification of what, when, who, how is to be produced any information. Also, the concept like the identification of key decision points that help to define information deliverables.

2.2. Guidance

The UK BIM Framework (2022) is a guidance that facilitates the understanding and implementation of the international standard ISO 19650 series. From the UK BIM Framework (2022) it was extracted some important insights about the ISO 19650 series considering the perspective of the appointing party. Also, the BIM project execution planning guide of the Pennsylvania State (2019) is a guidance for developing a BIM plan (BEP).

2.2.1. Guidance ISO 19650-Part 1 (2019): Concepts

Firstly, there are four resources that helps to set out the appointing party information requirements and bring clear definitions for the information needed: organization information requirements (OIR), project information requirement (PIR), asset information requirement (AIR) and exchange information requirement (EIR). The following figure 2 – Information requirements, shows how the requirements influence each other in a cascade mode.

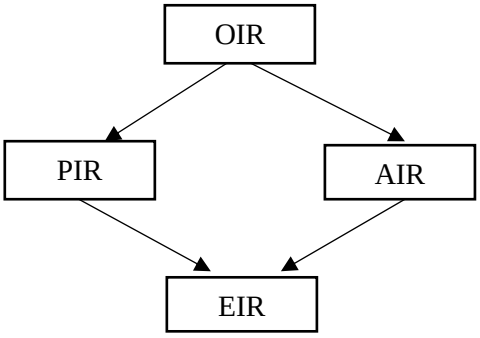

Figure 2 – Information requirements. Adapted from ISO 19650-Part 1 (2018)

Secondly, the guidance points out about the use of two matrix: information management activities and information deliverables. Also, it is said that this last matrix matches the deliverables against the information exchange stages. Nevertheless, there is not further guidance about how to proceed in the elaboration of this matrix. Then, this is an opportunity for this dissertation to explore on this.

Thirdly, it is necessary to use a metadata attribute for each information container in order to retrieve information. Then, there are different possibilities for choosing the classification system which can be Uniclass, Onmiclass or MasterFormat.

Fourthly, management and processes need to be set up at the beginning from the appointing party. These can be done by the information production methods and procedures, information standards, the level of information need and information protocols.

2.2.2. Guidance ISO19650-Part 2 (2022): Delivery phase

In this guidance, it is explained that the interaction between parties (i.e., appointing party, lead appointed parties and appointed parties) can be adopted by any delivery method of a project (i.e., integrated project delivery -IPD, design-bid-construction, design-construction, and construction management). This is shown in the following figure 3 – Interaction between stakeholders- in which we have one appointing party and different lead appointed parties:

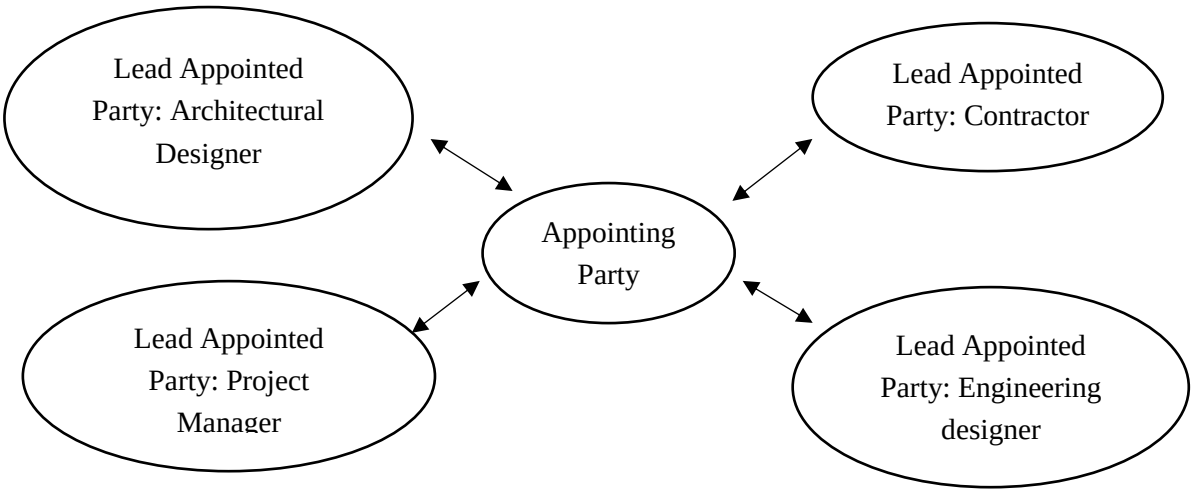

Figure 3 – Interaction between stakeholders. Adapted from ISO 19650-Part 2 (2018)

Certainly, there are some delivery methods as the IPD that enables and foster collaboration and BIM implementation. Also, there are other delivery methods as Design-Bid-Build that for its fragmentation in nature bring more challenges and more responsibilities to the appointing party for implementing BIM.

Moreover, this guidance shows how in the eight stages of the process information management are involved each party. Considering the perspective of the appointing party, the following figure 4 – Information management processes- points out its level of involvement from low to high. A color code is used, in which high involvement is color sky blue, medium involvement is green and low involvement is yellow:

1. Assessment and need	2. Invitation to tender	3. Tender response	4. Appointment	5. Mobilization	6. Collaborative production of information	7. Information model delivery	8. Project close-out
High	High	Low	Medium	Low	Low	Medium	High

Figure 4 – Information management processes. Adapted from Guidance Part A (2019) and Guidance ISO 19650- 2 (2022)

Also, those processes (from "invitation to tender" until "project close-out") can be grouped in: information procurement, information planning and information production according to the ISO 19650 Guidance Part A (2021).

From the guidance, it can be elaborated a RACI matrix showing more details in the activities related to the appointing party and the responsibility in each activity. The importance of this table 1 -Responsibility of the appointing party- is to make clear what should be the focus of this appointing party. This is shown in the following table:

Table 1 - Responsibility of the appointing party

Clause in ISO 19650- 2	Activity	Appointing Party
5.1.1	Appoint individuals to undertake the information management function.	Resp./Acc.
5.1.2	Establish the project´s information requirements.	Resp./Acc.
5.1.3	Establish the project´s information delivery milestone.	Resp./Acc.
5.1.4	Establish the project´s information delivery standard.	Resp./Acc.
5.1.5	Establish the project´s information production methods and procedures.	Resp./Acc.
5.1.6	Establish the project´s reference information and shared resources.	Resp./Acc.
5.1.7	Establish the project´s common data environment.	Resp./Acc.
5.1.8	Establish the project´s information protocol.	Resp./Acc.
5.2.1	Establish the appointing party´s exchange information requirements.	Resp./Acc.
5.2.2	Assemble reference information and shared resources.	Resp./Acc.
5.2.3	Establish tender response requirements and evaluation criteria.	Resp./Acc.
5.2.4	Compile invitation to tender information.	Resp./Acc.
5.4.6	Complete lead appointed party´s appointment documents.	Resp./Acc.
5.7.4	Review and accept the information model.	Resp./Acc.
5.8.1	Archive the project information model.	Resp./Acc.
5.8.2	Compile lessons learned for future projects.	Resp./Acc.
5.4.1	Confirm the delivery team´s BIM execution plan.	Consulted
5.4.5	Establish the master information delivery plan.	Informed
5.5.2	Mobilize information technology.	Informed

This guidance highlights the importance to set key decision points as a manner to create the information delivery milestone. Also, it is mentioned how the exchange information requirements derived from the project information requirement and the assets information requirement. As part of the invitation to tender documentation, the appointing party could attach a pre-BIM execution plan as a template.

Finally, in the activity of review the information model, the appointing party should check the information container against the EIR, MIDP and the level of information need.

2.2.3. ISO 19650 Guidance Part A (2021)

This part of the guidance presents a list of what an appointing party should expect when receives the proposals from the prospected lead appointed party: Pre appointment BIM execution plan, capability and capacity summary, mobilization plan, and a risk register.

Thereafter, in the appointment process the appointing party must expect to receive from the lead appointed party the following resources: BIM execution plan, detailed responsibility matrix, lead appointed party´s exchange information requirements; and master information delivery plan.

Moreover, this guidance gives a recommendation about how to deal with multiple lead appointed parties in the same stage. In this regard, it is said that is a good practice that the appointing party share templates in order to create consistency (regarding structure and format) between the different BIM execution plans of each lead appointed parties. Also, those lead appointed parties working in parallel should share and communicate between each other their BIM execution plan.

Furthermore, this guidance shows a more detail (expanded) information management function assignment matrix. This helps an appointing party knowing the sub-activities that need to be done. For instance, for process 1 named "Assessment and need", this guidance reports a detail assignment matrix. See following figures 5 and 6:

	Information management process - Assessment and need	**Appointing party**
1.1	**Appoint individuals to undertake the information management function**	
1.1.1	Appoint individuals to undertake the information management function	A/R
1.1.2	Establish a scope of services for the information management function (if appointing a third party)	A/R
1.1.3	Establish the tasks to be provided as part of the scope of services (if appointing a third party	A/R
1.1.4	Establish the authority that the appointing party will delegate to the prospective lead appointed party or third party (if delegating the authority to a prospective lead appointed party or third party).	A/R
1.1.5	Establish the competency (knowledge or skills) that the individuals undertaking the function will need (applicable whether delegating or not).	A/R
1.2	**Establishing the need for a security-minded approach**	
1.2.1	Determine the range of security risks that arise through greater availability of information, integration of services and systems, and the increased dependency on technology-based systems.	A/R
1.2.2	Undertake the security triage process and record the outcome.	A/R
1.2.3	If appllicable: Develop and maintain a security strategy.	A/R
1.2.4	If appllicable: Develop and maintain a security management plan.	A/R
1.3	**Establish the project´s information requirements**	
1.3.1	Establish the project´s information requirements	A/R
1.4	**Establish the project´s information delivery milestones**	
1.4.1	Ensure that the project´s information delivery milestones are included within the project programme.	A/R
1.5	**Establish the project´s information standard**	
1.5.1	Establish the project´s information standard and (if applicable) review the security management plan.	A/R

Figure 5 –Detail assignment matrix for activities 1.1 to 1.5. Extracted from Guidance Part A (2021).

	Information management process - Assessment and need	Appointing party
1.6	**Establish the project´s information production methods and procedures**	
1.6.1	Establish the project´s information production methods and procedures (if applicable) review the security management plan.	A/R
1.7	**Establish the project´s reference information and shared resources.**	
1.7.1	Establish the project´s reference information and shared resources.	A/R
1.8	**Establish the project´s common data environment**	
1.8.1	Consider the security management plan (if applicable) in the context of the project´s common data environment.	A/R
1.8.2	Implement the project´s common data environment.	A/R
1.8.3	Configure the project´s common data environment for the project.	A/R
1.8.4	Provide support for the project´s common data environment.	A/R
1.8.5	Host the project´s common data environment.	A/R
1.8.6	Manage the project´s common data environment.	A/R
1.8.7	Provide training for the project´s common data environment.	A/R
1.9	**Establish the project´s information protocol**	
1.9.1	Establish the project´s information protocol	A/R
1.9.2	Complete the information Particulars for the project´s information protocol (for the specific project).	A/R

Figure 6 – Detail assignment detail matrix for activities 1.6 to 1.9. Extracted from Guidance Part A (2021),

Also, in the case of the following process there is a detailed matrix of sub-activities. Apart from process 1 showed early, other process that an appointing party should take attention are: invitation to tender, tender response, appointment, mobilization, information model delivery and project close-out. Those figures are presented in appendix 1 “information management function assignment matrix”.

A list of resources is pointed out in this guidance A and it is helpful for mapping what the appointing party shall produce and it is shown in figure 7-List of resources- but there is not more detail on how to proceed creating those resources.

Resource	Resource Level	Created by
Security strategy	Organization	Appointing party
Security management plan	Organization	Appointing party
Information requirements	Organization	Appointing party
Information requirements	Asset	Appointing party
Information requirements	Project	Appointing party
Information delivery, milestones/schedule of planned trigger	Project/asset	Appointing party
Information standard	Project/asset	Appointing party
Information production methods and procedures	Project/asset	Appointing party
Reference information	Project/asset	Appointing party
Shared resources	Project/asset	Appointing party
Information protocol	Project/asset	Appointing party
Exchange information requirements	Appointment	Appointing party
Tender response requirements	Appointment	Appointing party
Tender evaluation criteria	Appointment	Appointing party

Figure 7 – List of resources-Extracted from Guidance Part A (2021)

2.2.4. BIM execution planning Pennsylvania State (2019)

The BIM execution planning of Pennsylvania State (2019) is a guide for developing a BIM plan (BEP). This guide states five steps which are the following: define the goals, select model uses, define the BIM execution process, define the information deliverables, and develop the infrastructure.

Moreover, this Pennsylvania State document states that it will be necessary at least four meetings for developing the BIM plan. Also, it was depicted the agenda for each meeting and the tasks between meetings. Certainly, this will help organizations to keep in mind a route map.

Besides, the document can be used as a guidance for creating a BIM plan for a particular project, but also for developing a BIM execution planning standard at the organization level. By doing this, stakeholders in an individual project will have a starting point and they will benefit from the organizational standards. In this effort of developing a BIM plan at organizational level, it is necessary to follow the same five steps showed paragraphs above. Although, there is one additional consideration about the BIM mission statement in the step one.

Furthermore, the BIM execution planning of Pennsylvania State (2019) shows ten recommendations for developing a BIM plan. Between those the following deserve some particular attention: each project team needs a BIM champion, owner involvement is critical throughout the entire process, the BIM project execution planning procedure can be adapted to different contracting structures and developing an organizational BIM project execution plan.

2.2.5. Past dissertations: Mirniazmandan, S. (2021)

It is presented a proposal of a company BIM guide (the company is an international BIM consultant) aligned to ISO 19650 series, this BIM guide is divided into four sections: policy, people, process, and technology. Then, for each section, the author developed sub-sections that permit to establish a clear structure which help to have a clear view of the guide and its component. Furthermore, for each sub-section there are different components that are useful for taken into account for implementing BIM.

For instance, the policy section has two sub-sections: regulatory and contractual. Each of them has one component or resources: standards/classification and BIM execution plan respectively.

The contribution of this reference is that establishes a baseline of different components/resources/topics or documents to be addressed in the context of a BIM implementation such as: standards, BIM execution plan, roles, responsibilities, competencies, education/training/support, BIM uses, BIM deliverables, Lox, quality control, information exchange and collaboration, CDE, clash detection, COBie, folder structure, naming conventions, presentation styles, software and file format, software template, BIM Object, and modelling procedures.

Therefore, those components will be useful material for considering in this work for taking into account the perspective of an appointing party plus ISO 19650 series and OpenBIM. For example, the recommendation stated by Mirniazdan (2021) about a minimum list of IFC parameters in objects such as: ifcExportAs, ifcExportType, NominalLenght, NominalHeight, and NominalDepth. As well as the use of reference model for sharing coordinates with all disciplines.

2.3. OpenBIM

2.3.1. ISO 19650 Guidance Part B Open Data (2020)

The definition about open data is given in this guidance as one that can be freely used, re-used, re-published and redistributed. On the other hand, proprietary data is restricted. Also, in the clause 6.1 of the ISO 19650-1 (2018) and clause 5.1.6 of ISO 19650-2 (2018) is mentioned that information exchange should be done using open standards when is possible.

There are different standardized solutions that support the use of open data, such as: IFC, BCF, IDM, MVD, IDS and bSDD.

Industry foundations classes (IFC): is a schema and a file format definition The schema is defined in EXPRESS language and XML. It permits information exchange between different software.

Information delivery manual (IDM) helps to document business process and information requirements.

Model view definition (MVD) it is part of IFC schema but it is used for specific purposes like coordination.

BIM collaboration format (BCF) it is used as a communication protocol based in a model, this solution help to speed up issues between stakeholders.

Information delivery specification (IDS) is a machine-readable format of requirements that permits an automatic revision.

BuildingSmart data dictionary (bSDD) it delivers a standard library for objects. It helps to define properties and prevent ambiguity.

Therefore, IFC can be used for defining not only project information requirements (PIR), but also exchange information requirements (EIR). Those requirements can be structured aligning to the IFC schema.

Also, the use of IDM as a methodology can help to establish the information production methods and procedures and the review and acceptance of the information model.

2.3.2. BuildingSmart International

2.3.2.1. OpenBIM

According to BuildingSmart International-bSI (2022a) OpenBIM “improves accessibility, usability, management, and sustainability of digital data”. Also, it is vendor neutral and foster interoperability which means OpenBIM looks for removing constrains to the BIM data created by proprietary vendors.

2.3.2.2. Industry Foundation Classes (IFC)

BuildingSmart International-bSI (2022a) points out that IFC (industry foundation classes) is a standardized, digital description of the built asset industry. The IFC consists of a data schema that

codifies in a logical way objects, abstract concepts, processes, and people by given them identity, semantics, attributes and relationships. The schema is defined in EXPRESS language and XML. By doing this, IFC permits to exchange information using different formats such as: XML, JSON and STEP. The official IFC specification database is IFC4 ADD2 TC1 published in 2017, IFC2X3 TC1 published in 2007, and IFC 4.3 which is under ISO voting.

2.3.2.3. Model View Definition (MVD)

According to BuildingSmart International- bSI (2022a) an MVD is a subset of the data schema that is created to support a workflow or to facilitate a specific use. There are official MVD definitions considering IFC4: IF4Precast and Reference View. Considering IFC2X3 TC1 the official MVDs are: Coordination View, Reference View, Design Transfer View, Space Boundary Addon View, Basic FM Handover View, and Structural Analysis View. It is said by Léon van Berlo (2019) that "there are more and more examples of Exchange Information Requirements that define entities from IFC without looking at MVDs and adding additional requirements for classifications and properties. The ISO 19650 definition of Exchange Information Requirements is much more dynamic and is based on the Project Information Requirements".

2.3.2.4. BIM Collaboration Format (BCF)

BIM collaboration format (BCF) helps to communicate model base-issues which brings shorter lead times. It has three steps: define the issue, specify the original problem and causes, delegate for solution. There are two manners to use BCF: exchanging files or through a web service. According to BuildingSmart International- bSI (2022a), there are different stages in which BCF can be used: design phase, procurement, construction, and operation.

2.3.2.5. Information Delivery Specification (IDS)

It is a computer interpretable document that defines the exchange requirements. This is the standard that will help to define the level of information need. It will be used to validate an IFC, to specify requirements for properties sets, file name, local position, construction level arrangement and naming, materials, and specific classifications, spaces, building services related systems, load-bearing/non load-bearing, internal/external, fire safety, building physics properties according to BIM base IDS published by BuildingSmart International (2022a). IDS is in the second phase of this development, which is about to be tested with software vendors.

2.4. CDE

The use of a CDE helps to work in a collaboratively environment. It is important to understand that a CDE is comprised of a workflow of the processes and a technological solution.

Considering the ISO 19650 Guidance Part C of the UK BIM Framework (2021), an appointing party is responsible for providing and managing a CDE. The workflow depicts how is going to be collecting, managing, and disseminating information and this workflow needs to be addressed before the election of the technology solution.

The information container must be assigned a unique ID and metadata. This metadata must comprise status (work in progress, shared, published and archive), revision and a classification system. In the project information standard must be defined by the appointing party the classification system. The status code shows the permitted use of the information container.

