BIM STANDARDS AND PROTOCOLS, THEIR REQUIREMENTS AND IMPLEMENTATION PROCESS

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Approval sheet of the Thesis

This is to certify that we have read this thesis entitled **"BIM Standards and Protocols, their requirements and implementation process"** and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

BIM STANDARDS AND PROTOCOLS, THEIR REQUIREMENTS AND IMPLEMENTATION PROCESS

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Building Information Modelling (BIM) is a process through which architects and engineers gain the ability to manage, plan, design and construct buildings in a more efficient way. This is achieved via artificial 3D computer files that store data and allows the modifying, extracting and exchange via different parties that are collaborating on the project. The objective of this study is to see how some of the standards and protocols of BIM have been developed, implemented and adapted in certain countries where BIM is mandatory, and help as a reference to create the environment and select the standards that would be best applied in Albania. The selection of the best protocols will be made via analysing a case study from each different pioneer state that has applied BIM in their respective construction industry. BIM has been progressing at different paces in different countries and its international standards have been developed mainly by the United Kingdom which will be our main point of reference alongside other pioneer countries, for setting standards like ISO 19650, etc.

Keywords: *BIM, plan, construct, design, maintenance, efficiency, computer files, construction industry, international standards, process, implementation, protocol, management.*

ABSTRAKT

STANDARTET DHE PROTOKOLLET PER BIM, KERKESAT DHE PROCESI I IMPLEMENTIMIT TE TYRE

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BIM eshte nje proces nepermjet te cilit arkitektet, inxhinieret dhe pjesemarresit e tjere ne nje project kane mundesine to menaxhojne, planifikojne, dizenojne dhe ndertojne godina ne nje menyre me teper efikase. Kjo arrihet nepermjet modeleve artificale 3D te krijuara ne kompjuter te cilat kane te njejtat parametra si ne jeten reale dhe te mundesojne te futjen apo terheqjen e te dhenave si dhe modifikimin e tyre. Synimi i kesaj pune kerkimore eshte te shiohim sesi disa nga standartet dhe protkollet e BIM jane fromuar, vendosur the pershtatur ne shtete te ndryshme ne te cilet perdorimi i BIM eshte i detyrueshem me ligj, dhe te sherbeje si nje reference ndihmuese per te krijuar mjedisin e pershtatshem dhe perzgjedhjene e standarteve me te mira per industrine e ndertimit ne Shqiperi. Kjo perzgjedhje do te behet nepermjet studimit te disa shembujve nga projekte ne vende te ndryshme ku BIM eshte i detyrueshem dhe te shohim sesi eshte aplikuar ne industrite e tyre te ndertimit. BIM ka ecur me hapa te ndryshem ne vende te ndryshme dhe standertet nderkombetare te tij sic eshte ISO 19650, jane vendosur kryesisht nga Mbreteria e Bashkuar dhe vendet e tjera te cilar e kane perdorur dhe kane pare sukses te madh me BIM.

Fjalët kyçe: *BIM, ndertim, protokoll, implementim, standart, te dhena komjuterike, process bashkepunimi.*

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CHAPTER 1

INTRODUCTION

1.1 BIM intro.

BIM as a "Building Information Modelling (BIM) is an intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure."

BIM has passed through many stages before coming to us in the form that we know today, but its purpose to ensure that all needed information is brought to the user in a suitable format at the right place at the right time to make out the best of decisions there are to be made in regard of design, construction, operation and management of built assets. Starting from things as simple as clashing pipes to more difficult design and construction challenges and solutions.

"Never generate anything closely coupled to a specific architecture. And make sure you keep things open to communicate with other systems, even your competitors." - *Dr. Patrick J. Hanratty* [1]

All in all, BIM is not just simply making a 3D model just for its sake and definitely is not just a process to be added. Instead, BIM is about using it as a way to set up and run a project. BIM revolves around the employer's information requirements (EIR). The agreement between the two sides needs to be set out via contract document with the appropriate information at a suitable format.

[https://www.letsbuild.com/blog/a-history-of-bim;
https://www.archdaily.com/302490/a-brief-history-of-bim]

1.2 Problem statement

Development of BIM regards to the fact that it not possible to move brutally from a traditional common sense modelling approach towards an entirely new, open BIM approach. Although the change has to be managed it also comes naturally progressively step by step, just like climbing a stair. As you will often see it mentioned here about UK being the pioneer, they have helped set out some standards or rather developed some levels to determine in which stage of BIM their construction industry is.

So basically, despite the great number of benefits that come along with BIM usage and its challenges, one can not simply just apply BIM. As I mentioned earlier BIM revolves around EIR and the agreements of partaking sides, that needs setting via contracts and other documents and legal papers, which require a certain number of standards and laws to fall that Albania does not have in BIM direction.

1.3 Thesis Objective

The main objective of this research is to help create an environment that would easy the way of BIM implementation and accelerate it in Albanian Construction Industry. Despite showing how BIM is implemented step by step we will also see what are the protocols and normative for its adaption in the construction industry. Along the research many interesting impacts that BIM has on different aspects of the buildings such as: simulation, analysis, visualization, cost, schedule, quality, efficiency etc. will come to light.

As BIM is slowly making its first appearances in Albania, clear standards are not yet part of our agenda and there are a lot of voids to be filled in this aspect. Considering that currently most of the construction companies and architectural studios are using borrowed or loaned standards from international protocols the need to have our own normatives arises.

Via my thesis I aspire to analyze how were the standards of BIM applied in international projects and what impact did they bring to them. Starting from the implementation process to continue with the usage during different phases of the project and as a result what benefits bring which certain protocol to what area of the entire BIM process is what my analysis will consist of.

A comparison between the protocols of different BIM pioneer countries with similarities and unique values brought to each of them will take place alongside a study on the Albanian architects and what are their expectations from BIM to help decide on our standards.

Regarding the conclusion and my objective is to identify and elect the best possible and applicable standards and protocols for Albania, via researching and comparing different case studies in different countries how they were cooped and the impact that they had.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

BIM is the most talked term of the moment in construction industry as it can be called the most widely including tool that has been brought to AEC so far. This literature review is collected from sources that ar focused on studying, analysing and evaluating BIM will help us understand BIM standards and implementation. Below are listed some of datas and informations frome reliable sources such as researches on this topic or articles from BIM oriented browser sites and social medias.

Table 1. Reviewed scientific literature

Contribution Area	***Authors***	***Description***
BIM as information tool.	Branner et al. (2017)	A study explaining BIM nature in terms of information access.
	Dell'Amico (2021)	Made a contrtibution on the facilitating information sharing via IFC and shared models' protocols.
	Hardin and McCool (2015)	Researched and studied the technologies which help the information and collaboration description.
BIM impact on Construction Industry	Charef and Emmitt (2020)	Studied how bim changes the impact of construction industry on environment.
	Bracht et al. (2020)	Researched BIM benefits in terms of energy simulation tools.
	Cortés-Pérez et al. (2020)	Made a study on the health and safety sector in construction and BIM methods for them.

	Xu et al. (2020)	Made a study to promote BIM as a tool to prevent gas emissions and energy consumptions.
BIM in different countries	Jingming et al. (2020)	Researched BIM adoption worldwide and its status in China.
	Sharafutdinova (2015)	Researched the status of BIM in Russia and the CAD systems, mainly focusing on Revit.
BIM adoption	Edirsinghe and London (2015)	Studied the efforts that were made to standardize BIM in international stage.
	Kumar (2015)	In his work he presents us with a detailed guide of BIM process.
	Eastman et al. (2011)	In this study it is shown how BIM approaches the fields of design, construction and management of facilities
BIM application	Beesley et al. (2013)	This work serves as a guide for real-life practices of BIM that talks about the usage of it in both private and public projects.
	Mordue et al (2016)	In their work they clarify and explain BIM to different level of users, beginner, intermediate or experts.