Moreover, Terrosi, G. (2020) developed a matrix for CDE comparison and analysis that facilitates in a systematic manner the evaluation of a potential CDE. This tool is available and facilitate the decision-making process by considering different aspects such as: user friendly interface, secured log in and access privileges, data management and notification, IFC, BCF and price.

2.5. BEP pre and post appointment

It is identified a BEP before the contract (pre) and one after contract-appointment (post). According to Terrosi, G. (2020) a BEP is a managerial and business document.

Considering the ISO 19650 Guidance Part E of the UK BIM Framework (2021), the BIM execution plan (BEP) explains what the information management approach of the lead appointing party will be. Certainly, this resource is developed for each lead appointed party, but also it can be given as a template by the appointing party. In other circumstances, the appointing party indicates the evaluation criteria and not a BEP template is given.

A pre appointment BEP comprises different resources as it is indicated in this guidance: details of individuals undertaking the information management function, proposed information delivery strategy, proposed federation strategy, high level responsibility matrix, confirmed schedule of software, hardware and IT infrastructure, summary of the prospective delivery team´s capability and capacity, proposed mobilization plan, risk register, proposed adds/amends to project´s methods and procedures, and proposed adds/amends to project´s information standard. This pre appointment BEP must fulfil the exchange information requirements, the level of information need, delivery dates and the acceptance criteria of the appointing party,

The pre appointment BEP is updated and transition to a post appointment BEP.

Also, the BIM execution planning Pennsylvania State (2019) points what should be the structure of a BIM plan: definition of scope, identification of BIM process flow, define information exchanges and describe required infrastructure. In specific, this document of Pennsylvania State establishes a series of points (fourteen) that needs to be address in this BIM plan:

1. BIM project execution plan overview information.
2. Project information.
3. Key project contacts.
4. Project goals/BIM objectives.
5. Organizational roles/staffing
6. BIM process design.
7. BIM information exchanges.
8. BIM and facility data requirements.
9. Collaboration procedures.

10. Model quality control procedures.
11. Technology infrastructure needs.
12. Model structure.
13. Project deliverables.
14. Delivery strategy/contracts.

By examining those fourteen topics, they can be correlated to different resources (documents) mentioned by ISO 19650-2 (2018) such as the "information methods and procedure", "information protocol", "information deliverables", "information standards" and "resources shared". A relevant point to highlight is the advice given in the Pennsylvania State document about including in the contract those BIM requirements not only with the input of the owner, but also with the subcontractor, the vendors, and the consultants. By doing that, team members will be required legally to complete the implementation. In section 2.12 "Templates" of this dissertation is described each sub-section of this BEP.

2.6. Level of information need

This is a crucial concept for defining what is the necessary information to be exchanged. In that sense, the level of information need supports the information exchange. One of the purposes of this concept is to deliver the right information to the right stakeholder at the right time. It consists of the combination of the geometrical details and the richness of datasets.

Considering the standard ISO 17412-1 (2020), it establishes the level of information need as a framework that defines the extend and granularity of the information. Also, the level of information need facilitates the validation and verification process.

In order to specify the level of information need is necessary to consider four prerequisites: purpose, information delivery milestone, actors (requester and deliver) and objects organized in a breakdown structure. The purpose gives reasons why the information is needed. At this point, it is common practice to relate this purpose with the BIM uses. Also, the purpose can be extracted from the OIR, PIR and AIR.

According to this standard the level of information need must be described by three concepts: geometrical information, alphanumerical information, and documentation.

For geometrical information the following aspects should be specified: detail, dimensionality, location, appearance, parametric behavior. In the case of alphanumerical information, it is necessary to specify the identification and information content. The identification is the positioning of the object within a breakdown structure (e.g. name, type name, classification) and the information content is the list of all required properties. Finally, for documentation it can be considered reports, specifications, manuals and photographs.

The following diagram helps to understand the whole picture of the level of information need, by connecting the prerequisites with the concepts:

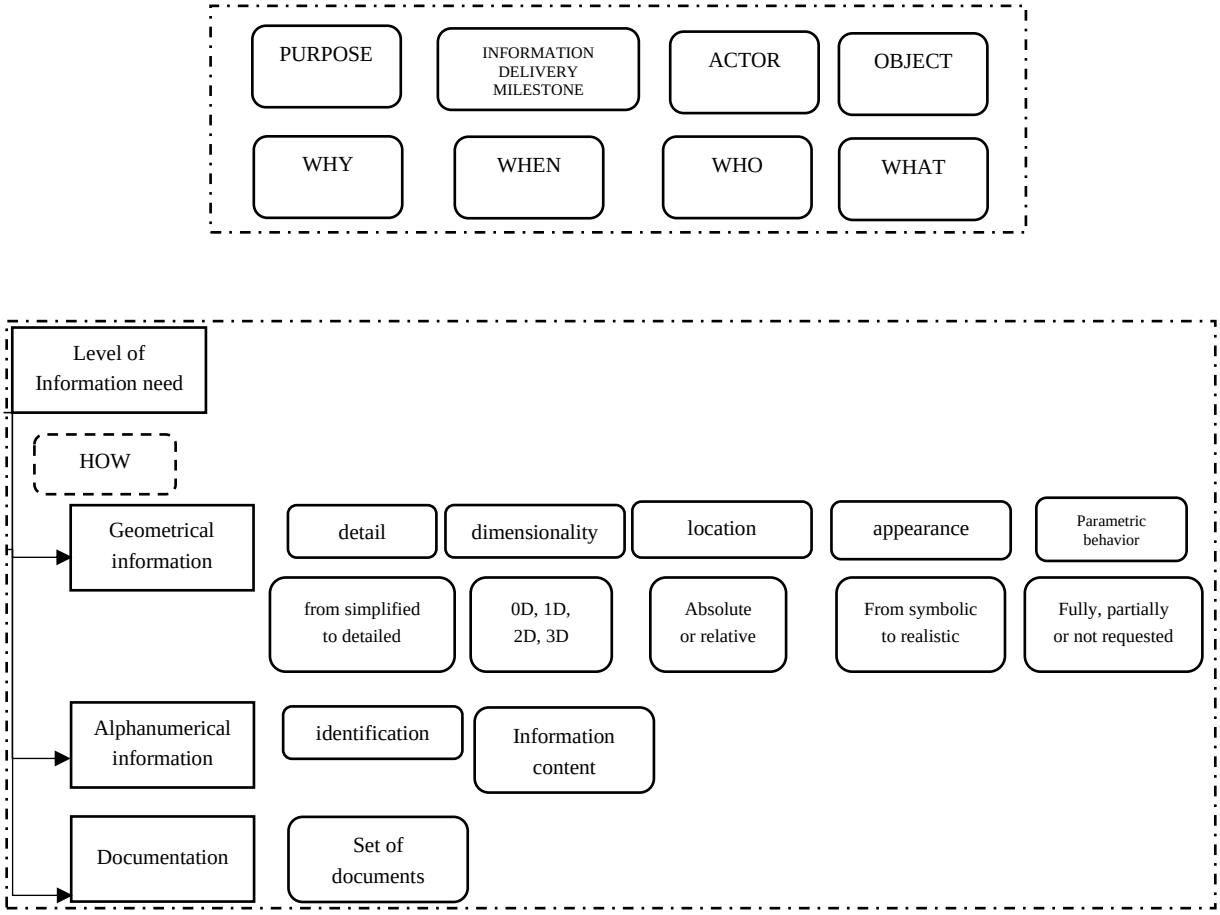

Figure 8 - Level of information need, ISO BS EN 17412-1:2020

Besides, it is also said that status, accuracy, reliability and tolerance are aspects of the level of information need that could be added as metadata.

Finally, in Annex B of this standard there is an example method to specify the level of information need. Those examples start by stating the information delivery milestone, purpose, actor and then with the geometrical information, alphanumerical information and documentation of an object.

Considering the ISO 19650 Guidance Part D of the UK BIM Framework (2022), the appointing party needs to address the level of information need in the project information standard. For a correct definition of the level of information need four aspects must be taken into account: the purpose of why the information is needed, the geometrical information, the alphanumerical information, the documentation. This guidance connects different concepts; for instance, key decision points help to define information delivery milestones, those last are considering in the exchange information requirement (EIR) and this EIR need to define the level of information need.

According to Plannerly (2022) the level of information need can be enhanced by the use of LOD. Considering that LOD as level of detail or level of development in a number scale which is not precisely accurate. However, Plannerly points out that those concepts (level of information need and LOD) can work even together, but this will depend on how is written the information requirement. This platform Plannerly offer the option to use: only LOD, only level of information need, and LOD plus level of information need as manner to define the information requirements.

2.7. Federation strategy and information container

The appointing party may define the federation strategy which is closely related to the information container identification number and a metadata attribute.

According to UK BIM Alliance (2019) this federation strategy is a "higher-level description of how and why the information model is divided up the information container breakdown structure to make the production and management of the information easier". Also, it is said that "the appointing party may determine the federation strategy where they have project-wide requirements. In this case their federation strategy will be communicated in the project´s information production methods and procedures".

2.8. Information requirements

Considering the ISO 19650 Guidance Part D of the UK BIM Framework (2022), it is said that information has four components of the information: purpose, content, form, format. Also, there are three sub-divisions: geometrical, alphanumerical and documentation.

It is important to define key decision points that are going to be linked to a plan of work (i.e. stages of the project). Moreover, the information delivery milestone should be defined considering those key decision points.

Organizational information requirement (OIR) is considered in the strategic level because it maps the business goals of the entire company (i.e., across departments and portfolios). In order to define OIR is important to understand: firstly, the reason why is necessary an information and secondly in which activity is needed. Some of the reasons why an appointing party need determined information are: make a decision, regulatory compliance, asset management or to sell the asset.

Asset information requirement (AIR) supports not only asset management, but also design and construction phases.

Project information requirement (PIR) defines what information is needed for the key decision points during the delivery phase and those points need to be mapped. It is a high-level information, and it is important to consider the plan of work when is establishing PIRs.

According to the guidance it is not necessary to describe in detail OIR, AIR and PIR because they are strategic (OIR) and high-level information requirements (AIR and PIR).

Exchange information requirement (EIR) needs to be detailed for being incorporated in the contract between an appointing party and a lead appointed party. This EIR helps to specify what information is needed. It is necessary to create a master set of EIR that then is tailored accordingly to each appointment. The relationship between OIR, PIR and AIR is that those contributes (i.e., they are an input) to the establishing of the EIR.

An EIR can be broken down in three: purposes, structuring information, and definition of information. Purposes is the beginning for starting to create EIR. Structuring will help to have open and shareable

information for the entire life of the asset. For the definition of information, the guidance mention that the level of information need will help to build an EIR. It is recommended in this guidance that an appointing party could develop a master set of EIR and then filter them according to each appointment.

The ISO 19650 Guidance part D (2022) depicts a flowchart for preparing EIR, in the figure information is divided in structured and unstructured information. Structured information is referring to models, databases, and spreadsheet. Unstructured information is the one cannot be queried by a machine and needs to be interpreted by a person for having meaning (e.g., drawings, reports, sounds, images). Figure 9- Structured and unstructured information- shows the decomposition explained.

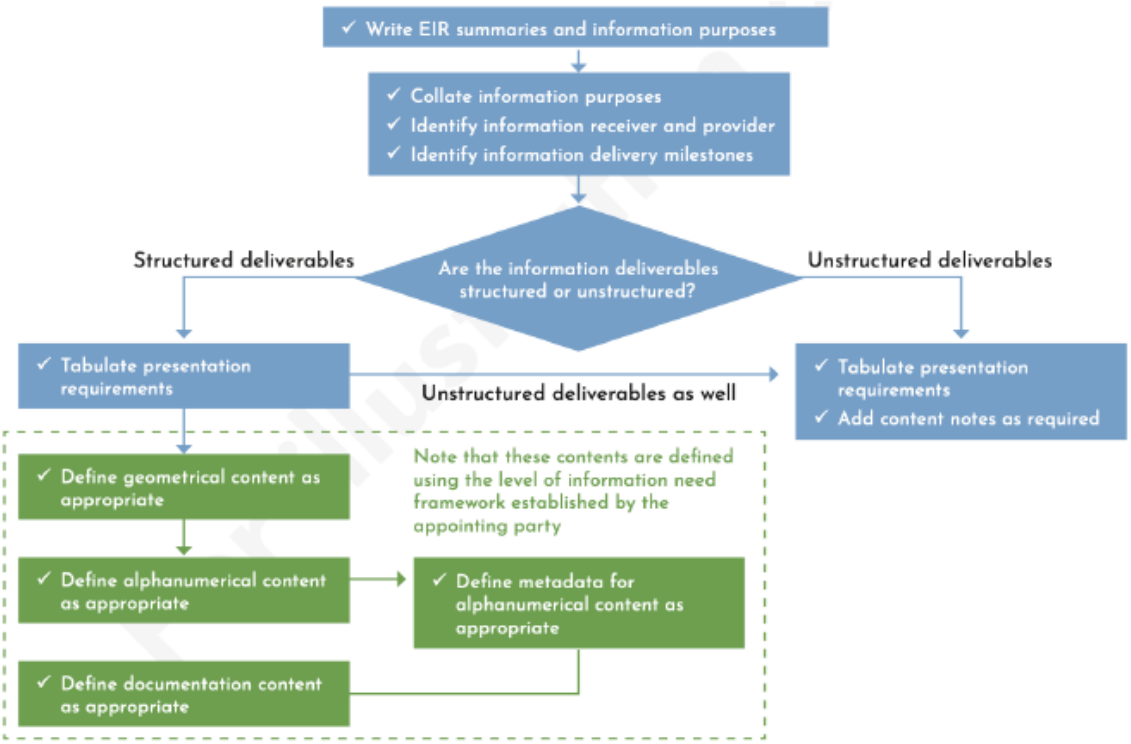

Figure 9 – Structured and unstructured information-Extracted from guidance part D

Also, the BIM execution planning of Pennsylvania State University (2019) points out the importance of determining the "specific implementation areas and uses" which at the end are information requirements. In this sense, the selection of BIM uses is an important step to define the information content. A strategy mentioned in the document is to "begin with the end in mind" and it refers to consider what is going to be the end use of the information and continue in reverse order in the project phases, this can help to choose conveniently the BIM uses. Also, there is special attention to five BIM uses which are: capture existing conditions, author design model, coordinate design model, review design model and compile record model. Those BIM uses are advised to implement. In the section "Templates" of this dissertation is analyzed the template presented for selection of BIM uses.

Moreover, in the BIM execution planning document, the definition of the information exchange means to detail what information is needed for delivering a specific BIM use. Not only for the author, but also for the receiver is important to understand and state clearly what will be the information content. Then,

there is presented a template for capturing this information exchange that will be analyzed in the sub-section “Templates”.

2.9. Information protocol

Considering the ISO 19650 Guidance Part E of the UK BIM Framework (2021), it is necessary to incorporate an information protocol in order to establish clearly the rights and obligations of each party (i.e., appointing party and lead appointing party), this incorporation must be done by a clause in the Appointment.

Also, the information protocol needs to be included since the invitation to tender process and goes through the appoint documents. About the terminology used in the information protocol, an appointor is an appointing party and an appointee is a lead appointed party.

The Information Particulars are part of the information protocol, and this Information Particulars contain a list of all the resources or relevant documents. Between those documents listed are: mobilization plan, master information delivery plan, and the task information delivery plan. It is a good practice that in case of conflicts between the Appointment and information protocol, this last should be take precedence.

2.10. Information standard

Considering the ISO 19650 Guidance Part E of the UK BIM Framework (2021), the information standard is formulated at the project level. A special characteristic of the information standard is that a lead appointed party can suggest additions or amendments. The information standard should include the following: the level of information need, classification system adopted, requirements for the designation of internal and external spaces, document headers and title block, and information container ID convention.

Mirniazmandan (2021), highlights the use of Industry Foundation Classes (IFC) as an open standard, the same as the Model view definition (MVD) and the BIM collaboration Format (BCF) as well. By using those standards, the information delivery will be aligned with an OpenBIM approach.

Besides, BuildingSmart International-Bsi (2022a) considers as data standards: IFC and MVD. Also, as workflow standards: BCF, IDS (information delivery specification) and IDM (information delivery manual).

Also, Mirniazmandan points out the use of a classification system as Uniclass 2015 because it is in accordance with ISO 12006-2, then it can be used in an international stage. Besides, the implementation of a plan of work as RIBA can be considered as a standard.

2.11. Information methods and procedures

Considering the ISO 19650 Guidance Part E of the UK BIM Framework (2021), this resource must be produced by the appointing party and this document describes the necessary processes for preparing deliverables. In this sense, it is said that methods and procedures could be captured by using information

delivery manual (IDM). Nevertheless, the guidance repeats what was indicated in the information standard with respect to the establishment of the form of the title block and document header.

According to this guidance "the information production methods and procedures may describe the process of preparing deliverables (such as drawings, models, other deliverables) prior to their use in an activity such as spatial coordination, quantity take-off by the lead appointed party, or review and acceptance by the appointing party". Then, it is closely related with defining the process of quality assurance and quality control as well. Also, the ISO 19650-1 (2018) points out the importance of information verification and validation at the start and end of project stages.

It is described in the BIM execution planning of Pennsylvania State (2019) the necessity of mapping the BIM process. To develop a high-level BIM overview map and a detailed BIM use process map. The first one looks for ordering in a sequence the different BIM uses to be implemented and it contains information exchanges. The second enters in more detail processes for each BIM use which also include sequencing those process establishing responsible parties, information content and information exchanges.

2.12. Templates and Tools

In this section is presented templates and tools found in the literature review coming from different sources. Also, an analysis was made in each template or tool.

2.12.1. Plannerly

Plannerly is a cloud-based BIM management tool, this platform developed different templates aligned to ISO 19650 series such as: OIR, PIR, EIR, BEP, Appointment, Risk, Mobilize, Lessons, RACI, Meetings and Glossary. All those templates can be customized according to the necessities.

Then, it is understandable that the original template developed by Plannerly has as many sections as possible to cover different scenarios and circumstances of different types of projects.

2.12.1.1. EIR Template

The template Exchange Information Requirement (EIR) of Plannerly is divided in sections and sub-sections. One of the most relevant sections is named "Process" which is in section 4 in the template. This section is comprised of 18 sub-sections and two of them demand special attention: 4.1 Assessment; and 4. 5 Establishing information requirement.

In this sub-section 4.1 Assessment, there is an indication that can creates confusion for an appointing party because it is said that the remaining sub-sections (from sub-section 4.2 to 4.18) must be completed by the prospective lead appointing party. But those remaining sub sections must be addressed in the pre-appointment BIM execution plan. Moreover, some of those sub-sections are declarative such as: 4.4 training requirements; 4.8 option appraisal; 4.9 design change control.

In the sub-section 4.5 Establishing information requirement is said the level of information need will be applied and it will be addressed in the template named “scope”. Then, this sub-section 4.5 does not bring value to the appointing party, it creates more documentation that is not necessary.

Moreover, in sub-section 7.1 High level responsibility matrix there are two points that need to be addressed: 1) This sub-section sends us to the template “scope”. Then, this sub-section does not need any development (i.e., section 7.1 does not bring value). 2) The table showed in this sub-section combines BIM uses with components or objects of a project. Therefore, this table is not matching with the high-level responsibility matrix showed in the annex A of the ISO 19650- 1.

Besides, in sub-section 7.4 Example information requirements is shown a table containing facets of information such as: description, form, format and milestone which are matching with the guidance part D of the UKBIM framework. Nevertheless, in the same sub-section 7.4 is pointed out that is recommended to use the template “scope” that might help to structure the requirements. Therefore, in this scenario the appointing party have the option to choose one direction or the other. But the burden of information can limit the implementation of BIM management from the appointing party.

2.12.1.2. BEP Template

In the BEP template of Plannerly, there is not an explicit separation between a pre-appointment BEP and a post-appointment BEP. This can create some misunderstanding, especially when an appointing party is in the first steps of its BIM journey. Even though, a BEP (pre or post appointment) will be developed by the prospective lead appointed parties. An appointing party might develop a template for the pre-appointment BEP. In this sense, some of the sub-sections from BEP template of Plannerly that can be important to include in this pre-appointment BEP created by the appointing party are the following: sub section 1.5; 4.1; 5.3; 6.4; 7.2 and 8.1.

For instance, in Sub-section 1.5 “Appointing party/client satisfaction” of the BEP template, there are questions that need to be answered by the prospective lead appointed party. Those questions want to understand how expectations related to the information management will be set out. Also, how progress will be measure and reported to the appointing party.

Also, section 4 “Processes” describe in a clear manner how the information production will be. For example: sub-section 4.1 describes how the project information model will be delivered by teams. Other sub-sections point out about scheduling meetings, coordination milestone and quality control.

Moreover, in sub-section 6.4 “Interactive workspace” is asked to the prospective lead appointed party how the workspace will be implemented in technology terms and if teams will be collocated. Apart from than, in sub-section 7.2 “OpenBIM file formats” is pointed out the requirements about delivering files in two formats: IFC and the native format. Besides, in sub-section 8.1 is stated in a clear manner what is excluded and the variations. This help to level expectations of different stakeholders.

Nevertheless, there are two sections who create certain misunderstanding. Sub-section 5.3 “Information container/file naming standard” is shown in the BEP but, it is not showed in the exchange requirement or in the project information standard. Then, an appointing party could think that this structure for the

information container must be indicated by the prospective lead appointed party, but this is not what the ISO 19650 series defines.

Also, there is the sub-section 5.4 “geometry and reliability definition” which seems unconnected with other parts specially with the level of information need. Then, this can be misleading for an appointing party.

2.12.2. BIM execution planning Pennsylvania State (2019)

2.12.2.1. Define BIM goals and potential BIM uses Template

It is presented in the document “BIM execution planning” of Pennsylvania State (2019) a template that helps to define goals and potential BIM uses. In this template, the goals are ranked between 1 to 3 considering its priority. This specific template can be aligned with the definition of OIR, PIR and AIR.

2.12.2.2. Evaluation of potential BIM uses

Moreover, there is a template for selecting BIM uses more conveniently. This template is a structure manner to evaluate potential BIM uses. This template combines an assessment of capacity and capability of the different stakeholders involved in the information production. Besides, it evaluates the value of a specific BIM uses for the project and for the responsible party as well. There is an evaluation of the potential value, the cost of implementation and the risk associated by the potential implementation of the BIM uses. Finally, it has the decision to implement or not the evaluated BIM use.

2.12.2.3. Process map Template

Furthermore, there is a detail explanation about how mapping the project execution process considering first an overview map and a detail BIM use process map. Both utilize the Business Process Modelling Notation (BPMN). For the overview map there are two lanes: BIM uses and information exchange. Meanwhile, for the detailed map there are three lanes: reference information, processes, and information exchange. It is said that is necessary to represent internal and external information exchange using this notation BPMN. In the annex of the Pennsylvania State document there are different detailed maps templates that can be customized.

2.12.2.4. Defining information exchanges Template

Then, for defining those information exchanges it was designed a worksheet that is characterized by five points: 1) it uses the CSI Uniformat II as a model element breakdown structure. 2) A three-tier level of detail structure: A: accurate, B: general and C: schematic; 3) Assign responsible party 4) model receiver 5) model file type.

Critically, this worksheet helps to keep track of what is an output for a particular BIM use and later will be an input for another BIM use. In this sense, the evaluation of consistency can be made by using this worksheet.

2.12.2.5. BIM project execution plan (BEP) Template

Finally, the BIM execution planning of Pennsylvania State (2019) presents the template of the BIM project execution plan (BEP) that contains 14 sections. This template shows a structure that looks for answering who, when, what, when is going to be deliver the information exchange and the information content. Following, it is shown some of the sections that deserves more attention:

Section B: Project information: It contains the project milestones.

Section D: Project goals/BIM uses: Designed to evaluate and support the decision of delivering determined BIM uses.

Section F: BIM process design: It is composed of two sub-sections a) level one process overview map and b) list of level two-detailed BIM use process map.

Section G: BIM information exchanges: It has two sub-sections named a) list of information exchange worksheet and b) model definition worksheet. Nevertheless, there is not clear the specific difference between those two. This slightly difference is that in the model definition worksheet is shown the project stage. The remaining data of those both documents show the same information.

Section L: Model structure: It explains the file name structure and the federation strategy.

Section M: Project deliverables: It indicates the stage, the approximate due date

Section N: Delivery strategy/Contract: It is addressed some specific measures to take considering the delivery method of the project. Also, it is established the team selection procedure.

2.12.3. International BIM toolkit (2020)-Cambridge University

2.12.3.1. EIR Template

It is divided into three sections: introduction, information requirements, information standards and information production methods and procedures. In the introduction section is established the purpose of the exchange information requirements through goals and objectives. Those are closely related to the OIR, PIR and AIR. Also, this section points out what is expected as a pre-appointment BEP.

Then, in the section information requirement it is stated the plan of work which is recommend being aligned to a national standard. Moreover, this section contains the information delivery milestone as the information management key performance indicator as well. Nevertheless, section 2.6 and 2.7 corresponding to project information model (PIM) and asset information model (AIM) respectively can be repetitive because all the expected outcomes (deliverables) were mentioned previously.

The last section contains not only the information standards but also the information production methods and procedures. Within the sub-topics of information standards there are: information container identification or naming convention, common data environment requirements, method of assignment the level of information need, and information model quality. The level of information need is explained in this document through the level of detail and the level of information, which can be misleading

considering the definition in BS ISO 17412-1 (2020). Then, the information production methods and procedures are composed by the information management function which can use a RACI matrix considering the activities of the annex A of the ISO 19650-2 (2018), common data environment workflow, information exchange frequency, authorization and acceptance process.

2.12.4. Past dissertations: Terrosi, G. (2020)

2.12.4.1. EIR Template

It is comprised of five sections: project general information, applicable standards, technical information, information management and plan of work. The technical information contains the following: model exchange formats, CDE platform, structure of the CDE and coordination system. The section named information management has roles and responsibilities, data segregation, security, collaboration, and issues management.

Besides, there is a detail matrix of roles in the EIR template. This matrix is not a RACI, but it points out who is the responsible and who is contributor. Then, the data security table shows who has access to different deliverables. Finally, the plan of work divides the project in stages and present the deliverables.

2.12.4.2. BEP Template

This template has eight sections which are the following: organigram, BIM coordination, RACI matrix, software, name convention, object library parameter, LOD and project milestone. The master information delivery plan (MIDP) is not developed in this BEP.

The RACI matrix considers deliverables in the design stage and the roles taken into account as owner, BIM consultant, BIM manager, BIM coordinator and BIM modeler. About the level of development (LOD) is considered the specification of the BIMForum (i.e., a scale between 100 to 500).

Also, there are recommended deliverables and an indication about who should be the responsible for presenting each deliverable in a meeting.

2.12.5. Past dissertations: Fontana, B. (2020)

2.12.5.1. Information Management Template

This template is divided into four sections: management, technical, commercial, and legal. Bianca Fontana (2020) based this division considering PAS 1192-3 “Asset information requirements”. From this document it can be taken some elements for using in the production of an EIR, AIR and BEP.

2.12.6. Guidance Part D: Information requirements – EIR Template

This template follows the line of thought depicted in the flowchart showed in section 2.8 of this dissertation. Then, a series of sections of the template are presented and the first one looks for establishing the relationship between the PIR and EIR through the purposes. The following table 2-EIR summaries and purposes- intends to show that connection that must be between the project information requirement PIR and the exchange information requirement EIR.

Table 2 - EIR summaries and purposes

PIR	EIR	Information purpose – to support

Then, the following table 3- Pre-requisites for EIR- states those pre-requisites that will condition EIR.

Table 3 – Pre-requisites for EIR

Information is required to meet the purposes-to support.	
Information specifier/receiver Information provider	
Information delivery milestone	

After, this other table 4 -Specifying detail for structured information- shows the presentation of structured information:

Table 4 - Specifying detail for structured information

Item	Content summary	Form	Format	Information exchange date	Plain language description

Next, this table 5- Specifying detail for unstructured information- shows the presentation of unstructured information:

Table 5 - Specifying detail for unstructured information

Item	Content summary	Form	Format	Information exchange date	Plain language description	Content comments

Later, table 6-Content breakdown-geometrical information-, table 7-Content breakdown-alphanumerical information- and table 8-Content breakdown-documentation information- show the content breakdown of the information, first geometrical, then alphanumerical and finally documentation.

Table 6 - Content Breakdown-Geometrical information

Object	Detail	Dimensionality	Location	Appearance	Parametric behavior

Table 7 - Content Breakdown-Alphanumerical information

Object (asset)	MaximumWeightPerHook	ElementWeight

Table 8 - Content Breakdown-Documentation information

Object (asset)	DocumentName	DocumentCategory (based on classification)	DocumentDescription

Next, this table 9- Metadata for alphanumerical information- shows the necessity to further indicate the nature of the expected content by given value types and units through metadata:

Table 9 - Metadata for alphanumerical information

Object and Attribute/Property	Metadata 1 Data type	Metadata 2 units	Metadata 3 Example value	Metadata 4 Placeholder value

Nevertheless, when in the guidance is showed some examples related to health and safety, they introduce a slightly different and reduced template, as the following table 10-detailed EIR for health and safety:

Table 10 - Detailed EIR for health and safety

Information requirement	Level of information need	Acceptance criteria	Supporting information	Key date

2.13. Lean and BIM

According to ISO 19650 series, building information modelling is about getting the right amount of information in different phases of a project such as design, construction and operation. It is said that this can be reached through better specification of information requirements. As it is pointed out by the guidance D of the UK BIM Framework (2022): “information management is to make sure that the right information is delivered to the right receiver at the right time in order to fulfill a specific purpose”. This last phrase is certainly close to the line of thought of Lean.

There are some tools coming from the methodology of Lean Construction that can be applied in the BIM process. Those could be: Choosing by advantages (CBA), Set based design (SBD), Plus/Delta analysis, Ishikawa diagram and 5 whys analysis.

Choosing by advantages consists of a structured comparison between different alternatives considering their attributes. This tool looks for avoiding bias analysis by comparing each attribute and pointing out the advantages of one over the other. The tool defines terms such as: factor, criteria and attributes as part of the methodology.

Set based design (SBD) looks for the creation of different scenarios or in our sector could be different design alternatives, different construction methods, different materials. This tool fosters the creativity and innovation by asking a set of alternatives and looking for the most optimal according to different criteria. SBD can works closely with CBA.

The analysis plus/delta is a collaboration meeting between stakeholders which is made at the end of the session. The objective of this tool is to point out what good practices are being made and what should be changed. This tool can help to detect deviations and to improve collaboration and productivity. Finally, Ishikawa diagram and 5 whys analysis look for identifying causes of a specific problem and by doing that to increase knowledge about a process.

3. TEMPLATES AND TECHNICAL GUIDE PROPOSED

In the following section of this chapter, it is explained and presented: a) the templates proposed and b) the technical guide. Both documents work in conjunction because the first one shows the structure and sections considered and the second document explains each section by given recommendations and considerations for completing the templates.

A comparison analysis was carried out in order to understand each of the different resources mentioned in the literature review. Those resources were templates, standards, guidelines, master thesis, books and papers. By doing this analysis it was created the following proposed templates and the technical guide.

3.1. Organizational Information Requirements - OIR

Different resources were used (i.e., the ones indicated in the literature review) for obtaining the structure of the Organizational Information Requirements template which is only focus in the physical and built assets and the information management for being the scope of this dissertation.

There are three sections in the proposed template which are: organizational statements, organizational activities, organizational information requirements. Each section has other sub-sections that are shown in the following figures. For instance, section 1 highlights how the organization see its present and future in a business context. As a manner to understand the important drivers of how the appointing party make decisions, this section address the mission, vision, and values of the company. This will work as a framework for the decision-making process. By clearly stating how the company envisions its future and how it is working now will help to articulate latter the information management process. Figure 10 – OIR proposed template-section 1: Organizational statements- shows the structure.

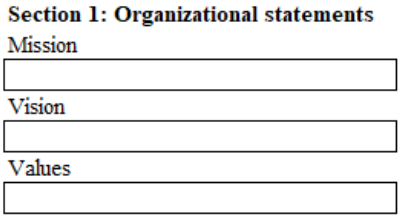

Figure 10 - OIR proposed template-section 1: Organizational statements

The following figure 11 – OIR proposed template-section 2: Organizational activities- shows the classification of organizational activities in three different nature or type such as: strategic, tactical and operational. The selection of the activities that are relevant for our scope must be done considering that those activities must be linked to physical/built assets.

Section 2: Organizational activities

Organizational actvities grouped by:

Strategic

Tactical

Operational

Figure 11 - OIR proposed template-section 2: Organizational activities

Finally, section 3 shows different considerations (i.e., each column) to take into account in order to define the organizational information requirements. In this section the columns "goal" and "objectives" comes from the evaluation made in section 1. Then, the column "activities" comes from section 2. The remaining columns tries to decompose the organizational information requirement in three: policy, information requirement and information delivery milestone.

Policy can be internal or external, this will help to understand the nature of the requirement. After, the information requirement is composed by process, people and technology. It is necessary to understand if the requirement is connected to one of those three aspects, in other words if affects or impacts one of them.

The project stage and information delivery milestone help to consider the point in time that requirements are needed. Figure 12 – OIR proposed template-section 3: Organizational information requirements- shows the structure.

Section 3: Organizational information requirements

			Policy		Information Requirement			Project stage
Goal	Objectives	Activities	Internal	External	People	Process	Technology	Information delivery milestone

Figure 12 - OIR proposed template-section 3: Organizational information requirements

3.2. Project Information Requirements - PIR

This template contains three sections named: project overview, project stages and milestones, and project information requirements. Considering the literature review a selection of sub-topics was made in each section. It is important that these requirements are project specific. The first section depicts the projects by providing the scope, type, objectives, constraints, and the existence of information about the project. It comprises of five sections, and they are characterized by its similarity to a project charter because the main objective of this section is to capture initial information of the project that permits to understand the scope and details of it. Section 1 comprises the following sub-section: project scope, project details, project objectives, project constrains and existing project information.

The last sub-section “existing project information” intents to gather in a structured manner information that can be helpful in the delivery of the project.

It is important to highlight that this section establishes the project deliverables and project objectives in a high level and always from the perspective of the appointing party. Figure 13- PIR proposed template-section 1: Project overview- shows the division mentioned.

Section 1: Project Overview

1.1 Project scope

Project justification	
Project description	
Project deliverables	

1.2 Project details

Project type,	
Address	
Procurement,	
Date of operation,	
Organisational team	

1.3 Project objectives

cost objective	
schedule objective	
acceptance criteria	

1.4 Project constrains

1.5 Existing project information

Reference	Revision	Date	Information container name	Format	Team originator	Location

Figure 13 - PIR proposed template-section 1: Project overview

Section 2 shows the plan of work that includes project stages and key decision points. It is necessary to define a plan of work that permits to establish phases in the delivery of a project. There are different standards, but one that could be used is the RIBA plan of work.

The second sub-section is about identifying key decision points in the delivery process of the project and not necessarily the information delivery milestones. It is included more details such as: activities to be completed, group team in charge and expected date to be accomplished. It is important to point out that a key decision point is different than an information delivery milestone. Again, it is not expected too much detail at this point since a PIR is a high-level requirement. Figure 14-PIR proposed template-section 2: Project stages and milestones- shows the division mentioned.

Section 2: Project stages and milestones

2.1 Plan of work

Workstages	Activities

2.2 Key decision points

Workstages	Key decision points	Activities	Group team	Dates

Figure 14 - PIR proposed template-section 2: Project stages and milestones

Section 3 (see figure 15- PIR proposed template-section 3: Project information requirements) depicts the project information requirements by using previous sections such as the identification of the key decision points made in section 2. In the table showed, there are columns such as "information requirement", "information container" and "acceptance criteria" which objective is to capture the requirements at a project level. Figure 15-PIR proposed template-section 3: Project stages and milestones- shows the structure.

Section 3: Project information requirements

3.1 Information requirements

Workstages	Key decision points	Activities	Information requirements	Information Container	Acceptance criteria

Figure 15 - PIR proposed template-section 3: Project information requirements

3.3. Exchange Information Requirements - EIR

The first section of this template is the introduction part (see figure 16- EIR proposed template-section 1: Introduction). Considering this is one of the documents that will be delivered to those prospective lead appointed party, it is necessary to give them some details in the introduction section about the project such as: scope, details, and constraints. This section should be completed considering what was wrote in the PIR. Also, this is the section in which the appointing party can describe details of the project that are relevant to the prospective lead appointed party and for the appointment as well. It is important to keep in mind that only the necessary information must be shared and one manner to address is to answer in what way particular information can be relevant for the prospective lead appointing party.

Section 1: Introduction

1.1	Project scope:	
1.2	Project details:	
1.3	Project contraints:	

Figure 16 - EIR proposed template-section 1: Introduction

Section 2 pretends to be more specific than in the PIR because is important to establish the EIR purpose, goals, and objectives (see figure 17- EIR proposed template-section 2: EIR purpose). Objectives are more specific than the goals, then special attention must be put on that. Always this section 2 must be linked to the template about the PIR.

Beginning with the question why it is necessary a particular information will help to complete this section. This section pretends to make it clear for any prospective lead appointing party the purpose, goals and objectives. The idea is to go from a general purpose to a deeper analysis by defining first the goals and later the objectives which should be made tangible and clear.

Section 2: EIR purpose

2.1	EIR purpose:	
2.2	Goals:	
2.3	Objectives:	

Figure 17 - EIR proposed template-section 2: EIR purpose

Then, section 3 is dedicated to describing the level of information need of each exchange information requirement (see figure 18- EIR proposed template-section 3: Level of information need). It is divided in two sub-sections: presentation and content. In the presentation section, there is broken down in: content summary, form, format, information exchange date, and plain language description. This is helpful for someone not to use to this level of information need concept.

Also, one of the sub-section is named "content" and it comprises: geometrical, alphanumerical, documentation and metadata. The geometrical sub-section utilizes the different aspect to consider such as: detail, dimensionality, location, appearance, and parametric behavior. In the sub-section alphanumerical is considered one aspect of OpenBIM such as the inclusion of IFC properties. Not all exchange information requirement needs to be completed with all the description asked in this template only what is strictly necessary. To highlight that in the alphanumerical sub-section is included the IFC properties as a manner to consider an OpenBIM approach and the later use of MVDs. Finally, a sub-section of unstructured information (e.g., tables or notes) can be completed, this type of information refers to the one which is not machine readable, cannot be queried and it needs to be interpretable by a person.