2.1.1 Scientific investigations (papers, books, guides, etc.)

[Branner, U., Froyen, D., Nolet, J., & Goubau, T. (2017)]

This study presents how BIM has a nature like social-media that allows everyone to access information, provide data and helps prevent and overcome issues that might lead to change of orders and result in expensive costs for the project. It was done by using BIM digital tools expenses can be reduced in very high numbers that would help the construction industry get the leap ahead that it deserves. [2]

[Charef, R., Emmitt, S., Uses of Building Information Modelling for overcoming barriers to a circular economy, (2020)]

This study presents the impact that contructions sector of industry has on the environment can be called partly as the result of the current linear economy approach that is being applied. It presents a circular approach being prioritized urgently as the use of BIM is being mandated in several countries. [3]

[Bracht, M. K., Melo, A. P., Lamberts, R., (2020)]

This study is about the benefits of BIM in terms of energy simulation tools to be performed. It explains how the early design stage can help solve this issue via metamodels performance prediction as an investigation tool. This paper shows the development and approvement of a tool which is input in building information models that predicts the thermal load of dwellings with gbXML. [4]

[Jingming, L., Kereshmeh, A., Nianping, L., Jingqing, P., Zhibin, W., Haijao. C., (2020)]

In this paper is presented how BIM is finding a wide adoption from construction industry worldwide and this technology has had an admirable number of contributors in its education. However, many regions have found difficulties in the discussion and spread of BIM. This study used literature review and case studies to reveal the status of BIM research and education in China. [5]

[Cortés-Pérez, J. P., Cortés-Pérez, A., Prieto-Muriel, P. (2020)]

This is a study which presents the industrys high rate of accidents which makes health and safety a very important sector of construction. BIM methods can help in the impromevement of working conditions during and after the construction of building as well as its maintenance. It shows how Spanish government has developed a

regulation regarding health and safety issues, which is to me implemented in the design phase. This study proposes a solution consistent to requirement of Spanish health system. [6]

[X. Xu, T. Mumford, P.X.W. Zou, Life-cycle building BIM engaged framework for improving building energy performance (2020)]

This study aims to promote BIM as a tool to help in creating more sustainable assets and prevent gass emissions and energy consumptions. The building sector alone is responsible for 32% and 19% of total consumption respectively. With the energy conservation and gas emission reduction being on top of the government agendas throughout many countries BIM as mean to overcome building energy performance gap (BEPG) has yet to be critically considered. A building life-cycle framework which included information exchange, design review, energy-related quality control, life-cycle commissioning and real time operation and management topics are performed in this study. [7]

[Aliia Sharafutdinova, (2015)]

This research is presenting a study and identification of the current status of BIM in Russia. It compares the adaption of it in the western countries and the infrequency of it in Russia. The study also shows a critical view and a thorough research of CAD systems in the building modelings as well as the benefits of a certain program of Autodesk Revit 2015 version as a major contributor in the process of BIM and its implementation. It shoes a methodology which used for this thesis was via print screens of a licensed version of Revit which was download and studied for its efficiency. [8]

[Edirisinghe, R., London, K., (2015)]

This paper presents the efforts that has been made to standardize the BIM in the international stage but not only. The policies and emphasis that different nations

have approved and mandated to make legislative protocols for their respective construction industries. [9]

[Bimal Kumar, (2015)]

In his work Kumar presents us with a detailed guide of BIM process which is very handy for the workers of construction industry. Alonside, a considerable amount of information both theoretical and practical material in BIM introduction is brought to us, where key elements and things that needs to be taken into consideration before setting out BIM projects are given a significant importance. [10]

[Hardin, B., McCool, D., (2015)]

The new technologies that have helped change the way the information and collaboration are descriped in this work. The obstacles and challenges that are faced in the construction industry and how they are addressed and being solved with the help of new cutting-edge tools and the practical application of the "right tools for the right job" ideology is presented. [11]

[Eastman, C., Teicholz, P., Rafael, S. and Liston, K., (2011)]

In this study it is shown how BIM approaches the fields of design, construction and management of facilities. It explains the way how BIM changes the method of traditional drawings doesn't matter paper or electronic and the impact it has in the way the buildings are built and function. The book explains the BIM as an activity rather than an object, as a means to achieve sustainability of buildings with fewer resources and lower risks. [12]

[Beesley, C., DLT Solutions, LLC, Herndon, Virginia (2013)]

This workserves as a guide for real-life practices of BIM that talks not only about the usage of building information modelling in private projects and buildings but also on things such as infrastructural and other big urbanistic changes. It talks about the options that BIM provides to help adopt the policies that are demanded by

governments and help make decisions during the design phase to lessen the costs, minimize on-site waste and improve the on-time delivery. [13]

[Mordue, S., Swaddle, P. and Philp, D., (2016)]

This is a work done to clarify and easily explain the BIM to all different users whether they are beginners, regulars and experts of BIM to help the users at whatever level of experience they might be. It uses a rather sarcastic and comic language to make the explanation of BIM as they point out common myths and stereotypes of BIM and point them out to show the correct way of BIM use. [14]

[letsbuild.com; loading-systems.com; andersenwindows.com; cms.law; designinbuildings; bimplus.co.uk]

The following sites have been used to collect information regarding the BIM history and its evolution step by step. Citations, years, and information about BIM as a term and the creation and development of computer programs and applications that since their creation, acquisition and usage alongside the necessary changes that were made to transform BIM from a term to a tool. The protocols and standards together with respective case studies alongside the level of BIM development in different and its data have been extracted from the above-mentioned sites as well. [1]

CHAPTER 3

METHODOLOGY

3.1 Methodology Introduction

This section of my research briefly explains the methodology that will be used for this study. Its framework will focus mainly on the identifying the standards and protocols of BIM in different countries. The impact these standards had and why was the necessity for them. As well as why protocols are important in BIM implementation process. This will be achieved by studying case studies for different projects on the countries that have been pioneers of BIM.

3.2 Quantitave Methodology

The quantitative methodology of this research will focus on selecting the case studies for different projects in different countries. This will be done for the reason so that we can have a wider variety of standards and protocols from countries that are in different stages of BIM in their industry and have adopted and developed different standards according to the necessities and the requirements of their projects and technology.

Another approach of the quantitative methodology that I have applied in my paper is the fact that via a survey that I have prepared a certain number of architects and engineers with different backgrounds have filled this survey and I have collected their responses which will be shown with tables and diagrams further in my thesis.

3.3 Qualitative Methodology

As for qualitative methodology we will analyse one public project and private project where BIM has been implemented. We will analyse and identify which protocols of the selected country has been applied according to its standards, as well as study why and how it was developed and indirectly the impact it had. As well as analyze which of these protocols and standards would be suitable for Albania.

As for the qualitative methodology of my survey we will see that architects and engineers that have filled the survey have different characteristics and experiences, in terms of age, specialization and experience. Their feedback as actual part of Albanian construction industry will be a great value added to my research as it will help me briefly understand the level of BIM in a general view from their point of perspective as well as, what are the expectations from BIM in Albania and which benefits are we most looking forward to gain. This will also serve as a point of reference to start setting the standards for fields and topics that are achieveable in our current level of construction technology.

3.4 Collected Data Processing & Evaluation

As this is a research mainly but not most importantly focused on actual projects that have used or are still being developed and are using the BIM, we will analyze them with an objective eye in terms of standards, which has followed more their protocols, what have they added from their side, which protocols have faced difficulties during implementation and which ones have been easier. All the data will be extracted from the case studies and their respective companies in terms of design phase, construction process and maintanace.

This data collection will also accord to a survey which I have prepared with a certain number of questions that within themselves also give an insight to BIM briefly. This survey took place for around 2 months and I was able to collect 41 responses from architects and engineers that are currently working in their positions or young graduates who have finished their internships and are getting experience in several architecture studios. Their experience is a valuable source for my research since it is a concrete example of what our construction industry looks like and are we looking forward to gain from BIM and how well prepared are we to leave behind the traditional method and move towards a new BIM approach. The survey can be found further in my thesis, while the data I have collected from it will also be analyzed and conclusion will be given according to it in another chapter.

CHAPTER 4

THEORITICAL FRAMEWORK

4.1 BIM Protocols in different countries

Listed below are the protocols that are being used in different countries.

4.1.1 United Kingdom Protocols

The procces of BIM implementation is indeed very long and has several ‘levels’ if we can call them so, which will act as milestones within theirselves. In broad terms we can prescribe these levels as:

Level 0: 2D CAD without collaboration.

Level 1: 2D or 3D CAD without collaboration.