Section 3: Level of Information Need

- 3.1 **Presentation**
  - 3.1.1 Content summary
  - 3.1.2 Form
  - 3.1.3 Format
  - 3.1.4 Information exchange date
  - 3.1.5 Plain language description
- 3.2 **Content**
  - 3.2.1 **Structured information**
    - 3.2.1.1 Geometrical
      - 3.2.1.1.1 Detail
      - 3.2.1.1.2 Dimensionality
      - 3.2.1.1.3 Location
      - 3.2.1.1.4 Appearance
      - 3.2.1.1.5 Parametric behaviour
    - 3.2.1.2 Alphanumerical
      - 3.2.1.2.1 IFC properties
    - 3.2.1.3 Documentation
    - 3.2.1.4 Metadata
  - 3.2.2 **Unstructured information**

Figure 18 - EIR proposed template-section 3: Level of information need

Section 4 must be completed with a list of key decision points that the appointing party consider important for the delivery phase of the project (see figure 19- EIR proposed template-section 4:

Appointing´s party key decision points). By indicating also, the time is needed will help to take into account time restrictions. This section permits to keep track of relevant key decision point in the delivery phase of the project. Then, a structured manner is to link the decision points with the phases (plan of work). Also, it can be included the point in time by given the date, but with a reference it can be enough, for instance: key decision point A must be made 60 days after the start of the appointment.

Section 4: Appointing party´s key decistion points

Decision Points	Phase/Date

Figure 19 - EIR proposed template-section 4: Appointing party´s key decision points

Section 5 is about the information delivery milestones (see figure 20- EIR proposed template-section 5: Information delivery milestones); these milestones need to be delivered some time before the key decision points. For instance, an information delivery milestone can be fifteen days in advance that the key decision point. This occurs because that information needs to be reviewed and accepted for taking a final decision. In this section, it is asked to list those milestones relevant to the delivery phase of the project and its associated phase (plan of work) as well the date in time in which is needed that particular information.

An information delivery milestone could be linked to a key decision point considering some time to review and accept the information in order to take the most informed decision at the end. Then, a milestone can be referenced in the timeline as: milestone 1 must be reached 2 weeks in advance of the key decision point.

Section 5: Information delivery milestones

Milestones	Phase/Date

Figure 20 - EIR proposed template-section 5: Information delivery milestones

Section 6 (see figure 21- EIR proposed template-section 6: Plan of work) defines the plan of work with its respective stages and deliverables associated. It is important to establish a plan of work which help to divide the delivery of the project in phases. There are different plans of work but one which is used is the RIBA. Also, there are the deliverables associated to those phases.

Section 6: Plan of work

Stages	Deliverables

Figure 21 - EIR proposed template-section 6: Plan of work

The CDE is described in section 7 (see figure 22- EIR proposed template-section 7: CDE) considering both of aspects: workflow and as solution. This according to the ISO 19650-2. In sub-section 7.1 named CDE workflow is necessary to describe the detail how stakeholders are going to interact and dealing with information. This means, to establish the different process such as working in progress, shared, published and archive of the information. This can be made with a process map or by describing step by step the entire process.

Sub-section 7.2 called CDE solution explains the technology, the software, the necessary hardware for working in the common data environment. It is important to give details in order to avoid delays in the use of the CDE.

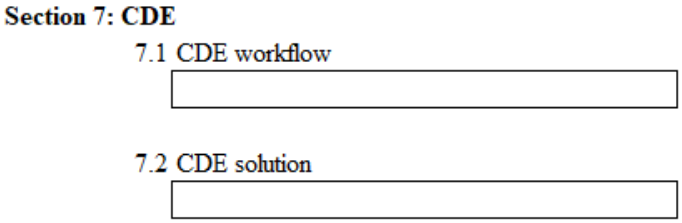

Figure 22 - EIR proposed template-section 7: CDE

Section 8 (see figure 23- EIR proposed template-section 8: Capturing lesson learned) is dedicated to describe what is expected from the prospective lead appointed party for capturing lesson learned. This section describes what is expected to do from the prospective lead appointing party for capturing lessons learned. The collaboration that is need from this role and the responsibility must be described for avoiding misunderstanding and lack of commitment.

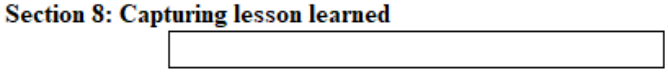

Figure 23 - EIR proposed template-section 8: Capturing lesson learned

3.4. Pre BEP

This is the template that should be delivered to the prospective lead appointing party for filling according of how the information management are going to be handled. This pre BEP template once was completed in the tender process will be assessed by the appointing party. It is composed by seven sections. In section 1 (see figure 24- Pre BEP proposed template-section 1: Details of individuals undertaking the information management). describes the professional experience of those individuals who will be responsible for information management. This section must be completed considering the capacity and capability assessment that also must be delivered by the prospective lead appointing party. By assuring that the right people are on board, it will assure to fulfill the expectation of the appointing party. An appointing party should evaluate if the experience presented are relevant for the task in hand. It is a good practice to ask for a presentation of the team in a meeting where some questions arise in order to measure the appropriateness of the team.

Section 1: Details of individuals undertaking the information

1.1 Professionals Experience

Name	CV/resumé	Relevant professional

1.2 Key project contacts

Name	role	email	cellphone

Figure 24 - Pre BEP proposed template-section 1: Details of individuals undertaking the information management

The following section 2 (see figure 25- Pre BEP proposed template-section 2: Proposed information delivery strategy) divides the information delivery strategy in seven different dimensions: delivery team scope, delivery team organizational structure and composition, objectives/goals for the collaborative production of information, approach to meet the EIR, quality assurance and quality control.

This section pretends to measure the level of understanding and experience of the prospective lead appointing party by addressing different issues. First, by clearly stating what the scope and second by presenting the composition and structure of the team.

Then, objectives for the collaborative production of information must be specific and achievable this will help to express the team approach to meet the exchange information requirements. Finally, as part of the work how the quality assurance in the entire process and how quality control will be carry out by the prospective lead appointing party are the last two sub-sections.

Section 2: Proposed information delivery strategy

2.1 Delivery team scope

2.2 Delivery team organizational structure and composition

2.3 Objectives/goals for the collaborative production of information

2.4 Set out the delivery team´s approach to meet the EIR.

2.5 Quality assurance

2.6 Quality control

Figure 25 - Pre BEP proposed template-section 2: Proposed information delivery strategy

Section 3 defines the proposed federation strategy, and it is showed in the following figure 26- Pre BEP proposed template-section 3: Proposed federation strategy). It is divided in seven sub-sections: define strategy, BIM process design, breakdown structure, model delivery, project meetings, electronic communication, and coordination milestones.

The first sub-section of this part is the definition of the strategy and the supporting elements of how to handle the federation. Then, a description or a diagram that explains the entire process (activities, flow

and stakeholders) of federation is asked in sub-section 3.2. Later, a list or a diagram of the components of the federation in what is called the breakdown structure is required in sub-section 3.3.

The last four sections: model delivery, project meetings, electronic communication and coordination milestones address the collaboration environment that is needed. For instance, in the sub-section model delivery the definition of what information will be delivered, when, in what frequency and format are required. Also, a list of proposed project meeting and a description of a general structure of those meeting are necessary in sub section 3.5. The use of electronic communication must be clearly specified above the platform or CDE used. Finally, as a result of the model delivery and project meeting sub-sections is the interest to state which are the important milestones considering the coordination and federation of the project information model.

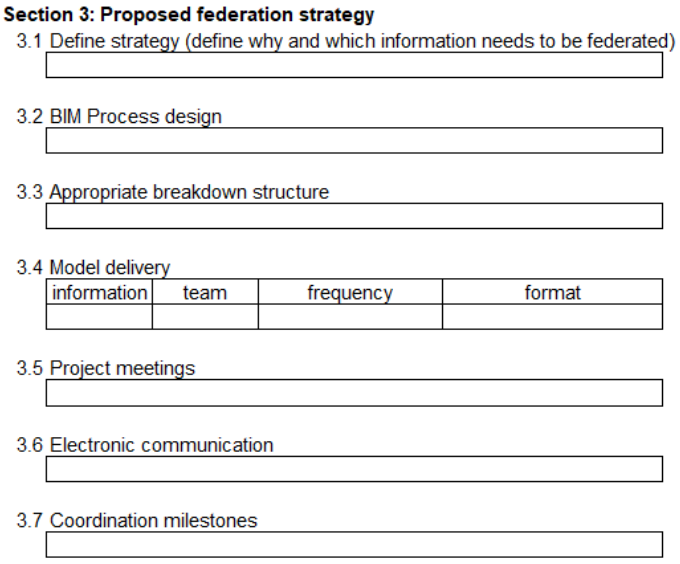

Figure 26 - Pre BEP proposed template-section 3: Proposed federation strategy

To establish a high-level responsibility matrix that matches deliverables and roles is asked in section 4 of the template (see figure 27- Pre BEP proposed template-section 4: High level responsibility matrix). A table connecting the deliverables and roles of the prospective lead appointed party is asked in this sub-section. The detail and granularity of this matrix will show the level of understanding and experience that will be assessed by the appointing party.

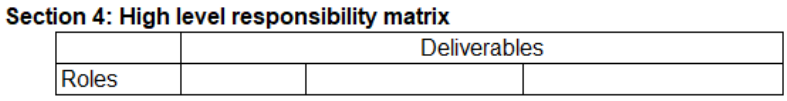

Figure 27 - Pre BEP proposed template-section 4: High level responsibility matrix

Section 5 is focused on the description of the software and hardware needed to implement the information delivery management strategy. This section also includes an OpenBIM approach and it asked to the prospective lead appointing party how is planned to use the IFC protocol, MVDs, BCF and IDS (see figure 28- Pre BEP proposed template-section 5: Confirmed schedule of software, hardware and IT). The description of the software solutions and the necessity of hardware are key elements to

evaluate, and the two sub-sections address them. Moreover, the third sub-section ask for a description of how an OpenBIM approach will be implemented by the prospective lead appointing party.

Section 5: Confirmed schedule of software, hardware and IT

5.1 Software version,

Software version	discipline	file format	version

5.2 Hardware, version

5.3 OpenBIM approach

OpenBIM file formats	Description of implementation
IFC protocol	
Types of MVD	
BCF	
IDS	

Figure 28 - Pre BEP proposed template-section 5: Confirmed schedule of software, hardware and IT

It is in section 6 that the prospective lead appointing party is asked to analyze and give feedback to the information methods and procedures prepared by the appointing party (see figure 29- Pre BEP proposed template-section 6: Proposed adds/amends to project´s methods and procedures). After an analysis of what was received as information methods and procedures. It is expected that the prospective lead appointing party is able to propose changes or improvements by supporting its suggestions with the aim to make it more feasible and with more value (lean approach) to reach the exchange information requirements

Section 6: Proposed adds/amends to project´s methods and procedures

Figure 29 - Pre BEP proposed template-section 6: Proposed adds/amends to project´s methods and procedures

The prospective lead appointing party is required to propose changes or improvements to the project information standards. This is made in section 7 of the template (see figure 30-Pre BEP proposed template-section 7: Proposed adds/amends to project´s information standards). After an analysis of what was received as information standards. It is expected that the prospective lead appointing party is able to propose changes or improvements by supporting its suggestions with the aim to make it more feasible and with more value (lean approach) to reach the exchange information requirements.

Section 7: Proposed adds/amends to project´s information standards

Figure 30 - Pre BEP proposed template-section 7: Proposed adds/amends to project´s information standards

3.5. Information Standards

It is proposed a series of standards as a reference for consideration of an appointing party. It is assumed in this proposal that is of interest to implement ISO 19650 series and an OpenBIM approach. Then, the appointing party can agree with this minimum list (see figure 31-Information standards proposed template) or to include other standards as ISO 7200 for considering technical product documentation or other standards as the National CAD Standards of USA.

Standard	Function
ISO 19650-1 and ISO 19650-2	Information management
BS EN ISO 19650-2:2018 National Annex UK	Information container naming convention
Uniclass 2015	Structuring and classification of information
ISO 17412-1:2020	Level of information need
IFC 4 ADD2 TC1 or IFC2X3TC1	IFC-Industry foundation classes
Reference View and Design transfer view	MVD-Model view definition
BCF v.3	BCF collaborate environment
IDS-in development	IDS specification of information exchange

Figure 31 - Information standards proposed template

3.6. Information Methods and Procedures

This proposed template contains four sections (see figure 32- Information methods and procedures proposed template-section 1: Capturing of existing asset information). The first of them pretends to list and deliver any previous information of the asset to be built, here it can be used a cross reference to section 1 of the template "reference information and shared resource". The appointing party must collect any information that brings value to the project, and this must be available to the prospective lead appointing party. This is important for taking into consideration in the tender response. Then, this section must describe the type and nature of the existing information.

Section 1: Capturing of existing asset information

Figure 32 - Information Methods and Procedures proposed template-section 1: Capturing of existing asset information

In section 2 is described the generation, review, and approval process. This section is divided in nine sub-sections: process map, production of information, federation strategy, intermediate reviews and verification (peer review), option appraisal/set based design, design change control, responsibility matrix, coordinates, and technology/file formats. See figure 33- Information methods and procedures proposed template-section 2: Generation, review or approval of new information.

In this section the appointing party establishes some guidelines. First, a general process map can be shared by the appointing party, this is a general process, and it shows how the appointing party consider the development of the process. Then, an explanation about how the production of information should

be from the perspective of the appointing party. Later, a federation strategy overview is described as a guideline.

Sub-section 2.4 states the necessity of revision of the progress as a verification that the work has been doing as planned and according the EIR and other resources such as the information standards and information methods and procedures. Then, in sub-section 2.5 the appointing party asks for the consideration of some options for the design, this is known as set based design in the lean construction community.

As any project, it is expected to have some changes in the process. So, a mechanism of design change control must be established by the appointing party for avoiding claims and issues. Then, in sub-section 2.7 is shown a responsibility matrix that contains the roles of the appointing party with the deliverable of information that this appointing party is in charge. Later, if it is known the coordinates (datum) of the project, they are shared. Finally, the sub-section 2.9 should describe some considerations of the technology to use and the necessity of implement an OpenBIM approach.

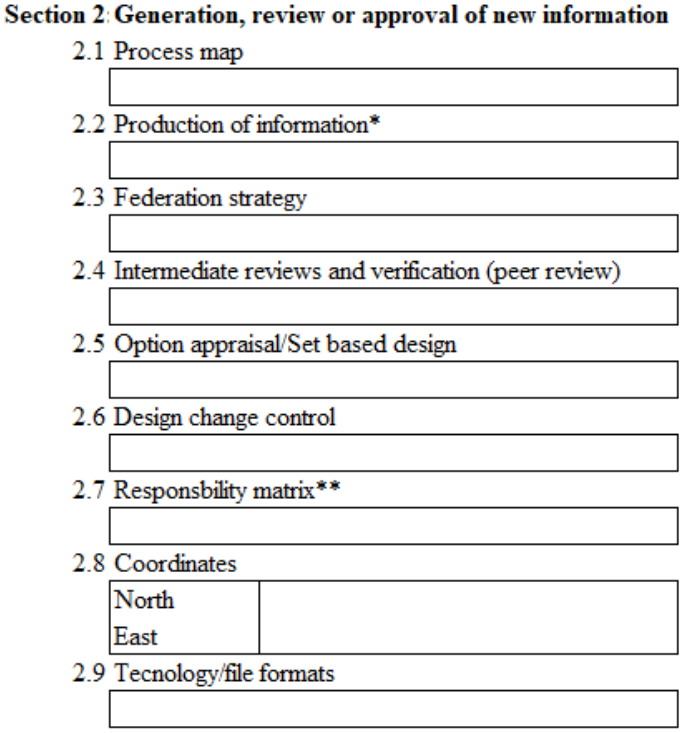

Figure 33 - Information Methods and Procedures proposed template-section 2: Generation, review or approval of new information

Any condition or restriction about security of the information is addressed by the appointing party in section 3 (see figure 34- Information methods and procedures proposed template-section 3: Security of distribution of information).

In this section is expected to complete the conditions, and requirements for the use of information. To follow the guidelines of ISO 19650-5 is a guarantee to maintain a security standard for the treatment of sensitive information. Also, it is important to define access requirements.

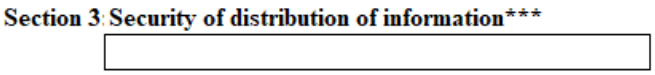

Figure 34 - Information Methods and Procedures proposed template-section 3: Security of distribution of information

The delivery process that includes quality assurance and quality control that is expected by the appointing party is described in section 4 (see figure 35-Information methods and procedures proposed template-section 4: Delivery of information to the appointing party). This section starts by describing the manner or protocol for delivering information to the appointing party. This includes necessity to include a quality assurance and quality control in different points of inspections of the process.

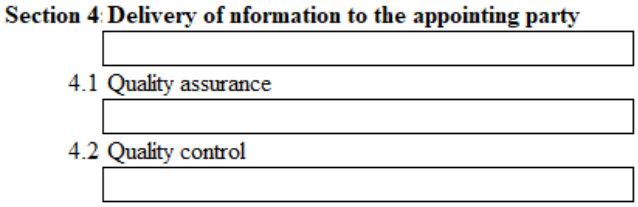

Figure 35 - Information Methods and Procedures proposed template-section 4: Delivery of information to the appointing party

3.7. Information Protocol

This is a proposal of the structure of an Information Protocol (see figure 36-Information protocol proposed template-structure). In the sense it pretends to make it easier for an appointing party to start its BIM journey. In this "proposal information protocol" is the intention to recommend what should be taken into account in this document, but it does not give specific clauses. The UK BIM Framework shows an exhaustive example with clauses that the author of the dissertation found relevant for its implementation with some minor recommendations. Specific recommendations in each section are described.

Section 1: Information Particulars

The importance of this first front page comes because it highlighted the most relevant documents or resources in the appointment. It is necessary to complete in detail by describing each item in the information particular showed in the UK BIM framework.

Section 2: Interpretation

It can be recommended to change clause 1.2: "provide or deliver information management according to the UK BIM Framework", instead of UK BIM Framework it should be: ISO 19650 series. Apart from that, the clause 1.5 is important because it establishes an order of precedence between documents when a conflict or inconsistency arises.

Section 3: Obligations of the appointing party

As an appointing party it is necessary to maintain updated the Information Particulars. Also, it is an obligation to carry a sensitivity assessment.

Section 4: Obligation of the appointee and appointor

This section in the template of UK BIM framework creates confusion to include the term "prepared documents" instead of "information deliverables" or "resources". Besides, the appointee and appointor must comply with security requirements. Finally, this protocol must be incorporated in all appointments, it must cascade.

Section 5: CDE solution and workflow

Clause 5.1 of the UK BIM template should change a little in order to add an OpenBIM approach because now how is written in the template aforementioned it does not give any room for interoperability. Then, it can consider to include: "the appointee shall use an OpenBIM approach for assuring interoperability between stakeholders. For instance, by defining appropriate MVDs according to the IFC schema selected (2x3 or 4).

Section 6: Use of information

It is about given grants and licenses for using the "Material". So, it is relevant that the appointing party must read and consider this clause. Consider to change the term “material” for resources or information deliverables.

Section 7: Transfer of information

It is recommended to use the term "exchange information requirements" instead of "works information requirements" that is the one used in the NEC contract. Also, it is mentioned that the appointee shall prepare a Risk assessment. Finally, it is said that the appointee shall help to capture lessons learn by providing relevant information.

Section 8: Liability

It is stated there is not liability if the information is used in other purpose not declared in the exchange information requirement (i.e., level of information need).

Section 9: Remedies-security

It specifies the procedure of termination when there is a breach from the appointee.

Section 1:	**Information Particulars**
Section 2:	**Interpretation**
Section 3:	**Obligations of the appointing party**
Section 4:	**Obligation of the appointee and appointor**
Section 5:	**CDE solution and workflow**
Section 6:	**Use of information**
Section 7:	**Transfer of information**
Section 8:	**Liability**
Section 9:	**Remedies-security**

Figure 36 - Information Protocol proposed template-structure

3.8. Response Requirements and Evaluation Criteria

The section 1 points out what is expected to receive from the prospective lead appointing party as part of the response tender. Here the appointing party can agree with the 4 requirements that consist of the presentation of: pre BEP, mobilization plan, risk assessment and the team´s capability and capacity (see figure 37- Response requirements and evaluation criteria proposed template-section 1: response requirements). There is room to add another resource required but this will be different from the ones recommended by the ISO 19650 series.

Section 1: Response Requirements

The following is the response requirements for the tendering process:

1.1	The prospective lead appointed party shall complete entirely the pre BEP template.
1.2	The prospective lead appointed party shall present the mobiization plan.
1.3	The prospective lead appointed party shall present the information delivery risk assessment.
1.4	The prospective lead appointed party shall present the assessment of the delivery team´s capability and capacity.

Figure 37 - Response requirements and Evaluation Criteria proposed template-section 1: Response requirements

Then, the evaluation criteria is explicitly written in order to reach transparency in the tendering process. This section points out the six factors for evaluation of each tender response (see figure 38-Response requirements and evaluation criteria proposed template-section 2: evaluation criteria). Those factors are technical, competency, quality, economical, mobilization plan and risk register. It can be included other criteria as well according to the requirement of the appointing party.

Section 2: Evaluation Criteria

The evaluation criteria to be considered:

2.1	Technical
2.2	The competency of the prospective individuals undertaking the information management.
2.3	Quality process
2.4	Economical
2.5	Mobilization plan
2.6	Risk register

Figure 38 - Response requirements and Evaluation Criteria proposed template-section 2: Evaluation criteria

In section 3 is shown the templates for using the tool of lean construction called "choosing by advantages" CBA. The sub-section 3.1 (see figure 39- Response requirements and evaluation criteria proposed template-sub-section 3.1: using choosing by advantages CBA) consists of the factors and criteria to be considered in this methodology. This methodology defines the concepts of factor and criteria, those factors were stated in section 2 and now the criteria is defined. The criteria is the desired requirement considering an specific factor. Also, it can be understood this term criteria as the specification or description of the factor. In the template, it is presented a common criteria that can be considered by the appointing party.

Section 3: Using choosing by advantages-CBA

3.1 Factor and Criteria considered

Factor	Criteria
Technical - Methods	The methods, procedures and collaboration strategy proposed by the prospective lead appointed party are aligned and superseed with the one presenteds by the appointing party.
Technical - Federation	The federation strategy proposed by the prospective lead appointed party will benefit the coordination of the delivery phase.
Competency	The qualificaions of the key personnel and proved experience in past projects are relevant for the delivery of the project.
Quality	It is proposed a coherent quality assurance process and a quality control as well.
Economical	The proposal brings more value for money to the delivery phase of the project.
Mobilization plan	It describes the manner how is going to be tested: methods and procedures, CDE, information exchanges, information delivery, hardaware and software. Alos, it mentions how is developed: training, education, reference and
Risk register	Risks are evaluated considering the following topics: assumptions, milestones, information protocol, information delivery strategy, methods, procedures, information standards, mobilization, capability and capacity. Then, a qualitative analysis is made for establishing a priority risk. After, an strategy is elected with actions to take and the risk is assigned.

Figure 39 - Response requirements and Evaluation Criteria proposed template-sub-section 3.1: Using choosing by advantages CBA

Sub-section 3.2 shows the table of evaluation to be used for assigning points. The following figure 40- Response requirements and evaluation criteria-sub-section 3.2: Table for evaluation-1st part- evaluates the technical (methods and federation), competency and quality.

Then, all alternatives (tender responses) are analyzed, and each attribute is detected considering if address the corresponding factor. The following procedure will be made for each factor: the alternative with the less desired attribute is considered the baseline and against this alternative is evaluated the rest of alternatives, then the difference between attributes is the advantage of one over the baseline. In that manner is detected the advantages and it is necessary to write and describe that advantage by filling the table. Next, it is necessary to assign points to the most advantageous, the second one and the baseline.

3.2 Table for evaluation

Alternatives:		Alternative 1			Alternative 2			Alternative 3		
		Prospective lead appointed			Prospective lead appointed			Prospective lead appointed		
Factors	**Criteria**									
Technical - Methods	The methods, procedures and collaboration strategy proposed by the prospective lead appointed party are aligned and superseed with the one presenteds by the appointing party.	Atribute			Atribute			Atribute		
		Advantage:	Importance:		Advantage:	Importance:		Advantage:	Importance:	
Technical - Federation	The federation strategy proposed by the prospective lead appointed party will benefit the coordination of the delivery phase.	Atribute			Atribute			Atribute		
		Advantage:	Importance:		Advantage:	Importance:		Advantage:	Importance:	
Competency	The qualificaions of the key personnel and proved experience in past projects are relevant for the delivery of the project.	Atribute			Atribute			Atribute		
		Advantage:	Importance:		Advantage:	Importance:		Advantage:	Importance:	
Quality	It is proposed a coherent quality assurance process and a quality control as well.	Atribute			Atribute			Atribute		
		Advantage:	Importance:		Advantage:	Importance:		Advantage:	Importance:	

Figure 40 - Response requirements and Evaluation Criteria -sub-section 3.2: Table for evaluation - 1st part

Later, it is shown the second part of the table of evaluation (see figure 41- Response requirements and evaluation criteria-sub-section 3.2: Table for evaluation-2nd part). Here is considered other factors such as: economical, mobilization plan and risk register.

3.2 Table for evaluation

Alternatives:		Alternative 1			Alternative 2			Alternative 3		
		Prospective lead appointed			Prospective lead appointed			Prospective lead appointed		
Factors	**Criteria**									
Economical	The proposal brings more value for money to the delivery phase of the project.	Atribute			Atribute			Atribute		
		Advantage:	Importance:		Advantage:	Importance:		Advantage:	Importance:	
Mobilization plan	It describes the manner how is going to be tested: methods and procedures, CDE, information exchanges, information delivery, hardaware and software. Alos, it mentions how is developed: training, education, reference and shared resources.	Atribute			Atribute			Atribute		
		Advantage:	Importance:		Advantage:	Importance:		Advantage:	Importance:	
Risk register	Risks are evaluated considering the following topics: assumptions, milestones, information protocol, information delivery strategy, methods, procedures, information standards, mobilization, capability and capacity. Then, a qualitative analysis is made for establishing a priority risk. After, an strategy is elected with actions to take and the risk is assigned.	Atribute			Atribute			Atribute		
		Advantage:	Importance:		Advantage:	Importance:		Advantage:	Importance:	
	Total Importance			**0**			**0**			**0**

Figure 41 - Response requirements and Evaluation Criteria-sub-section 3.2: Table for evaluation- 2nd part

In sub-section 3.3 is established a scale of importance that permits to assign points to the most advantageous alternative as well the second and third one. Also, the scale of importance will help to define how to assign those points. In this scale the first task is to define the importance of each factor. The second task is to define how will be the criteria for assigning points to the second and third

alternative (according how were ranked considering the advantageous alternative). See figure 42-Response requirements and evaluation criteria-sub-section 3.3: Scale of importance.

3.3 Scale of importance

Order each factor assigning points. It must state how many points will get the most advantageous alternative, the second one and the third.

Importance	Advantage
100	
90	
80	
70	
60	
50	
40	
30	
20	
10	
0	

Figure 42 - Response requirements and Evaluation Criteria -sub-section 3.3: Scale of importance

The sub-section 3.4 is a description of the most advantageous alternative and a conclusion after completing the entire table of evaluation. Finally, after evaluating each factor with the attributes, analyzed the advantages and assigned the points. It is time to sum up all the points got for each alternative and to conclude by given the recommendation of the most advantageous alternative by describing it. See figure 43-Response requirements and evaluation criteria-sub-section 3.4: Conclusions.

3.4 Conclusión:

Figure 43 - Response requirements and Evaluation Criteria -sub-section 3.4: Conclusions

3.9. Reference Information and Shared Resources

The objective of this "reference information and shared resources" is to make available relevant information that can be useful in the delivery phase of the project. Then, section 1 (see figure 44-Reference information and shared resource-section 1: Existing asset information) consists of pointing out the existing information that the appointing party owns. Also, there could be other information coming for other actors such as utilities companies. This section looks for all the information that exist and it is available, this can come from the appointing party or even a third party as utility provider. Then, it is expected that not only a description of the information, but also the proper information must be available in the tendering process. It is important to annotate that the PIR also points out this necessity to considering the existing asset information.

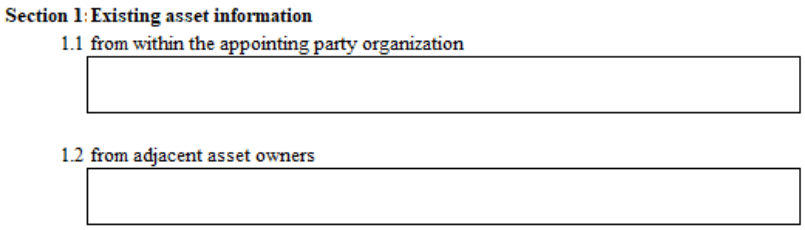

Figure 44 - Reference Information and Shared Resource - Section 1: Existing asset information

After, section 2 comprises three sub-sections: templates, style libraries and families/objects libraries. Figure 45-Reference information and shared resource-section 1: shared resource- shows the structure. Through the definition and by putting available those shared resource, the appointing party make sure they are going to be considered in the delivery phase of the project. In sub-section 2.1 is shared templates such the pre-BEP or even a template of the master information delivery plan. Then, sub-section 2.2 defines lines weights, patter, styles, fill patterns, text assignment, paper size, scales, annotations, and dimensioning. Besides, in section 2.3 is shared family, objects or even software templates.

The objective of this shared resource is to facilitate and align the information production with what is expected by the appointing party. In this sense, this section addresses topics as it is pointing out in the template. So, some of them need not only to describe what is necessary, but also to attach in a digital format by using the CDE such as the family/object library and the software template in case the appointing party considers this necessary.

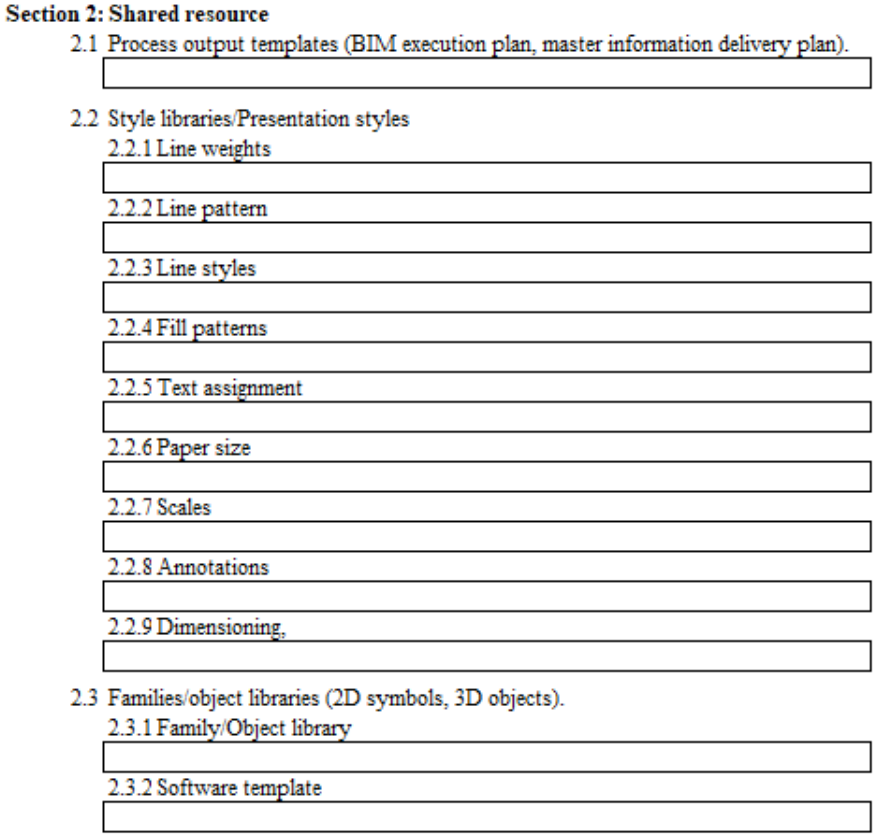

Figure 45 - Reference Information and Shared Resource - Section 2: Shared resource

Finally, section 3 addresses the possibility that the appointing party needs to be consider a particular product data template (PDT). Some appointing parties are willing to consider a particular product data template (PDT) as part of shared resource. If that is the case, not only the description of that PDT but also the digital information is needed. See figure 46-Reference information and shared resource-section 3: Library object within national and regional standards.

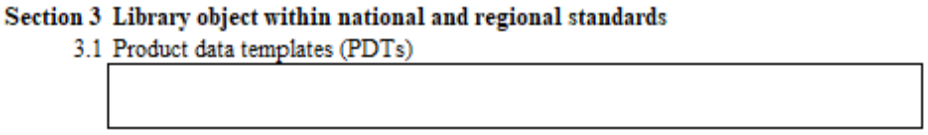

Figure 46 - Reference Information and Shared Resource - Section 3: Library object within national and regional standards

3.10. Review and Accept Model

It is proposed a checklist for the review and acceptance of the model for consideration of an appointing party. In the following figure 47-Review and accept the model proposed template- the review considers if the information received is aligned with the information standards, the information methods and procedures, the level of information need, the exchange information requirements, and the master information delivery plan.

It is expected that personnel who is undertaking the information management function will review considering those five sections in the proposed template. When, in this review there are reasons to reject the model it is important to describe each reason with comments and images that help to the lead appointed party to address those issues without hesitation. Certainly, the template seems quite simple, but it refers to other resources such as: information standards, information methods and procedures, level of information need, exchange requirements, and the master information delivery plan. With all of that is a quite large task this review. So, one manner to deal with this is to ask for delivering package of information instead of the entire PIM at the end.

Proposal Checklist Review and Accept Model

		Yes	No	Comments
1	Is the model submitted in accordance to the information standards?			
2	Is the model submitted in accordance to the information methods and procedures considering:			
2.1	the capturing of existing asset information			
2.2	the generation, review or approval of new information			
2.3	the security of distribution of information			
2.4	the delivery of nformation to the appointing party (quality control and quality assurance).			
3	Does the model submitted meet with the level of information need?			
4	Is the model sumitted in accordance to the exchange information requirements considering:			
4.1	the informaton delivery milestones?			
4.2	the CDE workflow and CDE technology?			
4.3	the reference information and shared resources?			
5	Is the model submitted containing all the deliverables listed in the master information delivery plan?			

Figure 47 - Review and Accept Model proposed template

3.11. Lesson Learned

A template for capturing lesson learned is shown and it is divided in two sections. The first one addresses the necessity to implement a continuous method to capture lessons learned which is the implementation of the analysis plus-delta that comes from the Lean Construction framework.

It is proposed to implement a plus/delta analysis at the end of each coordination meeting. It consists of 5-10 minutes of reflection about what should be maintain the way is done because it is delivering good results and what could be done better or in other words what can be improved. The participation in a free environment that promotes this discussion is crucial for getting best results in this plus/delta analysis. By doing this, the appointing party make sure that lessons learned are continuous evaluated and reflected. See figure 48-Lesson learned proposed template-section 1: recurring lesson learned.

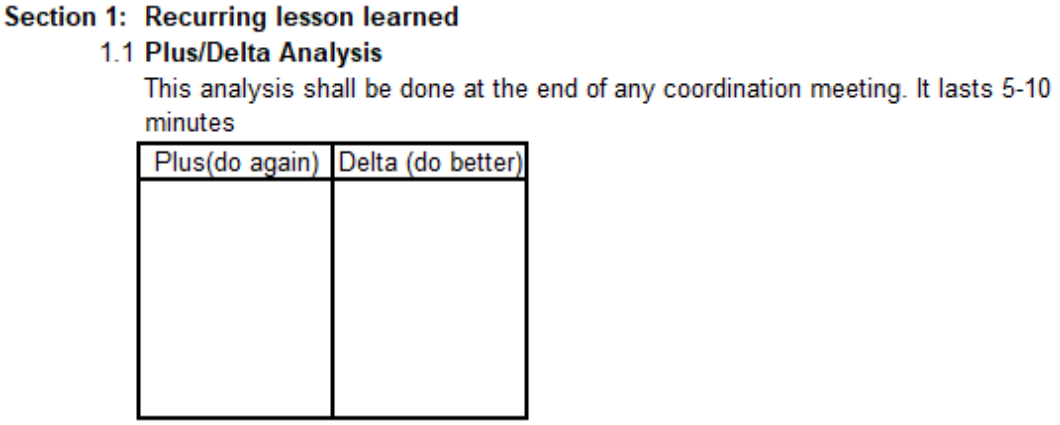

Figure 48 - Lesson Learned proposed template - Section 1: Recurring lesson learned

The second section address the capturing of the lesson learned at the end of the appointment or the project. Then, it consists of four sub-sections: assessment criteria, supporting information (qualitative or quantitative), analysis of root causes, and recommendations for future endeavors. See figure 49-Lesson learned proposed template-section 2: End appointment/project.

This section considers doing an analysis at the end of each appointment and at the end of the project. It is proposed a structured manner to do it which starts with an assessment over the outcomes, budget, schedule, procurement process, and information management process. Secondly, it is necessary to gather information that support the assessment, at this point is expected the collaboration of the lead appointed party for collecting the necessary information. Thirdly, the use of some tools for finding the root causes as Ishikawa diagram or five whys analysis should help to understand what occurred. Finally, a description of what is recommended for future projects must be made.