Level 2: 3D CAD with collaboration and information exchange between parties, but not via a single, shared model.

Level 3: Full collaboration between parties, working on a single, shared model.

As we well see further in this paper United Kingdom is vanguard of BIM among other nations that have applied and helped develop BIM further. A certain number of reference protocols to help the industry adopt level 2 of BIM. They stand as follows:

PAS 1192-2 Specification for information management for the capital/delivery phase of construction projects using building information modelling. (Now replaced by BS EN ISO 19650).

PAS 1192-3 Specification for information management for the operational phase of construction projects using building information modelling.

BS EN ISO 19650. Organization of information about construction works - information management using building information modelling.

CIC BIM Protocol. This establishes specific obligations, liabilities and limitations on the use of building information models and can be adopted by clients to mandate particular working practices. It can be incorporated into appointments or contracts by a model enabling amendment.

Uniclass2015. A classification system that can be used to organize information throughout all aspects of the design and construction process.

Industry Foundation Classes (IFC). The standard data format facilitating interoperability between different software systems.

COBie (Construction Operations Building Information Exchange). A spreadsheet data format for the publication of a subset of building model information focused on delivering building information (rather than geometric modelling), such as equipment lists, product data sheets, warranties, spare parts lists and preventive maintenance schedules. COBie presents information in a more accessible format, so that it is easier to use and re-purpose. This is essential to support operations, maintenance and asset management once the built asset is in service.

BIM Toolkit. Developed by NBS, and offering a Digital Plan of Work to help define roles and responsibilities for preparing information and a verification tool to identify correctly classified objects and confirm that required data is present in the model.

4.1.2 Finland Protocols

BuildingSMART Finland has assisted the most in setting protocols in this country. So far BIM standards in Finland are as mentioned below:

Common BIM Requirements (COBIM) Yleiset Tietomalli Vaatimukset (YTV) 2012 that define life cycle BIM standards (including facility management uses). The BIM uses defined in the COBIM include support for facility management, space management, energy and environmental management, maintenance budgeting, long-term planning and performance monitoring.

Common InfraBIM YIV 2015 that establish BIM standards for infrastructure projects.

Intramodel Data Exchange that defines an open standard for exchange of infrastructure data based on Land Extensible Markup Language (LandXML) standards.

IFC – Industry Foundation Classes. IFC is the common data structure definition of building information models. IFC is also the extension of the exchange format file that is the technical link between different BIM software (ifc-file). Today, the commonly used version of IFC is 2×3, although its successor, the IFC 4 has already been published. (ISO 16739-1:2018).

DD – Data Dictionary. Data Dictionary is an international nomenclature, which is a key to create an maintain open platform BIM elements. In addition, it helps the definition of multilingual product libraries that can utilized by BIM software. Data Dictionary was previously called IFC Library.

IDM – Information Delivery Manual. IDM is a process description of a specific use case of the models. It describes how and when the BIM based information is utilized by different project disciplines.

MVD – Model View Defination. MVD is a techical description of the process definations, in order to describe how the software developers should implement the IDMs.

BCF – Building Collaboration Format. Building Collaboration format was originally developed by Finnish buildingSMART members, Tekla and Solibri, who together developed a way to exchange intelligent messages between different BIM software. The message contains the location of the selected elements and a commentary that is attached to them, so that the receiving program can find the chosen scene and highlight the desired components. A very small, an XML-based file can be easily transfered between the disciplines. By now, the BCF has implemented by a number of software such as Tekla Structures, Solibri Model Checker, CADS Planner and the DDS Architecture.

4.1.3 Germany Protocols

Germany is one of the most industrialized countries in the world, this mainly thanks to their government being always ready to welcome new technology and even

pushing the development by helping with BIM transition in German construction industry.

- BIM specific legal conditions ("BIM-Besondere Vertragsbedingungen - **BIM-BVB");**

The Principal-Information-Requirements (" Auftraggeber-Informations-Anforderungen - **AIA**");

- The BIM specifications ("**BIM-Pflichtenheft**");
- The BIM execution plan ("BIM-Abwicklungsplan – **BIM BAP**").
- Project procurement and delivery based on **ISO 19650**
- Defining employer's information requirements (EIR) in each project providing the specification of use cases, model extent, as well as object and attribute catalogues creation of a BIM Execution Plan (BEP) by the supplier detailing the way the EIR are proposed to be satisfied
- Implementation of the principle of federated BIM model management according to ISO 19650
- Usage of a common data environment according to ISO 19650
- Use of open data exchange standards (mainly IFC, but also OKSTRA and GAEB)
- Formal checking of BIM models for fulfilment of the EIRs

4.1.4 Austria Protocols

Austria has had originally the ÖNORM A 6240-1 which defined regulations about storing grouped information, but since they are working on developing ÖNORM A 6241-1 and ÖNORM A 6241-2.

ÖNORM A 6241-1 "Digital structure documentation - Part 1: CAD data structures and building information modelling (BIM) - Level 2"

Scope: This standard applies to the technical implementation of data exchange and the storage of building information, including alphanumeric data contained in

building models that are required during planning and the life-cycle management of buildings and related spatial civil engineering structures. It lays down the most important terms and definitions, structures and presentation principles for fundamental methods used for transferring data held in two-dimensional CAD files and for building information modelling (BIM).

ÖNORM A 6241-2 "ÖNORM A 6241-2 Digital structure documentation - Part 2: Building Information modelling (BIM) - Level 3 iBIM"

Scope: This standard governs the technical implementation of a multidimensional, structured standard data model for buildings and related civil engineering structures based on Level 3 building information modelling (BIM).

4.1.5 International Protocols

International BIM standardization for countries in which BIM is not mandatory but is greatly encouraged to be applied especially in public sector will be mentioned in this section. Applying BIM is not an easy process, involving many organizations for determining the liaisons, not only between relevant ISO and CEN technical committees but also with geospatial and industrial entities alongside buildingSMART. Below are shown the most important liaisons but there are many more than just these:

- CEN TC442 BIM: Standardization in the field of structured semantic life-cycle information for the built environment
- CEN TC287 GIS: standardization in the field of digital geographic information for Europe.
- ISO/TC211 GIS: Standardization in the field of digital geographic information.
- ISO/TC59/SC13 BIM: Organization of information about construction works.
- ISO/TC184/SC4 STEP: Standards that describe and manage industrial product data throughout the life of the product.

- Open Geospatial Consortium: International not for profit organization committed to making quality open standards for the global geospatial community.
- buildingSMART: International organization which aims to improve the exchange of information between software applications used in the construction industry.
- EU BIM Task Group: It's aim is to bring together national efforts into a common and aligned European approach to develop a world-class digital construction sector.

4.2 Case Studies of BIM implementation

Below are listed the case studies that I have chosen to analyze in terms of BIM standards:

4.2.1 Case Studies for United Kingdom

Starting with United Kingdom we have two projects to analyze, one of them is a private project with housing typology while the other one is a public project considered to be the biggest civil engineering project in Europe.

4.2.1.1 (Private Project) E03 Canada Court and E05 Quebec residential in Wembley Park [15]

Table 2. UK Private project general information

Location:	London, United Kingdom
Client:	Quintain
Contractor:	John Sisk & Sons

Softwares:	Autodesk AEC Collection, BIM 360, Naviswork, ReCap, Revit, BIM Collab Synchro
Standards / Protocols	**CIC BIM Protocol:** Obligations and limtations for bims. **ISO-19650:** Organization of information about construction. **IFC:** Standard data format for different software exchanges. **BIM Toolkit:** Digital Plan of Work for evaluating infos. **COBie:** A format for publication of information used during construction and maintenance phase. **Uniclass 2015:** Classification of information. **DPD:** A mean for digitizing the delivery of the Project.

This Project is about the “Eastern Quarter” of the Wembley Park Masterplan. It includes over 1000 apartments and build-to-rent homes ranging in height from 10-21 storeys as well as a seven-acre park. It is calculated to come on line in different stages between December 2020 and March 2021, and is key node of eastern part of the Wembley Park and the stadium.