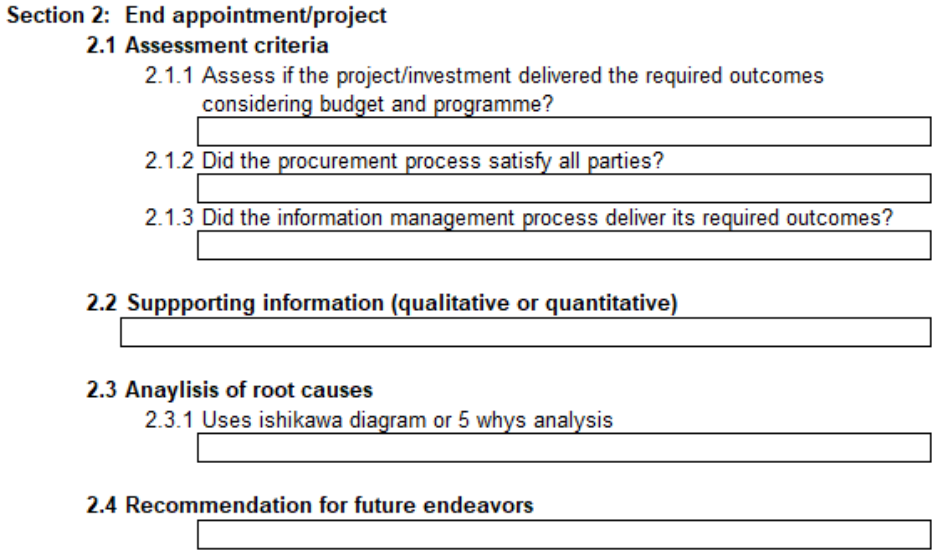

Figure 49 - Lesson Learned proposed template - Section 2: End appointment/project

3.12. Archive Project Information Model (PIM)

It is proposed a checklist for the archive of the project information model for consideration of an appointing party. Figure 50-archive PIM proposed template- considers five sections: verifying of availability of the information containers, selection of appropriate information, policies retention, future access, and future re-use.

The appointing party needs to address how is going to be the archiving process of the project information model. The sections presented in the proposed template pretend to firstly assess if the information is completed and secondly which information containers will be part of the asset information model. Thirdly, how long the information will be available. Fourthly, to establish the access requirements and policies are needed. Finally, the future re use of the information must be analyzed considering the lesson learned obtained.

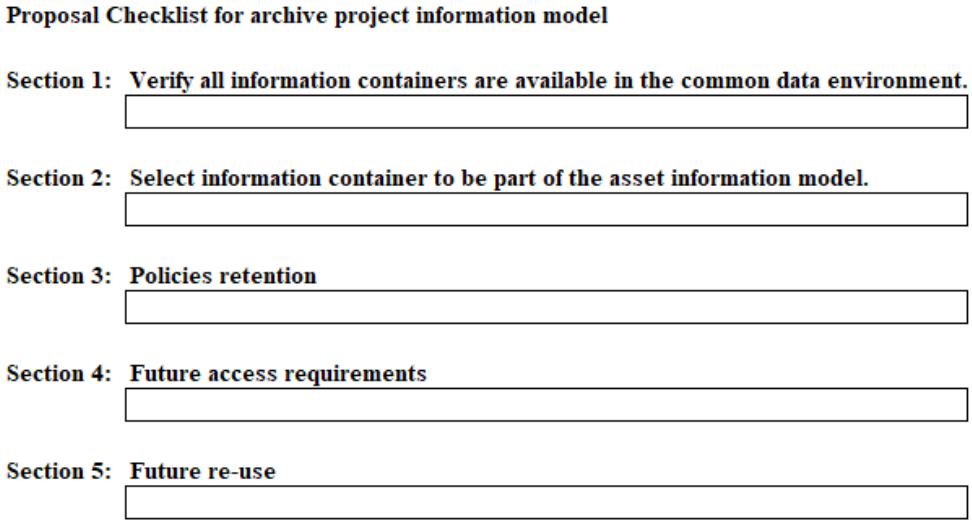

Figure 50 - Archive PIM proposed template

3.13. Master Information Delivery Plan - MIDP

It is proposed a Master Information Delivery Plan (MIDP) as a template to be delivered to the lead appointing party in order to comply with some requirements at the moment of elaboration of the MIDP: information container (name and title), delivery milestone (dates), predecessor, duration (production), time to review for lead appointed party, time to review and acceptance for appointing party, responsible/actor, and level of information need.

The appointing party does not need to complete anything about the master information delivery plan MIDP. The objective to propose a template is to facilitate the analysis of what is presented by the lead appointed party and to make sure is included some important details. For instance, the time for review that needs not only the lead appointed party, but also the appointing party is crucial for consideration in the entire information delivery process. Also, it is of particular interest the match that the lead appointed party must do between the information container, deliver milestone, predecessors, and level of information need. The form of this MIDP is a table, but it can also be presented as a Gantt diagram as a complement. The following figure 51- MIDP proposed template- shows the structure of the template.

Proposal template to be adopted for Master Information Delivery Plan - MIDP

Information container/Deliverable (name and title)	Delivery milestones(date)	Predecesor/dependencies	Duration (production)	Time to review for Lead appointed party	Time to review and accept for Appointing party	Responsable/ Author	Level of information need			
							Presentation		Content	
							Format	Form	Structure	Unsutructure

Figure 51 - MIDP proposed template

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4. VALIDATION AND ANALYSIS OF RESULTS

4.1. 1st Round of Interviews –Validation Process

This first round of interviews has the aim to make an introductory exploration of the knowledge level of 3 experts. Those experts came from the industry and their day-to-day they deal with information management using BIM. During the interviews were asked about specific topics such as: ISO 19650 series and OpenBIM and some tools about Lean Construction.

Those interviews consist of five open questions. In the following, it is showed the answers and statistics for each one. The first question was "are you aware of ISO 19650 series?" and the responses were that all experts were acquainted about the ISO 19650 series and two-thirds pointed out that they have a referential knowledge or just about part 1 of ISO 19650.

The second question was "How do you rate your knowledge about ISO 19650 series? Limited, regular, good or excellent". The responses go from limited to good. One third of the answers mentioned limited, other third regular, and the last third good.

The third question was "Are you aware of OpenBIM approach?". All of the interviewees mentioned that they know about OpenBIM but in different levels. One of them mentioned IFC as part of the OpenBIM and other interviewee explained that OpenBIM consist of sharing information freely.

The fourth question was "How do you rate your knowledge about OpenBIM? Limited, regular, good or excellent. Two-thirds of the answers mentioned "limited" as the level of knowledge and just one-third pointed out as "good" level.

The last question was "How do you define the information requirements for a project?". One of the interviewees mentioned that the information requirement needs to be specific and related to the nature or type of project, for buildings are different from lineal projects. Also, that those information requirements need to be elaborated by the client or a third party in its representation, but not for the contractor. This in order to maintain transparency in the workflow. Then, another interviewee stated that the objectives must be taken into account for formulating the information requirements. Besides, other interviewee started answering about a request for information requirements as a manner of dealing with a scope not properly defined.

Through this first interview it can be considered that ISO 19650 is slightly better known than OpenBIM standards. Nevertheless, this does not mean that knowledge about ISO 19650 series is depth between interviewees. There is a convergence about the importance for defining information requirements which must be adjusted or aligned to the goals or expectations of the client or in terms of the ISO 19650 the appointing party.

The answers collected in this first round of interviews will help to weight the answers, comments, and suggestions coming from the interviewees in the second round of interviews and in the survey.

4.2. Survey –Validation Process

In this second part of the validation process the specific objective was to test different sections or parts of the proposed templates and the technical guide through 29 questions in a survey using the Likert scale and 6 open questions to capture in more detail some of the considerations of the experts. There were the same interviewees than in the first round. Also, the survey is divided according to the proposed template and the specific section or consideration that is required to test.

Survey Section 1: OIR proposed template

In table 11- OIR proposed template question- is shown the questions and results obtained.

Table 11 - OIR proposed template questions

N°	Template	Question	Totally disagree	Disagree	Neutral	Agree	Totally agree
1	OIR	Do you agree that the organizational information requirements (OIR) includes the organizational statements such as: mission, vission, and values as a framework?	0.0%	0.0%	0.0%	33.3%	66.7%
2	OIR	Do you agree to have this separation between "goals" and "objectives"	0%	0%	0%	33.3%	66.7%
3	OIR	Do you agrre to classify the organizational activities in strategic, tactical and operational?	0.0%	0.0%	33.3%	33.3%	33.3%

Two-thirds of the interviewees answered as “totally agree” and one-third as “agree” to the question about mapping the mission, vision, and value of the organization.

In the second question people answered to be at least agree for including this separation between goals and objectives.

The third question in this section was about to classify the activities of the organization between: strategic, tactical and operational. Here, the experts have a divided position: neutral, agree and totally agree. The majority of them are at least “agree” to classify those activities.

Survey Section 2: PIR proposed template

In this section was proposed to include a specific plan of work and all participants were at least “agree” with the statement. Moreover, two-thirds of them were “agree”.

The second question is about the importance to incorporate in the template a table of key decision points, all participants were at least “agree” to include it. Table 12 – PIR proposed template question- shows the results.

Table 12 - PIR proposed template questions

N°	Template	Question	Totally disagree	Disagree	Neutral	Agree	Totally agree
4	PIR	Do you agree to define an specific plan of work in the Project Information Requirement (PIR)	0.0%	0.0%	0.0%	66.7%	33.3%
5	PIR	Do you agree to define key decision point in the PIR?	0.0%	0.0%	0.0%	66.7%	33.3%

Survey Section 3: EIR proposed template

Table 13- EIR proposed template question- shows the questions and results for this section. Interviewees in the first question of this section mentioned to be agreed with the use of the framework of level of information need, 67% of them indicated the level of "agree", and only 33% "totally agree". There are some comments from the participants in this regard that will be analyzed in the sub-section 4.4 of this dissertation.

Table 13 - EIR proposed template questions

N°	Template	Question	Totally disagree	Disagree	Neutral	Agree	Totally agree
6	EIR	Do you agre to use the framework of the level of information need for defining exchange information requirements (EIR)?	0.0%	0.0%	0.0%	66.7%	33.3%
7	EIR	Do you agree to make the distintion between key decision points and information delivery milestones?	0.0%	0.0%	33.3%	33.3%	33.3%
8	EIR	Do you agree with the extent of the introduction of the EIR template?	0.0%	0.0%	0.0%	33.3%	66.7%

In the second question of this section, it addresses the necessity to distinguish between "key decision points" and "information delivery milestones", the answers are divided between neutral, agree and totally agree in equal proportion. The participant mentioned different comments that will be analyzed in sub-section 4.4 of this dissertation.

The last question is about what should have the introduction section of the template. It is presented the following parts: project scope, project details and project constraints. The results shows that all participants are at least "agree" with the content.

Survey Section 4: Pre BEP proposed template

Table 14- Pre BEP proposed template questions- shows the questions and results for this section. The first question of this section is about the inclusion of OpenBIM by asking to define which IFC protocol, MVDs, BCF and IDS are going to be used in the information production process and the results shows that 67% of participant market "totally agree" and 33% "agree". There are some comments to analyze in sub-section 4.4 of this dissertation.

Table 14 - Pre BEP proposed template questions

N°	Template	Question	Totally disagree	Disagree	Neutral	Agree	Totally agree
9	pre BEP template	Do you agree to include an OpenBIM approach by asking to define which IFC protocol, MVDs, BCF and IDS are going to be used?	0.0%	0.0%	0.0%	33.3%	66.7%
10	pre BEP	Do you agree to ask for a BIM process design (a process map)?	0.0%	33.3%	33.3%	0.0%	33.3%
11	pre BEP	Do you agree to ask for quality assurance and quality control details?	0.0%	0.0%	33.3%	33.3%	33.3%

The second question is about the inclusion of a process map as part of the template. The results are divided and go from "disagree", "neutral" and "totally agree". There are different comments from the participants in this question that will be showed and analyzed in sub-section 4.4 of this dissertation.

The last question in this section, and it is about the consideration for quality assurance and quality control in the Pre BEP. The results show a divided position between the participants because 33% of them marked a “neutral” position, another 33% marked “agree” and the rest indicated “totally agree”.

Survey Section 5: Information Standards proposed template

Table 15- Information standards proposed template questions- shows the questions and results for this section. This first question of the section points out the necessity to be more specific about what is mandatory to consider in the information production about the different standards. This “description” column included in the template pretend to be more specific about what is important in respect to a specific standard. The results show that 33% of the participants marked “disagree” and 67% marked “agree”.

Table 15 - Information standards proposed template questions

N°	Template	Question	Totally disagree	Disagree	Neutral	Agree	Totally agree
12	Information Standards	Do you agree of including a description that indicates what aspects must be included of each specific standards by the prospective lead	0.0%	33.3%	0.0%	66.7%	0.0%
13	Information Standards	Do you agree to have a the "Information Standards" as a separate resource (document) from the EIR?	0.0%	33.3%	33.3%	33.3%	0

The last question of the section shows a divided position between the participants about considering the “information standards” as a separate resource from the EIR. In this sense, 33% of participants marked “disagree”, 33% “neutral” and the rest “agree”. There are some comments from the interviewees that will be showed and analyzed in sub-section 4.4.

Survey Section 6: Information Methods and Procedures proposed template

Table 16- Information methods and procedures proposed template question- shows the question and results for this section. This question wanted to know the position of the participants about to have the “information methods and procedures” as a separate document from the EIR. The results shows that 33% marked “neutral” and 67% marked “agree”. There are some comments from the interviewees that will be shown and analyzed in sub-section 4.4.

Table 16 - Information methods and procedures proposed template question

N°	Template	Question	Totally disagree	Disagree	Neutral	Agree	Totally agree
14	Information Methods and	Do you agree to have a the "Information Methods and Procedures" as a separate resource (document) from the EIR?	0.0%	0.0%	33.3%	66.7%	0.0%

Survey Section 7: Information Protocol proposed template

Since in the information protocol the term “material” is used to refer a resources or deliverable. In the first question of this section 67% of the participants are not willing to use the term “material”, they prefer the terms “resources” or “deliverables” as appropriate. On the other hand, 33% of the interviewees

are willing to use the term “material” as used in the information protocol template. In sub-section 4.4 is discussed this term. Table 17- Information protocol proposed template questions- shows the questions and results for this section.

Table 17 - Information protocol proposed template questions

N°	Template	Question	Totally disagree	Disagree	Neutral	Agree	Totally agree
15	Information Protocol	Do you agree not to use the term "materials" for refering to resources and deliverables?	0.0%	33.3%	0.0%	66.7%	0.0%
16	Information Protocol	Do you agree not to use the term "prepared documents" for refering to resources and deliverables?	0.0%	0.0%	0.0%	100.0%	0.0%
17	Information Protocol	Do you agree not to use the term "works information requirements" for refering to the exchange information requirements?	0.0%	33.3%	0.0%	66.7%	0.0%

Since in the information protocol the term “prepared documents” is used to refer resources or deliverables. In the second question of this section 100% of the participants are not willing to use the term “prepared documents”, they prefer the terms “resources” or “deliverables” as appropriate. In sub-section 4.4 is discussed this term according to the comments of the participants.

Then, in the information protocol the term “works information requirements” is used to refer to the exchange information requirements. In the last question of this section 67% of the participants are not willing to use the term “works information requirements”, they prefer the terms “exchange information requirements”. On the other hand, 33% of the interviewees are willing to use the term “works information requirements” as used in the information protocol template of the UK BIM Framework. In sub-section 4.4 is discussed this term and the comments given by the participants in this regard.

Survey Section 8: Response requirements and Evaluation Criteria proposed template

Table 18- Response requirements and evaluation criteria proposed template questions- shows the questions and results for this section. This first question of the section intends to measure the willingness of the participants for implementing a tool of Lean Construction as “Choosing by advantages (CBA)” for this template. All the interviewees marked “agree”.

Table 18 - Response requirements and Evaluation Criteria proposed template questions

N°	Template	Question	Totally disagree	Disagree	Neutral	Agree	Totally agree
18	Response requirements and Evaluation Criteria	Do you agree to implement the tool "Choosing by advantages" from the Lean Construction methodology in order to evaluate different tender response?	0.0%	0.0%	0.0%	100.0%	0.0%
19	Response requirements and Evaluation Criteria	Do you agree to include as factors for evaluation: technical, competency, quality, economical, mobilization plan and risk register?	0.0%	0.0%	0	100.0%	0.0%

In the last question of this section, as part of the procedure for implementing CBA is necessary to define the factors for evaluation, then it was asked if those factors considered are adequate. All participants agree with those six factors.

Survey Section 9: Reference Information and Shared Resource proposed template

Table 19- Reference information and shared resource proposed template questions- shows the questions and results for this section. All interviewees mentioned to be agreed to include a section for "product data template" as part of the proposed "reference information and shared resource".

Table 19 - Reference Information and Shared Resource proposed template questions

N°	Template	Question	Totally disagree	Disagree	Neutral	Agree	Totally agree
20	Reference Information and Shared Resource	Do you agree to include a "Product data template" as part of the shared resources?	0.0%	0.0%	0.0%	100.0%	0.0%
21	Reference Information and Shared Resource	Do you agree to define "Presentation styles" (line patten, line weights, paper size, text assignments) as part of the shared resources?	0.0%	33.3%	33.3%	33.3%	0.0%
22	Reference Information and Shared Resource	Do you agree to include a "object libraries and software templates" as part of the shared resources?	0.0%	0.0%	0.0%	100.0%	0.0%

The positions of the experts are divided in the question about "presentation styles". The answers go from disagree, neutral and agree. There are comments from the participants that will be discussed in sub-section 4.4.

The consensus of the participants in last question of the section about including object libraries as part of the "reference information and shared resources".

Survey Section 10: Review and Accept the model proposed template

Table 20- Review and accept model proposed template questions- shows the question and results for this section. It was asked if it is appropriate to consider five different references (see table 20) to take into account for the review and accept process. All participants are at least "agree" from them 33% marked "totally agree".

Table 20 - Review and Accept the model proposed template question

N°	Template	Question	Totally disagree	Disagree	Neutral	Agree	Totally agree
23	Review and Accept Model	Do you agree to include in the Review and Accept Model the revision with the: information standards, information methods and procedures, level of information need, exchange information requirements, and master information delivery plan?	0.0%	0.0%	0.0%	66.7%	33.3%

Survey Section 11: Lesson Learned proposed template

Table 21- Lesson learned proposed template questions- shows the questions and results for this section. The first question of this section pretends to measure the willingness to include a tool from Lean Construction named "plus/delta analysis" for capturing lessons learned on a recurring basis. 67% of the participants expressed they agree and 33% "totally agree".

Table 21 - Lesson Learned proposed template questions

N°	Template	Question	Totally disagree	Disagree	Neutral	Agree	Totally agree
24	Lesson Learned	Do you agree to include the tool Plus/Delta analysis in each coordination meeting?	0.0%	0.0%	0.0%	66.7%	33.3%
25	Lesson Learned	Do you agree to include the tool Ishikawa diagram or five whys for analysis of the root causes at the end of the appointment?	0.0%	0.0%	0.0%	100%	0.0%

In the second question of this section, all participants are willing to use the tools “Ishikawa diagram” or “five whys” for the analysis of causes when capturing lessons learned at the end of the appointment or project.

Survey Section 12: Archive Project Information Model proposed template

Table 22- Archive project information model proposed template question- shows the question and results for this section. All participants agree about the criteria considered for selecting information to be archived.

Table 22 - Archive Project Information Model proposed template question

N°	Template	Question	Totally disagree	Disagree	Neutral	Agree	Totally agree
26	Project Information Model	Do you agree to consider for archiving the following topics: verify and select information containers, policies retention, access requirements, and future re-use?	0.0%	0.0%	0.0%	100.0%	0.0%

Survey Section 13: Master Information Delivery Plan proposed template

Table 23- Master information delivery plan proposed template questions- shows the questions and results for this section. In the Master Information Delivery Plan (MIDP) template was added an explicit column for showing the time that will take to review and to accept for the appointing party. All participants agree to include this time according to the first question of this section.