The client asked for digitized processes of design, construction and maintenance to increase the effectiveness and the efficiency of the management of its assets through its lifecycle. (CIC BIM Protocol)

Sisk came up with delivering digital twins that incorporated as-built data alongside asset information that allowed Quintain’s FM team to leave behind the traditional CAFM systems and used shared 3D models as their single, main, source of information for operating and maintaining purposes.

A full-time project information management team (BIM Toolkit) was created by the side of Sisk for delivery and data management as well as validate the data throughout project delivery stage, which required a significant investment in terms bringing the right tools and knowledge to bring out the best of BIM digitization.

Sisk has its Digital Project Delivery (DPD) which has allowed the above-mentioned processes to take place, but it is indeed a very valuable asset that goes beyond just delivering BIM standards. It is a vehicle that transforms the whole project delivery functions through digitization. Sisk has tried 15 different technologies to create innovative approaches such as 'digital containers' (PAS 1192-3) that develop a digital mapping solution which links the project information produced by designers/suppliers in the BIM environment to smart containers in the BIM360 Field platform. These containers are associated with a QR code, allowing it to link to an unlimited amount of information to each asset.

This allows two main processes to take place: the first one is retrieving the drawings of the relevant area by scanning its QR code placed on a flat summary panel outside the flat; and the second one to contain within the necessary digital forms needed for quality assurance (QA) and handover.

The digital containers provide the following information (Uniclass2015) that updates in real-time:

- when the flat was checked, and by whom;
- if issues were found during the QA,
- provides the images and location tags
- when action was taken or if the issue remains unsolved
- current handover stage of each flat

This was made with support from Autodesk that allowed Sisk to develop a cloud-based API between their CDE (viewpoint) and BIM360. (IFC) The information is automatically transferred from VFP to BIM360 Field via the API that ensures up-to-date and approved information which benefits the data capture, data management as well as the planning stage in which they used 4D planning as a virtual construction rehearsal tool to create different scenarios of the project and identify potential impacts allowing the team to take more informed decisions before the construction begins, this dynamic reports significantly reduced the reworks and saved at least £90k (PAS 1192-2) cost in concrete reworks alone among other things.

The results of using the digital smart containers provided major benefits in terms of project delivery as it saved a notably 35% time consume in the QA process versus the traditional paper methods, 21.1% increase in production efficiency, 44% reduction of printed drawings in Sisk office which cut the CO2 produced in one year by 145.5 kg; and 15% efficiency in terms of project management, certainty of delivery.

4.2.1.2 (Public Project) Crossrail [16]

Table 3 UK Public project general information

Location:	London, United Kingdom
Client:	London Municipality
Contractor:	Crossrail
Softwares:	Autodesk AEC Collection, BIM 360, Naviswork, Revit, SynchroStructure Sensor scanner, Metaio software, iBeacon transmitters, smartphones
Standards / Protocols	**ISO-19650:** Organization of information about construction. **IFC:** Standard data format for different software exchanges. **BIM Toolkit:** Digital Plan of Work for evaluating infos. **COBie:** A format for publication of information used during construction and maintenance phase. **Uniclass 2015:** Classification of information.

Crossrail is Europe's biggest civil engineering project, connects central London's existing Network Rail lines to the east and west of the city. Like every other major project, this one had tight timeframe and budget and hundreds of contracts had to be procured, controlled and managed. Many of which are closely depended in between each other, making the management of this project a challenge. For every alignment change that had to be made a chain reaction was triggered that affected entire project.

BIM has played an important role (by applying ISO-19650) in this project not only about 3D models but as a collaborative work to an infrastructure project that

convergences CAD and GIS information with different type of project information within a digital setting, such that the necessary information is available to the right person, in the right form, at the right time. BIM has helped in virtually creating a ‘digital Crossrail’ to develop and improve the design as well as optimize it together with construction, decision making and managing.

The last requires collaboration between parties in implementation, (IFC had to be used) for which the following environment had to be created:

The requirements for information needed arrangement, in terms of classifications and data structure to procure the criterias, and needed to be very well defined (according to the BIM Toolkit). Common Data Environment was also need to be accessible to everyone but owned by the client who on his side would also have the opportunity to manage the flowing information.

But on the other side all this information brings ashore databases that need technological knowledge and requires defined roles, procedures, deliveries and process set outs, according to old BS 1192.

So basically, what they did was linking up different databases and systems via tools which would bring the right information, to the right person at the right time by flowing the information which is as follows: different type of databases concerning geotechnic, land ownership, risk, mapping, assets, etc. 2D and 3D CAD drawing for design production. Both desktop GIS and web GIS were needed, the first one for analysis, visualization, data management amd the last one for data sharing and dissemination, a number of other communications for office applications and calculations reporting. A system to manage the documents to store and save them for later usage.

All in all, we can say that what made BIM so successful in the Crossrail Project is that the implementers:

- Establish your requirements
- Treat data as a valuable resource!

- Structure data with the end-use in mind – from the start
- Become data-centric
- Use relational databases – from the start
- Good asset breakdown structure & classification - from the start

Which are key nodes to a successful and one of probably the best examples of how BIM functions and why it is so important in the construction industry.

4.2.1.3 UK Public-Private Comparison

Table 4 UK Public-Private standard comparison

UK Private Project	UK Public Project	Albania
CIC BIM Protocol: Obligations and limtations for bims.	N/A	N/A
ISO-19650: Organization of information about construction.	**ISO-19650:** Organization of information about construction.	**ISO-19650** ✓
IFC: Standard data format for different software exchanges.	**IFC:** Standard data format for different software exchanges.	**IFC** ✓
BIM Toolkit: Digital Plan of Work for evaluating infos.	**BIM Toolkit:** Digital Plan of Work for evaluating infos.	N/A
COBie: A format for publication of information used during construction and maintenance phase.	**COBie:** A format for publication of information used during construction and maintenance phase.	N/A
Uniclass 2015: Classification of information.	**Uniclass 2015:** Classification of information.	**Uniclass 2015** ✓
DPD: A mean for digitizing the delivery of the Project.	N/A	N/A

This is a comparison between the different standards used on the projects which I studied. I should note that The Crossrail is a project that aims to bring together two

existing railroads. By this I mean that there are already other standards applied in the construction not necessarily BIM related, which may be specific to UK or general construction standards.

Highlihted in red colour are standards not Not Available.

Highlihted in green colour are standards published by DPS.

4.2.2 Case Studies for Finland

NOTE*: As all the Nordic countries have welcomed BIM in their construction Industry and not only have made it mandatory for their projects, they have also helped develop it even farther ahead, they have pretty much similar protocols and standards with slight differences in their respective countries but, for research purposes I am focusing mainly on Finland in their aspect.

4.2.2.1 (Private Project) Urban Environment House, Helsinki [17]

Table 5 Finland Private project general information.

Location:	Helsinki, Finland
Client:	Helsinki's Urban Environment Departments
Contractor:	Skanska
Softwares:	Autodesk Revit, Trimble Connect, Tekla Structures, Dalux Field
Standards / Protocols	**ISO-19650:** Organization of information about construction. **IFC:** Standard data format for different software exchanges. **IDE:** Equivalent of IFC for exchangeing infrastructure data. **IDM:** Provides utilization for BIM based information. **MVD:** Technical guides for IDM impementations.

	BCF: Collaboration format for Tekla and Solibri softwares. **COBIM:** Lifecycle BIM standards fort he built asset.

The Urban Environment House is located in Verkkosaari, near Kalastrama metro station in Helsinki and it aims to bring all the City's urban environment departments and their 1'500 employees within one building for the first time. The building will cover approximately 40'000 sq meters, and will be seven storeys above ground and one storey underground.

As Finland have been using BIM for a longer while now, they already knew what they needed in this project where detailed BIM requirements, were already given and written down into the contracts of planners, designers, manufacturers and contractors since an early stage of the project to help the city help spread the lengths of BIM usage, in regard to their past projects' success. (Common BIM Requirements (COBIM) Yleiset Tietomalli Vaatimukset (YTV))

Early design phase saw the usage of BIM in a very versatile and extensive way. Designers collaborated with the City's employees to gather their ideas and try to input them into their models, which were later shown, into several 'pop-op' workshops, to the employees, for them to experience the spaces virtually with VR glasses, by watching 360-degree panoramas or in a BIM cave.