Table 23 - Master Information Delivery Plan proposed template questions

N°	Template	Question	Totally disagree	Disagree	Neutral	Agree	Totally agree
27	Master Information Delivery Plan	Do you agree to include the column "Time to review and accept for appointing party"?	0.0%	0.0%	0.0%	100.0%	0.0%
28	Master Information Delivery Plan	Do you agree to include the column "Time to review for lead appointed party"?	0.0%	0.0%	0.0%	66.7%	33.3%
29	Master Information Delivery Plan	Do you agree to include the column "level of information need" as part of the "master information delivery plan"?	0.0%	0.0%	0.0%	100.0%	0.0%

In the MIDP template was added an explicit column for showing the time that will take to review for the lead appointing party. 67% of the participants expresses to be agreed and 33% marked “totally agree”.

In the proposed template (MIDP) was added an explicit column for making a cross-reference to the level of information need and to show in a crystal-clear manner what corresponds to each deliverable or information container. All participants express to be agreed.

4.3. 2nd Round of Interviews –Validation Process

There were six open questions which aim to develop further a position from the interviewee. Following it is presented those questions with relevant comments from the participants.

The first question was about “What other details do you suggest for the introduction section of the EIR template?”. It was pointed out to make a cross reference to the specification or previous information of the project. Also, it was mentioned to add a narrative description of the real expectations from the perspective of the appointing party in the implementation of BIM.

The second question was about “What other consideration do you suggest for the Review and Accept Model?”. The participants agreed with the criteria considered in the template and no further comments were added.

The third question was about “What other consideration do you suggest for archiving the project information model?”. There is a comment form one of the experts about public projects and consist of revising which information can be valuable for future project not only of the appointing party (a governmental institution) but for other institutions as well. For instance, all the geotechnical information and topography of an area could be useful for other projects.

The fourth question was about: “Do you consider a technical guide should explain and give recommendations about how to complete the templates?”. All interviewees agree that is necessary to have a document with recommendations of how to complete the templates. One of the participants mentioned this will help to clarify doubts and to facilitate the mind change that BIM is just a 3D model.

The fifth question was about “How do you improve these templates?”. One of the participants stated that is necessary to include an implementation plan linked to change management that can take the form of regular meetings explaining to the stakeholders what the aim of the BIM implementation is. Other interviewee mentioned that is necessary to get the involvement of the stakeholders in the process to reach the goals. Also, to include a period evaluation about what should be done and what was done. Besides, another participant pointed out that all information (including these templates) should be in the common data environment.

The sixth and last question was about “what kind of problems do you have when defining information requirements for your project?”. One of the participants pointed out it is necessary to consider the type or the nature of the project when defining information requirements. Another interviewee insists on the difficulty of getting people eager to collaborate in the process and to achieve the compromise of the stakeholders.

4.4. Analysis of results

In the third question of the survey in which is evaluated how necessary participants considered to map the activities of the organization and classify them in: strategic, tactical and operational. Despite there is a majority of 67% that at least is agree with this analysis of the organizational activities, there is a 33% who is neutral. One of the reasons of this last position is because the participant believe is not necessary too much detail in this OIR document, so it is indifferent to this inclusion. Nevertheless, it is a good practice to start doing this classification for knowing an entire vision of how the organization works and its necessity. So, this section is maintained in the OIR proposed template.

Considering the exchange information requirements (EIR) template it was asked to the participants if they think necessary to make the distinction between key decision points and information delivery milestones. Despite the fact there is a majority of 67% who is at least agree, the 33% marked as a neutral position and the reason is that this separation brings confusion, and it is better to specific clear milestones for just one event. Considering this last comment and with the aim to state in a clear manner the difference between key decision points and information delivery milestones is incorporated a footnote an explanation in the template.

It deserves special attention one of the questions considering the pre-BEP template, it is about "Do you agree to ask for a BIM process design (a process map)?" because there is a divided position, people against, neutral, and in favor. One of the reasons that participant mentioned it was this requirement (process map) is too much detail for a pre-BEP coming from a prospective lead appointed party. Since just 33% of interviewees marked "agree" with the inclusion of this requirement. Then, considering this industry perspective of 66% that are not favor, it will be better to take it out from the template this process design (process map).

The third question of the survey that is related to the pre-BEP is about the convenience to require to the prospective lead appointed party for details in the quality assurance and quality control that will be deployed. There is a 67% in favor to ask for this information in the pre-BEP template, but there is a 33% who is neutral, and the reason given is that considering the timeframe to complete the pre-BEP is short, it will be necessary to clearly state that this section will be further developed in the post-BEP. Then, this recommendation is included in the template as a footnote.

Moreover, considering the information standards template proposed to the participants there is a disagreement between interviewees about the inclusion of a narrative part that intents to describe what is the most crucial part for the appointing party in each standard listed. The opposition comes because the interviewees explained that this can be considered for the prospective lead appointed party as the unique part to be achieved in a particular standard and it makes not to consider the rest of the document (standard). Also, other point stated was the fact that not necessarily the appointing party has the expertise to reach that level of knowledge of a particular standard even a BIM consultant could make a mistake in selecting what to include in that description. Then, in the information standard proposed template it was taken out this "description" part of the template.

Besides, in the information standards template it was asked if this should be a separate document from the EIR. Only 33% of the participants considered a good practice to have those documents (resources)

separate, but other 33% prefers to maintain the information standards as part of the EIR. The rest of participants are neutral. The reasons explained by the participants in favor to have one just document is that this will help to have a clear vision about what is expected from the appointing party. Then, considering that the descriptive part was taken out (see explanation in the precedence paragraph), this make less heavy the information standards and it is included as part of the EIR.

Later, in the information methods and procedures template it was asked if this should be a separate document from the EIR. 67% of the participants considered a good practice to have those documents (resources) separate, but other 33% maintain a neutral position. The reason given for this neutrality is that depends on the extension of the information methods and procedures. Then, for our purposes this document is maintained as a separate document from the EIR.

In the questions related to the information protocol it was asked if participants are willing to use the term “materials” for referring what in the ISO 19650 series are “resources” or “deliverables” according to the case. Despite the scenario in which 67% of the interviewees prefer to use the terms “resources” and “deliverable”, there is a 33% that do not have problem of using the term “materials”. This 33% commented that it is necessary to define properly “materials” along the documents for avoiding any misleading or confusion. Then, considering that the template of the information protocol is customizable then each can use the preferred term.

A situation like the explained in the previous paragraph happen with the term “works information requirements” for referring to the “exchange information requirements”. The majority of participants prefer to include the terms “exchange information requirements”. Then, considering that the template of the information protocol is customizable then each can use the preferred term.

Next, the template about “information reference and shared resource” has a section devoted to set the “presentation style” such as: line pattern, line weights, paper size, text, and annotations. Only 33% of the participants agree to include this section, but another 33% disagree and the rest is neutral. One of the reasons pointed out by the interviewees for being against is that this constraint too much to the lead appointed party and it represents an enormous effort to the appointing party to set those guidelines. Despite this position, the implementation of some criteria for “presentation style” give consistency across the deliverables of different lead appointed parties. Then, this section is maintained.

5. CONCLUSIONS AND RECOMMENDATIONS

From the initial interviews and according to the answers given it is fair to say that there is more knowledge and expertise about the ISO 19650 series, and less when OpenBIM standards is discussed. Participants recognize the importance of an international standards as ISO that permits to have common frameworks in which terms are defined and properly used. Meanwhile, the superfluous level of knowledge about OpenBIM that was captured in the interview was that participants associate the idea of interoperability with the use of IFC but it does not go deeper. Then, there is a necessity to generate more forums for delivering more knowledge about OpenBIM standards in the industry level.

There were proposed five different tools coming from the Lean Construction community: set based design, choosing by advantages, plus/delta analysis, and Ishikawa diagram and 5 whys analysis. Those tools were included in different templates in the proposal. Through the survey it can be concluded that there is an openness for using those tools for implementing BIM in an organization. It can be deduced that experts match productivity improvement and increase of quality with tools coming from Lean Construction community. Also, there is an intention from bringing those characteristics to the BIM workflow. Nevertheless, it could be noticed that there is a need for acquiring more knowledge about the implementation of those Lean tools in an industry level as well.

There were presented thirteen templates to the consideration of the panel of experts and according to the results of the survey and the second round of interviews the changes or adjustments were minimal. The experts highlighted the importance to gather different sources and, compile them and offered as a good practice to follow. Also, the experts highlighted the necessity to accompany those templates with a technical guide which states how to complete them and to contain recommendations for a better understanding of the templates.

The validation process helped to adjust the content of the templates and the technical guide. The information standards template, the pre-BEP template, the EIR, and the information protocol checklist were modified after considering the comments and positions from the panel of experts. The changes were associated to avoid confusion in the terminology and not overburden the prospective lead appointed party. Those changes are explained in detail in the previous section, specifically sub-section 4.4.

The level of information need that is the framework proposed in the ISO 19650 series was included in the proposed templates and the comments from the panel of experts address some issues about its implementation. It was highlighted in the comments given by them about the practicality and usability of the level of information need in contrast of the well-known level of development (LOD). Then, there is a necessity to show in public forums about the advantages of adhering to the framework of level of information need and at certain point to address that both approaches can work in a complementary manner.

Then, the proposed templates and technical guide were developed in this dissertation with the intention to ease the path of an appointing party who intends to implement a BIM methodology. Nevertheless, as it was pointed out for comments from the panel of experts there is a necessity from the beginning to keep in mind the nature or type of infrastructure at hand and to clarify the north by having what the purpose of the organization are about information management. In this regard, the resources presented

in this dissertation can help, but it is also necessary to implement a holistic approach that considering change management not only in the appointing party but also for other stakeholders.

Finally, for future research it can be used those templates and technical guide and implemented in a real case scenario (i.e., a company willing to use those documents in a project). By doing that, this will help to adjust and improve the resources and to get other insights.

REFERENCES

Baldwin, M. (2019). *"The BIM Manager, a practical guide for BIM project management"*. Beuth Verlag GMbh.

Barbosa, F. et al. (2017) *"Reinventing Construction: a route to higher productivity"*. McKinsey & Company.

Berlo, L. (2019) *"The curious case of the MVD".* Available at https://blog.buildingsmart.org/blog/the-curious-case-of-the-mvd / (Accessed: 11 May2022)

Borrmann, A., Konig, M., Koch, C. and Beetz, J. (2020) *"Building information modeling"*. Springer.

BuildingSmart International (2022a). *"Standards"* Available at https://www.buildingsmart.org/standards/bsi-standards/ (Accessed: 11 May2022)

BuildingSmart International (2022b). *"BIM basis IDS"* Available at https://ucm.buildingsmart.org/use-case-details/2594/en (Accessed: 11 May2022)

Casini, M. (2020). "*Construction 4.0 Advanced technology, tools and materials for the digital transformation of the construction industry"*. Elsevier.

Eastman, C., Teicholz, P., Sacks, R., and Liston, K., (2011). "*BIM handbook: A guide to building information modeling for owners, designer, engineers, and contractors*. 2nd edition. Jhon Wiley & Sons.

Fenwick Elliot LLP (2020) *"BIM and the new Information Protocol"*. Available at https://www.youtube.com/watch?v=bJbL3QqTDv8 (Accessed: 29 May 2022).

Fontana, B. (2020) *'Information management workflow for the construction and operation phases on a BIM process'*, Master thesis, University of Minho, Minho, Portugal.

International BIM toolkit (2020), Centre for Digital Built Britain. Cambridge University. Available at: https://www.cdbb.cam.ac.uk/AboutDBB/Promoting-digital-construction-Internationally/international-bim-toolkit (Accessed: 12 May2022)

International Organization for Standardization. (2018). ISO 19650-1: *"Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling — Part 1: Concepts and principles".*

International Organization for Standardization. (2018). ISO 19650-2: *"Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling — Part 2: Delivery phase of the assets".*

International Organization for Standardization. (2020). BS EN ISO 17412-1: *"Building information modelling - Level of Information Need - Part 1: Concepts and Principles".*

Lean Construction Mexico. Available at https://www.leanconstructionmexico.com.mx/post/uso-de-plus-delta-para-la-retroalimentaci%C3%B3n-y-la-mejora-de-los-procesos-sociales (Accessed: 31 May 2022)

Messner, J., Anumba C., Dubler C., Goodman S., Kasprzak C., Kreider R., Leicht R., Saluja C., Nevena Z., and Bhawani S. (2019). *BIM Project Execution Planning Guide version 3*. Computer Integrated Program at Pennsylvania State University.
Available at: https://bim.psu.edu/downloads/ (Accessed: 10 May 2022)

Mirniazmandan, S. (2021) *'Proposal of a company BIM guide in alignment with ISO 19650'*, Master thesis, University of Minho, Minho, Portugal.

National Institute of Building Services (2017), *"National BIM guide for owners"*.

Plannerly (2022), *"ISO 19650 webinar series"*. Available at https://www.plannerly.com/iso-19650-webinar/ (Accessed: 12 May 2022)

Terrosi, G. (2020) *'Guidelines for BIM information management at design stage'*, Master thesis, University of Minho, Minho, Portugal.

UK BIM Framework (2022). *"The overarching approach to implementing BIM in the UK".* Available at https://www.ukbimframework.org/ (Accessed: 10 May 2022). Available at https://ukbimframeworkguidance.notion.site/ukbimframeworkguidance/UK-BIM-Framework-Guidance-20a045d01cfb42fea2fef35a7b988dbc (Accessed: 16 March 2022)

UK BIM Framework (2019). *"ISO 19650 Guidance Part 1: "Concepts".* Available at https://ukbimframeworkguidance.notion.site/ukbimframeworkguidance/UK-BIM-Framework-Guidance-20a045d01cfb42fea2fef35a7b988dbc (Accessed: 16 March 2022).

UK BIM Framework (2022). *"ISO 19650 Guidance Part 2: "Delivery phase".* Available at https://ukbimframeworkguidance.notion.site/ukbimframeworkguidance/UK-BIM-Framework-Guidance-20a045d01cfb42fea2fef35a7b988dbc (Accessed: 16 March 2022).

UK BIM Framework (2021). *"ISO 19650 Guidance Part A: The information management function and resources".* Available at https://ukbimframeworkguidance.notion.site/ukbimframeworkguidance/UK-BIM-Framework-Guidance-20a045d01cfb42fea2fef35a7b988dbc (Accessed: 16 March 2022).

UK BIM Framework (2020). *"ISO 19650 Guidance Part B: Open data, buildingSMART and COBie".* Available at https://ukbimframeworkguidance.notion.site/ukbimframeworkguidance/UK-BIM-Framework-Guidance-20a045d01cfb42fea2fef35a7b988dbc (Accessed: 16 March 2022).

UK BIM Framework (2021). *"ISO 19650 Guidance Part C: Facilitating the CDE (workflow and technical solutions".* Available at https://ukbimframeworkguidance.notion.site/ukbimframeworkguidance/UK-BIM-Framework-Guidance-20a045d01cfb42fea2fef35a7b988dbc (Accessed: 16 March 2022).

UK BIM Framework (2022). *"ISO 19650 Guidance Part D: Developing information requirements".* Available at https://ukbimframeworkguidance.notion.site/ukbimframeworkguidance/UK-BIM-Framework-Guidance-20a045d01cfb42fea2fef35a7b988dbc (Accessed: 16 March 2022).

UK BIM Framework (2021). *"ISO 19650 Guidance Part E: Tendering and appointments".* Available at https://ukbimframeworkguidance.notion.site/ukbimframeworkguidance/UK-BIM-Framework-Guidance-20a045d01cfb42fea2fef35a7b988dbc (Accessed: 16 March 2022).

UK BIM Alliance (20199: *"Information management according to BS EN ISO 19650 Guidance Part 1: Concepts*". Available at https://www.ukbimalliance.org/wp-content/uploads/2019/04/Information-Management-according-to-BS-EN-ISO-19650_-Guidance-Part-1_Concepts_2ndEdition.pdf (Accessed: 12 May 2022)

UK BIM Alliance (2021): "Information Protocol Guidance". Available at https://www.youtube.com/watch?v=Xkd2mq6iBSc (Accessed: 29 May 2022).

LIST OF ACRONYMS AND ABBREVIATIONS

Example:

BCF	BIM Collaboration Format
BEP	BIM Execution Plan
BIM	Building Information Modelling
CBA	Choosing by Advantages
EIR	Exchange Information Requirements
IDS	Information Delivery Specification
IFC	Industry Foundation Classes
MIDP	Master Information Delivery Plan
MVD	Model View Definition
OIR	Organizational Information Requirements
PIR	Project Information Requirements
SBD	Set based Design

APPENDICES

APPENDIX 1: INFORMATION MANAGEMENTE FUNCTION ASSIGNMENT MATRIX

ID		Appointing party
2	Information management process - Invitation to tender	
2.1	Establishing the appointing party's exchange information requirements	
2.1.1	Establish the appointing party's exchange information requirements and review the security management plan (if applicable)	A/R
2.1.2	Establish the appointing party's information requirements to be served during the appointment	A/R
2.1.3	Establish the level of information need required to meet each information requirement	A/R
2.1.4	Establish the acceptance criteria for each information requirement	A/R
2.1.5	Establish the supporting information that the prospective lead appointed party might need, to fully understand or evaluate each information requirement or its acceptance	A/R
2.1.6	Establish the dates, relative to the project's information delivery milestones and appointing party's key decision points, that each requirement has to be met	A/R
2.2	Assemble reference information and shared resources	
2.2.1	Assemble the reference information or shared resources that the appointing party intends to provide to the prospective lead appointed party during the tender process or appointment	A/R
2.2.2	Establish the suitability for which the information can be used by the prospective lead appointed party, by assigning appropriate status codes to all reference information and shared resources to indicate how they can be used	A/R
2.2.3	Make reference information and shared resources available to tendering organizations in a secure environment, such as the project's common data environment	A/R
2.3	Establish tender response requirements and evaluation criteria	
2.3.1	Establish the tender response requirements with an information sharing agreement (as applicable)	A/R
2.3.2	Establish the evaluation criteria to be used to assess the tender response	A/R

Extracted from Guidance A: Activities 2.1 to 2.3

ID		Appointing party
2	Information management process - Invitation to tender	
2.4	Compile invitation to tender information	
2.4.1	Compile the information to be included within the invitation to tender package, including:	A/R
2.4.2	Ensure that the appointing party's exchange information requirements are included within the invitation to tender package	A/R
2.4.3	Ensure that the relevant reference information and shared resources (within the project's common data environment) are included within the invitation to tender package	A/R
2.4.4	Ensure that the tender response requirements are included within the invitation to tender package	A/R
2.4.5	Ensure that the project's information delivery milestones are included within the invitation to tender package	A/R
2.4.6	Ensure that the project's information standard is included within the invitation to tender package	A/R
2.4.7	Ensure that the project's information production methods and procedure included within the invitation to tender package	A/R
2.4.8	Ensure that the project's information protocol is included within the invitation to tender package	A/R
2.4.9	Ensure that any other information required for the invitation to tender package is	A/R