One of the strongest reasons this project was a BIM success is that the service products and the components of this building were modelled to an astonishing extreme level of detail on the project to meet the architect's demand. MEP models for example were developed to an as-built level of detail. Before ordering and delivering on site the heating and cooling equipment, manufacturer created accurate 3D models of its units and hauling routes so the equipment installation orders could be checked on BIM to see if any adjustment should be made. (Intramodel Data Exchange)

"In an ideal world, BIM models should be as accurate as what is going to be built on site, so that there is no question that the detail is accurate, especially for the structure,"-Marko Rajala

To help plan and arrange the schedules, BIM-based 4D programs were used for different sequences of work, for example: a wall needed painting before the pipes were installed because they prevented physical access to the spaces as mention by the BIM expert which helped them organizing in a right order, the work and tasks on different sites.

In construction phase we have technological visualization of design, fabrication and the progress that had been made thus far. BIM was used to make a dynamic simulation of energy use as well supporting the lifecycle objectives and maintenance issues, such as: comprehensive evaluations of emissions, energy efficiency and indoor air quality. (Common InfraBIM YIV 2015)

To follow the construction progress in real time. Trimble Connect was plugged into Tekla Model to communicate to all parties to share the information on the design, fabrication and installation of building components by five key suppliers, where the components already installed were highlighted in their 3D models in design or in the factory.

BIM saw many other forms of application in this project, the likes of virtual interactive site safety inductions as well as a mobile app of Dalux Field to check the quality and hand over rooms. This and many others cause this project to win the Tekla BIM Awards 2020 and was also voted by the public as their favorite project. (Common InfraBIM YIV 2015).

4.2.2.2 (Public Project) HUS Bridge Hospital, Helsinki [18]

Table 6 Finland Public project general information.

Location:	Helsinki, Finland
Client:	Helsinki Healthcare Department
Contractor:	SRV Rakennus Oy
Softwares:	Tekla Software

Standards / Protocols	**ISO-19650:** Organization of information about construction. **IFC:** Standard data format for different software exchanges. **IDE:** Equivalent of IFC for exchangeing infrastructure data. **IDM:** Provides utilization for BIM based information. **MVD:** Technical guides for IDM impementations. **BCF:** Collaboration format for Tekla and Solibri softwares. **COBIM:** Lifecycle BIM standards fort he built asset. **DD:** International nomenclature for BIM elements.

The HUS Bridge Hospital design phase started in 2016 and is planned to completed in 2023, when it will join the Töölö and Meilhati hospitals' operations into a single unit. Both lay on a 71'500 sq m area, where the tallest arts go as high as 9 storeys. It will have a mainly steel and precast concrete structure.

As in other BIM projects the fluent cooperation with subcontractors and designers, is what has been the main factor od success in this project for the main contractor.

BIMs have played an important role not only in the design process but in the planning and coordinating the time schedule as well as visualizing the design solutions to the different project partakers. Efficient information management has been of essential value to this project as it has brought together 16 different fields of planning and 194 sub model components.

Combining the information of the model detections was done in almost real-life sized pieces and relevant parts to find the possible clashes, like fire safety doors for example that have been checked via software. VR glasses has been used in this project as well but in difference from the experience of the users in this case we have possible solutions given the alternative to the clashes that happen.

The construction phase was made by implementing the Tekla Model Sharing of the structural design. Notable is the fact that 50 different designers were working on the same model during the project. The beams for the shared model were designed

by the manufacturers, and the suppliers up to the detail of the partition walls, façade elements and even examples elevators and shafts.

The 3D models have helped to coordinate the installations, prevent clashes and create the site layout plan, constantly updating Dalux mobile model which helped on site workers.

One of the challenges that this project faced as a public project is that it had to connect 2 existing buildings with a new structure and considering that the location of hospital was in a tight, trafficky spot the construction had to be done without trying to disrupt the daily life activity.

4.2.2.3 Finland Public-Private Comparison

Table 7 Finalnd Public-Private standard comparison

Finland Private Project	Finland Public Project	Albania
ISO-19650: Organization of information about construction.	**ISO-19650:** Organization of information about construction.	**ISO-19650** ✓
IFC: Standard data format for different software exchanges.	**IFC:** Standard data format for different software exchanges.	**IFC** ✓
IDE: Equivalent of IFC for exchangeing infrastructure data.	**IDE:** Equivalent of IFC for exchangeing infrastructure data.	N/A
IDM: Provides utilization for BIM based information.	**IDM:** Provides utilization for BIM based information.	N/A
MVD: Technical guides for IDM impementations.	**MVD:** Technical guides for IDM impementations.	N/A
BCF: Collaboration format for Tekla and Solibri softwares.	**BCF:** Collaboration format for Tekla and Solibri softwares.	N/A
COBIM: Lifecycle BIM standards fort he built asset.	**COBIM:** Lifecycle BIM standards fort he built asset.	N/A

	DD: International nomenclature for BIM elements.	**Uniclass 2015** ✓

This is a comparison shows the level of accuracy and just how much used the Finland construction industry is to BIM, as there is little to no differences in terms of standards used when it comes to BIM they are in the same terms on every project.

Highlihted in red colour are standards not Not Available.

Highlihted in green colour are standards published by DPS.

4.2.3 Case Studies for Germany [19]

Again, in Germany we will study and analyse two projects one of them will be private project and the other one is a public project.

4.2.3.1 (Private Project) Planen Bauen 4

Table 8 Germany Private project general information

Location:	Germany
Client:	N/A (Private Initiative)
Contractor:	N/A (Planen Bauen 4)
Softwares:	Autodesk Softwares,
Standards / Protocols	**BIM-BVB:** Legal conditions and BIM related specifications **ISO-19650:** Organization of information about construction. **IFC:** Standard data format for different software exchanges. **GAEB & OKSTRA:** Similar to IFC adapted by Planen Bauen. **AIA:** The principal ingormation requirements, equivalent of

	EIR. **BIM BAP:** The execution plan for BIM projects in Germany.

Planen Bauen 4 actually is a private initiative who was started by German major companies and non-governmental organisations with the objective to create a German BIM Steering Group which now goes by this name.

"*…the main impediment to BIM adoption in Germany is not in the technology, but rather in the companies' knowledge of BIM.*" -Dr. Ilka May.

What makes this case study valuable is that the "Planen Bauen 4.0" initiative has pretty much the same objective as my research but in their case for their country since there are no clear instructions as which stakeholder has to provide what data and don't know which are they responsibilities and what are the expectations from them. This initiative is setting not obligations but rather a guideline that would clarify the above-mentioned issues to make BIM methods more practical.

As of 2020 the BIM adaption is mandatory for public projects and with help from federal German government, which has provided a total fund of € 3,8 mill, they are promoting the BIM application in public projects such as: roads, rails construction, etc. to be realized by private companies with the hope to spread it in the private projects.

Industry Foundation Classes (IFC) is the point where public and private plans have come to agree as their common data format. They are helped from two official institutes tasked for standardization, the Association of German Engineers i or VDI, which currently is drafting the VDI2552, a standard for legal buildings, and the German Institute for Standardization, DIN, in cooperation with European Comitee of Normalization, CEN-Norm.

4.2.3.2 (Public Project) Stuttgart 21 Pilot project

Location:	Stuttgart, Germany
Client:	Government
Contractor:	Deutsche Bahn AG
Softwares:	Autodesk Softwares, Rhinoceros
Standards / Protocols	**BIM-BVB:** Legal conditions and BIM related specifications **ISO-19650:** Organization of information about construction. **IFC:** Standard data format for different software exchanges. ***** other general standards for german construction industry

Stuttgart 21 is part of the Stuttgart-Ulm rail project which is considered to be one of the largest infrastructure projects in Europe. The new rails will lay in a 120 km long distance, with 5 stations and two new quarters.

What makes this project impressive is its highly sophisticated shell roof, which is supported by 28 chalice-shaped columns that are an architectural masterpiece would not be possible without using BIM. The solution given to their design and construction largely relied on 3D models, which saw great success by the company Ed. Züblin AG which is now still discovering the advantages of digital workflow that BIM provides.

This project is enormous not only in terms of dimensions but its complex flow structure as well which despite not being mathematicaly calculatable and named a free-form structure, yet it is not arbitrary but follows the course of forces in a highly efficient manner and implements a wide-span and light-flooded station concourse of material-optimized methods.