Extracted from Guidance A: Activities 2.4

ID		Appointing party
3	Information management process - Tender response	
3.8	Carry out tender assessment of the delivery team's tender response	
3.8.1	Check the requested tender response information has been fully provided	A/R
3.8.2	Evaluate the delivery team's tender response(s) against the tender evaluation criteria	A/R
3.8.3	Inform delivery team(s) of the outcome of the tender assessment	A/R
4	Information management process - Appointment	
4.1	Confirm the delivery team's BIM execution plan	
4.1.1	Develop the delivery team's BIM execution plan in agreement with the supply chain, including:	I
4.1.2	Confirm the names of the individual(s) who will undertake the information management function	I
4.1.3	Update the delivery team's information delivery strategy (as required)	I
4.1.4	Update the delivery team's high-level responsibility matrix (as required)	I
4.1.5	Confirm and document the delivery team's proposed information production methods and procedures	I
4.1.6	Agree with the appointing party any additions or amendments to the project's information standard	I
4.1.7	Confirm the schedule of software, hardware and IT infrastructure the delivery team will	I

Extracted from Guidance A: Activities 3.8 to 4.1

ID		Appointing party
4	Information management process - Appointment	
4.5	Establish the master information delivery plan	
4.5.4	Inform the appointing party of any risks or issues which could impact on the project delivery milestones	I
4.6	Update shared resources	
4.6.1	Update the project's information standard with agreed additions or amendments proposed by lead appointed parties within their pre-appointment BIM execution plans and subsequently throughout their appointment (including any updates required by the security management plan)	A/R
4.6.2	Update the project's information production methods and procedures with agreed additions or amendments proposed by lead appointed parties within their pre-appointment BIM execution plans and subsequently throughout their appointment (including any updates required by the security management plan)	A/R
4.7	Complete lead appointed party's appointment documents	
4.7.1	Complete lead appointed party's appointment documents	A/R
4.7.2	Ensure the appointing party's exchange information requirements are included in the appointment	A/R
4.7.3	Ensure the project's information standard is included in the appointment with any agreed additions or amendments	A/R
4.7.4	Ensure the project's information production methods and procedures is included in the appointment with any agreed additions or amendments	A/R
4.7.5	Ensure the delivery team's BIM execution plan is included in the appointment	A/R
4.7.6	Ensure the delivery team's master information delivery plan (MIDP) is included in the appointment	A/R
4.7.7	Ensure the project's information protocol is included within the appointment	A/R
4.7.8	Manage change control process associated to lead appointed party(s) appointment documentation	A/R

Extracted from Guidance A: Activities 4.5 to 4.7

ID		Appointing party
5	Information management process - Mobilization	
5.3	Test the project's information production methods and procedures	
5.3.1	Test and document the project's information production methods and procedures	I
5.3.2	Refine and verify the proposed information container breakdown structure is workable	
5.3.3	Develop shared resources to be used by the delivery team	
5.3.4	Communicate the project's information production methods and procedures to all task teams	
7	Information management process - Information model delivery	
7.3	Submit information model for appointing party acceptance	
7.3.1	Submit information for appointing party review and acceptance within the project's common data environment	I
7.4	Review and accept the information model	
7.4.1	Review the information model in accordance with the project's information production methods and procedures	A/R
7.4.2	Produce report at each information exchange of the information model review carried	A/R
8	Information management process - Project close-out	
8.1	Archive the project information model	
8.1.1	Archive the information containers within the project's common data environment in accordance with the project's information production methods and procedures	A/R
8.2	Capture lessons learned for future projects	
8.2.1	Arrange and chair a lessons learned workshop (or include lessons learned within other agreed workshops) in accordance with workshops identified on the project programme	A/R
8.2.2	Capture lessons learned (using the lessons learned template) during the project. The lessons learned should be maintained throughout the project and uploaded to the project's common data environment or other agreed central knowledge store	A/R

Extracted from Guidance A: Activities 5.3 to 8.2

APPENDIX 2: PROPOSED TEMPLATES

Organizational Information Requirements - OIR

Section 1: Organizational statements

Mission

Vision

Values

Section 2: Organizational activities

Organizational actvities grouped by:

Strategic

Tactical

Operational

Section 3: Organizational information requirements

			Policy		Information Requirement			Project stage
Goal	Objectives	Activities	Internal	External	People	Process	Technology	Information delivery milestone

Project Information Requirements – PIR

Section 1: Project Overview

1.1 Project scope

Project justification

Project description

Project deliverables

1.2 Project details

Project type,

Address

Procurement,

Date of operation,

Organisational team

1.3 Project objectives

cost objective

schedule objective

acceptance criteria

1.4 Project constrains

1.5 Existing project information

Reference	Revision	Date	Information container name	Format	Team originator	Location

Section 2: Project stages and milestones

2.1 Plan of work

Workstages	Activities

2.2 Key decision points

Workstages	Key decision points	Activities	Group team	Dates

Section 3: Project information requirements

3.1 Information requirements

Workstages	Key decision points	Activities	Information requirements	Information Container	Acceptance criteria

Exchange Information Requirements - EIR

Section 1: Introduction

1.1	Project scope:	
1.2	Project details:	
1.3	Project contraints:	

Section 2: EIR purpose

2.1	EIR purpose:	
2.2	Goals:	
2.3	Objectives:	

Section 3: Level of Information Need

3.1 **Presentation**

3.1.1	Content summary
3.1.2	Form
3.1.3	Format
3.1.4	Information exchange date
3.1.5	Plain language description

3.2 **Content**

3.2.1 **Structured information**

3.2.1.1	Geometrical	
	3.2.1.1.1	Detail
	3.2.1.1.2	Dimensionality
	3.2.1.1.3	Location
	3.2.1.1.4	Appearance
	3.2.1.1.5	Parametric behaviour
3.2.1.2	Alphanumerical	
	3.2.1.2.1	IFC properties
3.2.1.3	Documentation	
3.2.1.4	Metadata	

3.2.2 **Unstructured information**

Section 4: Appointing party's key decistion points

Decision Point	Phase/Date

Section 5: Information delivery milestones

Milestones	Phase/Date

Section 6: Plan of work

Stages	Deliverables

Section 7: CDE

7.1 CDE workflow

7.2 CDE solution

Section 8: Capturing lesson learned

Pre BEP template

Section 1: Details of individuals undertaking the information

1.1 Professionals Experience

Name	CV/resume	Relevant professional

1.2 Key project contacts

Name	role	email	cellphone

Section 2: Proposed information delivery strategy

2.1 Delivery team scope

2.2 Delivery team organizational structure and composition

2.3 Objectives/goals for the collaborative production of information

2.4 Set out the delivery team´s approach to meet the EIR.

2.5 Quality assurance

2.6 Quality control

Section 3: Proposed federation strategy

3.1 Define strategy (define why and which information needs to be federated)

3.2 Appropriate breakdown structure

3.3 Model delivery

information	team	frequency	format

3.4 Project meetings

3.5 Electronic communication

3.6 Coordination milestones

Section 4: High level responsibility matrix

	Deliverables		
Roles			

Section 5: Confirmed schedule of software, hardware and IT

5.1 Software version,

Software version	discipline	file format	version

5.2 Hardware, version

5.3 OpenBIM approach

OpenBIM file formats	Description of implementation
IFC protocol	
Types of MVD	
BCF	
IDS	

Section 6: Proposed adds/amends to project´s methods and procedures

Section 7: Proposed adds/amends to project´s information standards

Information Standards

Standard	Function
ISO 19650-1 and ISO 19650-2	Information management
BS EN ISO 19650-2:2018 National Annex UK	Information container naming convention
Uniclass 2015	Structuring and classification of information
ISO 17412-1:2020	Level of information need
IFC 4 ADD2 TC1 or IFC2X3TC1	IFC-Industry foundation classes
Reference View and Design transfer view	MVD-Model view definition
BCF v.3	BCF collaborate environment
IDS-in development	IDS specification of information exchange

Information Methods and Procedures

Section 1 Capturing of existing asset information

Section 2 Generation, review or approval of new information

2.1 Process map

2.2 Production of information*

2.3 Federation strategy

2.4 Intermediate reviews and verification (peer review)

2.5 Option appraisal/Set based design

2.6 Design change control

2.7 Responsbility matrix**

2.8 Coordinates

North	
East	

2.9 Tecnology/file formats

Section 3 Security of distribution of information***

Section 4 Delivery of information to the appointing party

4.1 Quality assurance

4.2 Quality control

Information Protocol

Section 1: Information Particulars

Section 2: Interpretation

Section 3: Obligations of the appointing party

Section 4: Obligation of the appointee and appointor

Section 5: CDE solution and workflow

Section 6: Use of information

Section 7: Transfer of information

Section 8: Liability

Section 9: Remedies-security

Response Requirements and Evaluation Criteria

Section 1: Response Requirements

The following is the response requirements for the tendering process:

1.1	The prospective lead appointed party shall complete entirely the pre BEP template.
1.2	The prospective lead appointed party shall present the mobiization plan.
1.3	The prospective lead appointed party shall present the information delivery risk assessment.
1.4	The prospective lead appointed party shall present the assessment of the delivery team´s capability and capacity.

Section 2: Evaluation Criteria

The evaluation criteria to be considered:

2.1	Technical
2.2	The competency of the prospective individuals undertaking the information management.
2.3	Quality process
2.4	Economical
2.5	Mobilization plan
2.6	Risk register

Section 3: Using choosing by advantages-CBA

3.1 Factor and Criteria considered

Factor	Criteria
Technical - Methods	The methods, procedures and collaboration strategy proposed by the prospective lead appointed party are aligned and superseed with the one presenteds by the appointing party.
Technical - Federation	The federation strategy proposed by the prospective lead appointed party will benefit the coordination of the delivery phase.
Competency	The qualificaions of the key personnel and proved experience in past projects are relevant for the delivery of the project.
Quality	It is proposed a coherent quality assurance process and a quality control as well.
Economical	The proposal brings more value for money to the delivery phase of the project.
Mobilization plan	It describes the manner how is going to be tested: methods and procedures, CDE, information exchanges, information delivery, hardaware and software. Alos, it mentions how is developed: training, education, reference and
Risk register	Risks are evaluated considering the following topics: assumptions, milestones, information protocol, information delivery strategy, methods, procedures, information standards, mobilization, capability and capacity. Then, a qualitative analysis is made for establishing a priority risk. After, an strategy is elected with actions to take and the risk is assigned.

3.2 Table for evaluation

Alternatives:		**Alternative 1**			**Alternative 2**			**Alternative 3**		
Factors	**Criteria**	**Prospective lead appointed**			**Prospective lead appointed**			**Prospective lead appointed**		
Technical - Methods	The methods, procedures and collaboration strategy proposed by the prospective lead appointed party are aligned and superseed with the one presenteds by the appointing party.	Atribute			Atribute			Atribute		
		Advantage:	Importance:		Advantage:	Importance:		Advantage:	Importance:	
Technical - Federation	The federation strategy proposed by the prospective lead appointed party will benefit the coordination of the delivery phase.	Atribute			Atribute			Atribute		
		Advantage:	Importance:		Advantage:	Importance:		Advantage:	Importance:	
Competency	The qualificaions of the key personnel and proved experience in past projects are relevant for the delivery of the project.	Atribute			Atribute			Atribute		
		Advantage:	Importance:		Advantage:	Importance:		Advantage:	Importance:	
Quality	It is proposed a coherent quality assurance process and a quality control as well.	Atribute			Atribute			Atribute		
		Advantage:	Importance:		Advantage:	Importance:		Advantage:	Importance:	

3.2 Table for evaluation

Alternatives:		**Alternative 1**			**Alternative 2**			**Alternative 3**		
Factors	**Criteria**	**Prospective lead appointed**			**Prospective lead appointed**			**Prospective lead appointed**		
Economical	The proposal brings more value for money to the delivery phase of the project.	Atribute Advantage:	Importance:		Atribute Advantage:	Importance:		Atribute Advantage:	Importance:	
Mobilization plan	It describes the manner how is going to be tested: methods and procedures, CDE, information exchanges, information delivery, hardaware and software. Alos, it mentions how is developed: training, education, reference and shared resources.	Atribute Advantage:	Importance:		Atribute Advantage:	Importance:		Atribute Advantage:	Importance:	
Risk register	Risks are evaluated considering the following topics: assumptions, milestones, information protocol, information delivery strategy, methods, procedures, information standards, mobilization, capability and capacity. Then, a qualitative analysis is made for establishing a priority risk. After, an strategy is elected with actions to take and the risk is assigned.	Atribute Advantage:	Importance:		Atribute Advantage:	Importance:		Atribute Advantage:	Importance:	
	Total Importance			**0**			**0**			**0**

3.3 Scale of importance

Order each factor assigning points. It must state how many points will get the most advantageous alternative, the second one and the third.

Importance	Advantage
100	
90	
80	
70	
60	
50	
40	
30	
20	
10	
0	

3.4 Conclusión:

Reference Information and Shared Resource

Section 1: Existing asset information

1.1 from within the appointing party organization

1.2 from adjacent asset owners

Section 2: Shared resource

2.1 Process output templates (BIM execution plan, master information delivery plan).

2.2 Style libraries/Presentation styles

2.2.1 Line weights

2.2.2 Line pattern

2.2.3 Line styles

2.2.4 Fill patterns

2.2.5 Text assignment

2.2.6 Paper size

2.2.7 Scales

2.2.8 Annotations

2.2.9 Dimensioning,

2.3 Families/object libraries (2D symbols, 3D objects).

2.3.1 Family/Object library

2.3.2 Software template

Section 3 Library object within national and regional standards

3.1 Product data templates (PDTs)

Review and Accept Model

Proposal Checklist Review and Accept Model

		Yes	No	Comments
1	Is the model submitted in accordance to the information standards?			
2	Is the model submitted in accordance to the information methods and procedures considering:			
2.1	the capturing of existing asset information			
2.2	the generation, review or approval of new information			
2.3	the security of distribution of information			
2.4	the delivery of nformation to the appointing party (quality control and quality assurance).			
3	Does the model submitted meet with the level of information need?			
4	Is the model sumitted in accordance to the exchange information requirements considering:			
4.1	the informaton delivery milestones?			
4.2	the CDE workflow and CDE technology?			
4.3	the reference information and shared resources?			
5	Is the model submitted containing all the deliverables listed in the master information delivery plan?			

Lesson Learned

Section 1: Recurring lesson learned

1.1 **Plus/Delta Analysis**

This analysis shall be done at the end of any coordination meeting. It lasts 5-10 minutes

Plus(do again)	Delta (do better)

Section 2 End appointment/project

2.1 Assessment criteria

2.1.1 Assess if the project/investment delivered the required outcomes considering budget and programme?

2.1.2. Did the procurement process satisfy all parties?

2.1.3 Did the information management process deliver its required outcomes?

2.2 Suppporting information (qualitative or quantitative)

2.3 Anaylisis of root causes

2.3.1 Uses ishikawa diagram or 5 whys analysis

2.4 Recommendation for future endeavors

Archive Project Information Model

Proposal Checklist for archive project information model

Section 1: **Verify all information containers are available in the common data environment.**

Section 2: **Select information container to be part of the asset information model.**

Section 3: **Policies retention**

Section 4: **Future access requirements**

Section 5: **Future re-use**

Master Information Delivery Plan

Proposal template to be adopted for Master Information Delivery Plan - MIDP

Information container/Deliverable (name and title)	Delivery milestones(date)	Predecesor/dependencies	Duration (production)	Time to review for Lead appointed party	Time to review and accept for Appointing party	Responsable/ Author	Level of information need			
							Presentation		Content	
							Format	Form	Structure	Unsutructure

APPENDIX 3: INTERVIEWS QUESTIONS 1ST AND 2ND ROUND

First round

Nº	Questions
1	Are you aware of ISO 19650 series?
2	How do you rate your knowledge about ISO 19650 series? Limited, regular or excellent
3	Are ou aware of OpenBIM approach?
4	How do yo rate your knowledge about OpenBIM?
5	How do you define the information requirements for a project?

Second round

Nº	Questions
1	What other details do you suggest for the introduction section of the EIR template?
2	What other consideration do you suggest for the Review and Accept Model?
3	What other consideration do you suggest for archiving the project information model?
4	Do you consider a technical guide should explain and give recommendations about how to complete the templates?
5	How do you improve these templates?
6	What kind of problems do you have when defining information requirements for your project?

APPENDIX 4: SURVEY QUESTIONNAIRE

N°	Template	Question	Totally disagree	Disagree	Neutral	Agree	Totally agree
1	OIR	Do you agree that the organizational information requirements (OIR) includes the organizational statements such as: mission, vission, and values as a framework?					
2	OIR	Do you agree to have this separation between "goals" and "objectives" in the OIR					
3	OIR	Do you agrre to classify the organizational activities in strategic, tactical and operational					
4	PIR	Do you agree to define an specific plan of work in the Project Information Requirement (PIR)					
5	PIR	Do you agree to define key decision point in the PIR					
6	EIR	Do you agre to use the framework of the level of information need for defining exchange information requirements (EIR)					
7	EIR	Do you agree to make the distintion between key decision points and information delivery milestones?					
8	EIR	Do you agree with the extent of the introduction of the EIR template?					
9	pre BEP template	Do you agree to include an OpenBIM approach by asking to define which IFC protocol, MVDs, BCF and IDS are going to be used?					
10	pre BEP template	Do you agree to ask for a BIM process design (a process map)?					
11	pre BEP	Do you agree to ask for quality assurance and quality control details?					
12	Information Standards	Do you agree of including a description that indicates what aspects must be included of each specific standards by the prospective lead appointing party?					
13	Information Standards	Do you agree to have a the "Information Standards" as a separate resource (document) from the EIR?					
14	Information Methods and Procedures	Do you agree to have a the "Information Methods and Procedures" as a separate resource (document) from the EIR?					
15	Information Protocol	Do you agrree not to use the term "materials" for refering to resoruces and deliverables?					
16	Information Protocol	Do you agree not to use the term "prepared documents" for refering to resources and deliverables?					
17	Information Protocol	Do you agree not to use the term "works information requirements" for refering to the exchange information requirements?					
18	Response requirements and Evaluation Criteria	Do you agree to implement the tool "Choosing by advantages" from the Lean Construction methodology in order to evaluate different tender response?					
19	Response requirements and Evaluation Criteria	Do you agree to include as factors for evaluation: technical, competency, quality, economical, mobilization plan and risk register?					
20	Reference Information and Shared Resource	Do you agree to include a "Product data template" as part of the shared resources?					
21	Reference Information and Shared Resource	Do you agree to define "Presentation styles" (line patten, line weights, paper size, text assignments) as part of the shared resources?					

N°	Template	Question	Totally disagree	Disagree	Neutral	Agree	Totally agree
22	Reference Information and Shared Resource	Do you agree to include a "object libraries and software templates" as part of the shared resources?					
23	Review and Accept Model	Do you agree to include in the Review and Accept Model the revision with the: information standards, information methods and procedures, level of information need, exchange information requirements, and master information delivery plan?					
24	Lesson Learned	Do you agree to include the tool Plus/Delta analysis in each coordination meeting?					
25	Lesson Learned	Do you agree to include the tool Ishikawa diagram or five whys for analysis of the root causes at the end of the appointment?					
26	Archive Project Information Model	Do you agree to consider for archiving the following topics: verify and select information containers, policies retention, access requirements, and future re-use?					
27	Master Information Delivery Plan	Do you agree to include the column "Time to review and accept for appointing party"?					
28	Master Information Delivery Plan	Do you agree to include the column "Time to review for lead appointed party"?					
29	Master Information Delivery Plan	Do you agree to include the column "level of information need" as part of the "master information delivery plan"?					