BIM helped again in the 3D modeling of the shell roof which relied entirely on the 3D. By using Rhinoceros for its pure surface geometry additional data and information was provided such as: forming joints, coordintes of installation parts etc. It served as the reference basis to develop further the project as it contained different thicknesses, curvd aras and cicular or orthogonal rerinforcment systems. Obviously,

many of this high-complex component were expected to overlap somewhere and be an obstacle which was overcome by the usge of BIM that also helped with two other issues. There was another issue with the visible surface where small deviations needed to be made and an extremely precise calculation of whre the concrete had to be cast should be made. Lastly but not leastly was an accuracy to manufacture the complex bending shapes of the reinforcing bars.

4.2.3.3 Germany Public-Private Comparison

Table 9. Germany Public-Private standard comparison

Germany Private Initiative	Germany Public Project	Albania
ISO-19650: Organization of information about construction.	**ISO-19650:** Organization of information about construction.	**ISO-19650** ✓
IFC: Standard data format for different software exchanges.	**IFC:** Standard data format for different software exchanges.	**IFC** ✓
GAEB & OKSTRA: Similar to IFC adapted by Planen Bauen.	***:** General construction standards of Germany	*
AIA: The principal ingormation requirements, equivalent of EIR.		N/A
BIM BAP: The execution plan for BIM projects in Germany.		N/A

Just like in the case of the crossrail, Stuttgart 21 is also an asset added to an existing railroad, meaning that there are also general construction standards of Germany being present alongside the BIM standards that I mentioned.

Highlihted in red colour are standards not Not Available.

Highlihted in green colour are standards published by DPS.

CHAPTER 5

ANALYSIS

5.1 Standard comparison

In this chapter of my thesis, I will analyse the standards that were applied in the above-mentioned case studies, by comparing them to each other, identifying their common senses and the unique properties and values that each one of them brings to BIM. The reason that I took different case study typologies from different countries is so that I can be able to best inspect, different scenarios and analyse their outcome so we could boost the efficiency of BIM in our country or prevent some common mistakes that were usually made.

Table 10 Standards of different countries

BIM Protocol / Country	*ISO 19650*	IFC	CIC/IDM	Uniclass	CoBie/CoBIM	IDE	DD
United Kingdom	+	+	+	+	+	+	
Finland	+	+	+		+		+
Germany	+	+		+			

If we were to compare the protocols of the countries of the case studies from which I did my research we would notice that, the protocols regarding information management by a team that is to coordinate the work appears at each and every single one, since from my observations this was the key node for BIM process to take place and be successfully completed, my proposal is that we start from this point onward with the evaluation of the standards for BIM Albania.

Taking into consideration that the ISO 19650 standard although developed by and closely related to the UK BIM Framework, it has been accepted as an international standard regarding information management throughout the entire lifespan of a BIM built asset.

BS EN ISO 19650-(1/2/3/5) defines standards to organize and digitize the information of buildings and civil engineering works, (including BIM), information management of BIM in terms of: *concepts and principles*, *delivery phase of the assets*, *operational phase of the assets* and *security-minded approach to information management*.

While as I mentioned before that private initiative Planen Bauen 4.0 is working closely with two institutes for standardization DIN and VDI, our respective institute for standardization in Albania the DPS (Drejtoria e Përgjithshme e Standardizimit) has already approved and adopted ISO 19650 as a standard for civil engineering in our country making hese standards to serve as fundamentals for creating a BIM environment in Albania, but will also be asked to help in further developing the protocols which I am proposing.

Secondly, to make communication and the information exchange between different applications and programs easier, it would be only natural to suggest that all the companies use the same group of computer programs such as Autodesk products for example, this would not only be an obstacle that would greatly prevent the development of our construction industry but also would limit the potential of our countrys architects and engineers in the same level of knowledge that we currently posses while we are actually looking to bring it forward.

Such a thing can be achieved indeed and by taking a quick look at the other countries standards we notice that though they might go under different names they are clarified as Industry Foundation Classes (IFC), which are an actual open international standard for BIM data to be interexchanged and shared between different operating softwares used by the stakeholders of the projects. What IFC basically does is that it clarifies a format structure with data, information and schemes to come in an

exchangeable way. The above-mentioned formats are defined as Extensible Markup Language XML, for clear fonts and exchangeability in ISO 10303.

The information provided by IFC are as follows: the identity of the data, which makes sure the names and and everything is machine-readable and unique, the attributes or properties of the units like material, color, etc. their relationships with each other, in terms of as building units, like locations or how they are connected, the elements, like slabs, columns, beams, the processes that will be operated like installation etc. and of course in terms of people, the designer, supplier, owner.

To continue with the method of application or the rather during which phase of the process these protocols were applied, I have prepared yet another table which shows which protocols were applied at which phase of the project in the case studies I analyzed.

Table 11 Standards according to different phases of the projects

Cntry/Prjct Phase	United Kingdom		Germany		Finland		
	Private	Public	Private	Public	Private	Public	
Design	CIC/ISO-19650/ BIM Toolkit	CIC/ISO-19650/ BIM Toolkit	BIM-BVB/ AIA	ISO-19650/ IFC	IDE/ IDM/ MVD/ ISO-19650/ IFC	ISO-19650/ IFC/ MVD	Protocols Applied
Planning	IFC/ISO-19650/ COBie/	CIC/ COBie/ BIM Toolkit	IFC/ GAEB OKSTRA/	ISO-19650/ IFC	CoBIM/ IDE/ DD/ MVD/ BCF	ISO-19650/ IFC/ DD/ IDM/ IDE/ CoBIM	
Construction	CIC/ ISO-19650/ IFC/ COBie	CIC/ ISO-19650/ BIM Toolkit	BIM BEP	N/A	ISO-19650/ DD/ IDM/ BCF/ CoBIM	CoBIM/ DD/ IFC/ ISO-19650/ IDM	
Maintenance	IFC/ COBie	IFC/ COBie	BIM BAP	N/A	IFC/ IDM/ CoBIM/ ISO-19650	CoBIM/ IDM/ IFC/ BCF	

These standards will be very useful since as we will see further into my thesis, by the charts of the survey I made, what is expected from architects in our country, BIM will bring.

5.2 Survey Responses and Analysis

Below are the data which I was able to collect from the responses of my survey and the analysis and the conclusions I have reached according to the feedback received from it:

5.2.1 The general profile and information about the average interviewed person.

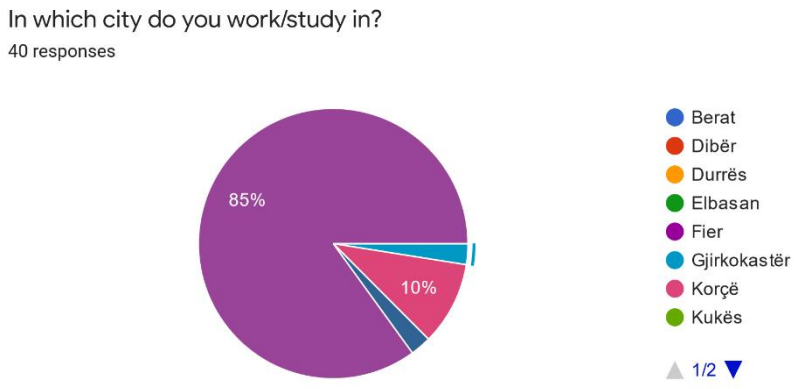


Chart Results 1

As can be seen from the pie chart above this survey took place mainly in the city of Tirana. Out of all the people who choose to respond this question 4 were from Korça, 1 from Shkodra and 1 from Gjirokastra.

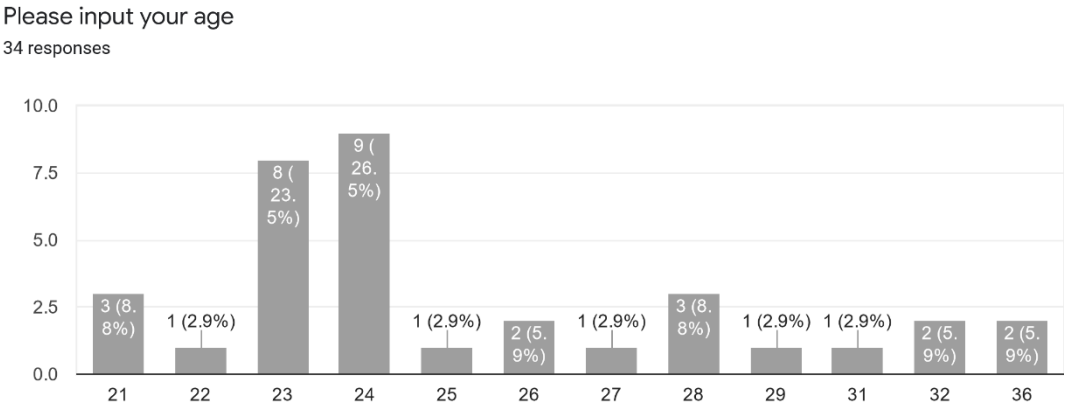


Chart Results 2

From the second chart we can see that most of the people were either young graduates or junior architects that have recently started in their profession or are working as interns in different studios or municipalities throughout our country. The average age of a profile who has filled this survey was around 26 years old.

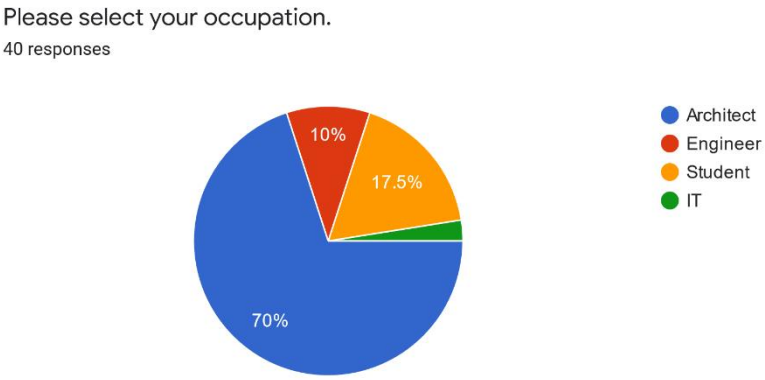


Chart Results 3

As we can see the greatest part of the responders were architects or architecture students in their last year of studies. Another 4 people were construction engineers with over 10 years of experience in their respective fields.

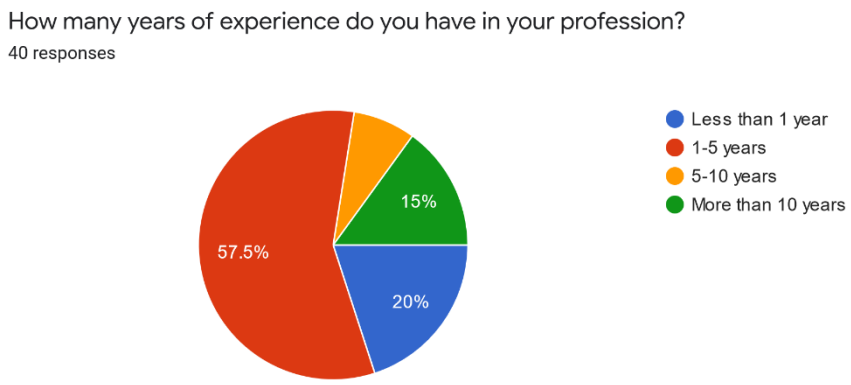


Chart Results 4

Most of the people that were interviewed had only recently started their long journey as architects but there also were a considerable amount of people who had a long and very rich experience with the construction industry in our country.

5.2.2 Where does BIM currently stand in terms of standards and in comparison, to other requirements in our country?

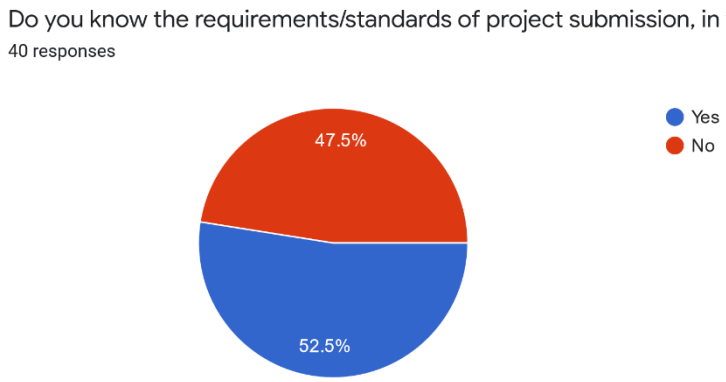


Chart Results 5

The responses I got from this question were really disturbing and this is one of the main challenges that our young graduates face in their first months of work in their profession. It is commonly believed actually that the requirements are posted online in the websites of the local government offices like municipalities or communes but actually as I have several times checked even myself they either completely miss or are really hard to find and not in an correct order or close to the topics related to them, even the ones which can be found are very unclear especially in scenarios where there appears a rare factor which should be taken in consideration and the architects learn about this when they go to submit the paperworks and they are not accepted or they have to go personally ask in the municipality whether there is or not firstly a standard for the problem they face or if they have to adopt an international standard in case it is not clarified by our government.

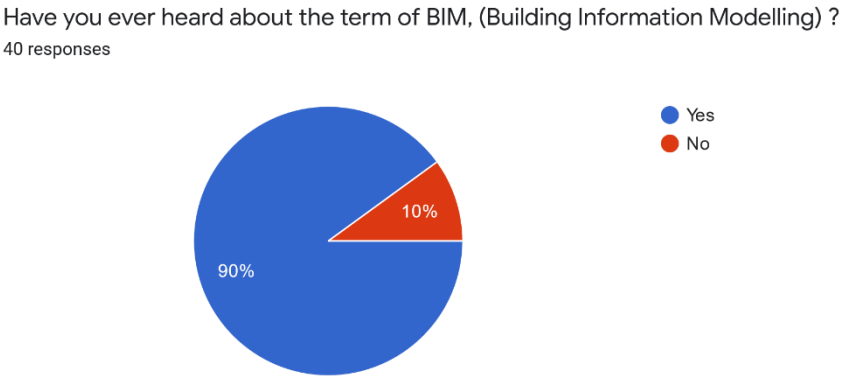


Chart Results 6

While BIM is a term which most of the architects have come across at least once during their lifetime, it is a term which is being more commonly heard day by day and the architects in Albania are familiar with this term.

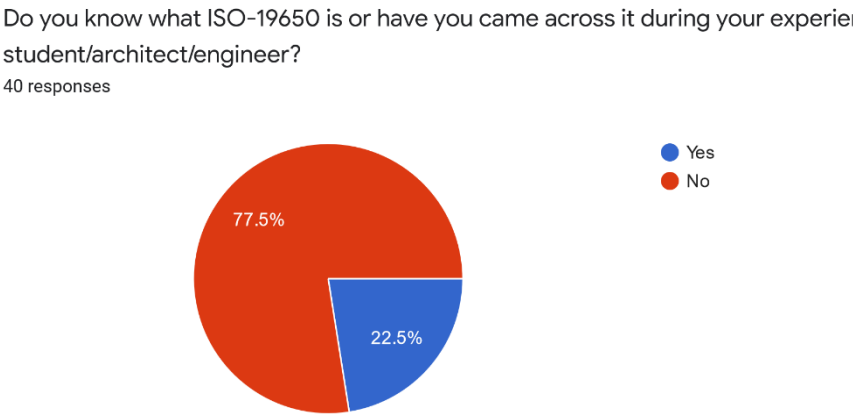


Chart Results 7

I randomly took one of the most widely used BIM standards across the world to ask if they were familiar with or not. The responses I got were started to concern me especially due to the fact that the only ones to recognize this standard, even if simply by name were the ones that were either using BIM or were undergoing training in this field.

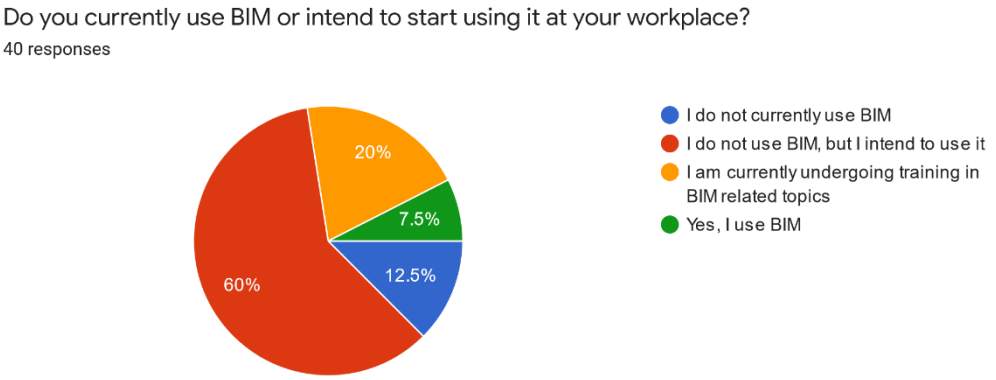


Chart Results 8

While the number of the people using BIM is relatively smaller than the ones not using it, there is heart-warming approach towards a BIM future in our country, since there is a really big number of architects that either undergoing training to use BIM in their studios or very much willing to use it in a near future, as some of the people that I personally interviewed told me.

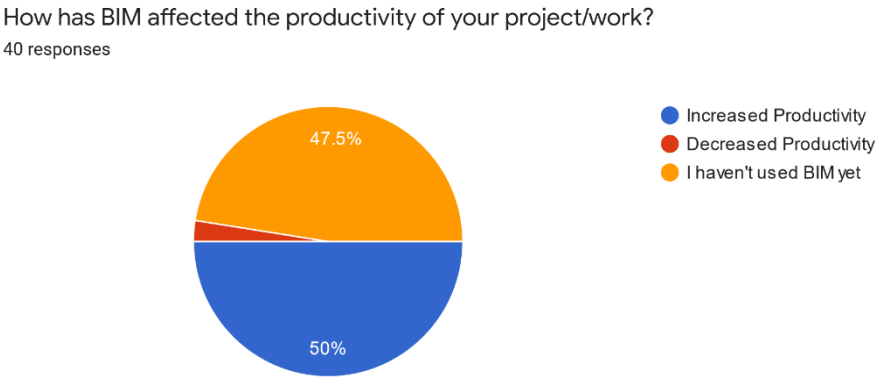


Chart Results 9

Another factor that BIM is going to be successful in our country is the fact that according to the persons that are already using BIM in their projects the overall

performance and productivity has significantly increased, which in itself is great added value to our industry.

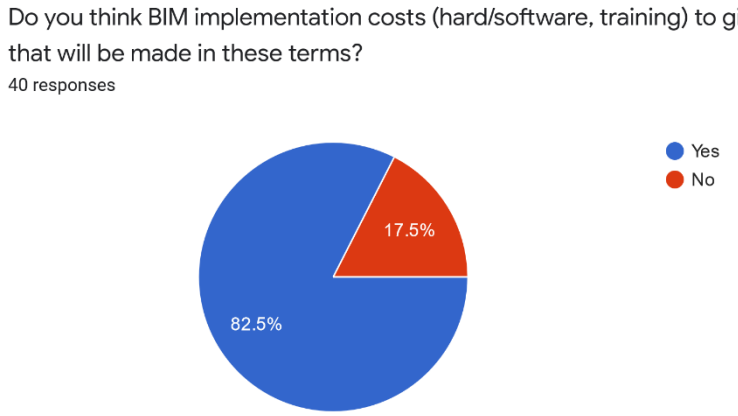


Chart Results 10

One of the main challenges that BIM faces almost everywhere is the return of investment issue. This happens mostly due to the fact that it requires a lot of investment both in money and time for training the staff but it is an investment worth making as we see in the analyses of the previous case studies made in other countries. Apparently Albanian market tends to be more open minded towards this approach and are believers that this investment is worth it. My suggestion is that our government follows the example of the UK government since it resulted successfully.

To overcome this issue the public-private relationship between sectors is really important and the small companies and studios should be motivated and given the opportunities to adopt BIM as well to avoid the monopolization of it by the larger and stronger firms.

5.2.3 Which standards would amplify the benefits that our architects are most looking forward to gain from BIM?

Information management and data sharing is in my opinon the most valuable asset of BIM which makes it so unique and successful in the benefits that it brings to a project in every aspect. Below are the answers to it and several other benefits that we may expect to see from BIM along with my proposal of standards according to analysis made.

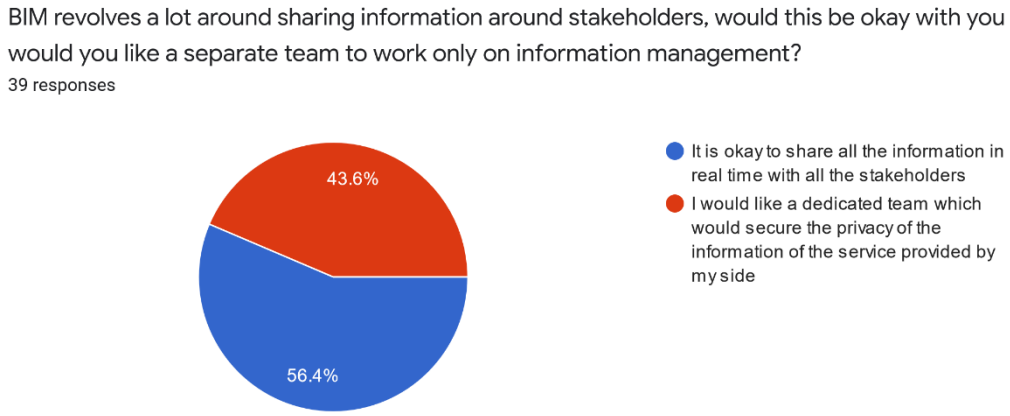


Chart Results 11

Even though, this looks like a close call between being pro or against the total sharing of information between stakeholders. One of the aspects that I mentioned since earlier in my thesis is that BIM revolves around employer's information requirments. In itself the client has it's right to interfere or check how far the project has progressed or request changes and briefing occasionally.

Via BIM it becomes a lot easier to explain the progress of the construction even to those unrelated to architecture or common folk. For instance, in the case study of private project in UK, the parts and components of the building that were already finished or installed were highlited to make them visibilly distinguishable from the ones that were under construction (highlighted with another colour) or even from the ones that had not started yet.

My proposal is that we adopt the “CIC BIM Protocol”, which allows the client to legally request building information models in order for him to organize certain working methods but also helps government to set obligations and liabilities as to how far these bims can be used and their purpose.

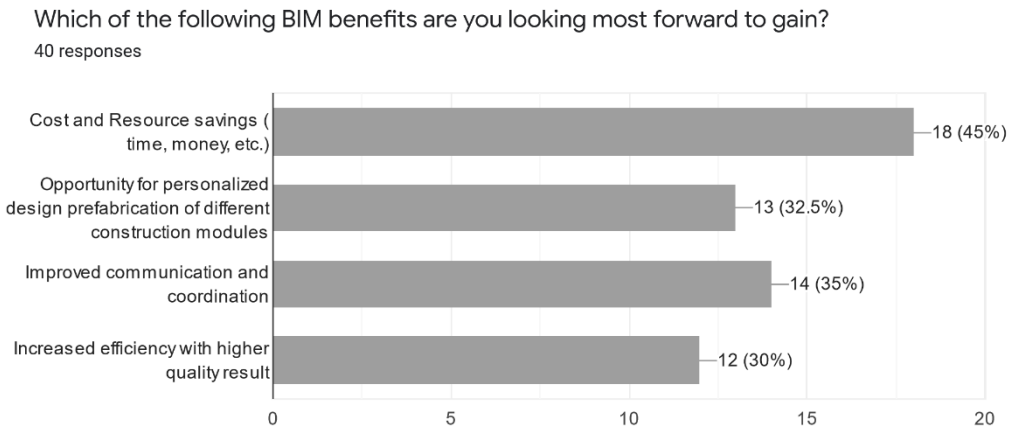


Chart Results 12

Now this one was a multiple answers option for the survey responders and as can be seen architects in our country are mostly looking forward to. As I mentioned in the previous questions’ analysis a team for information management is a must that not only assures the providers that the components and the services, they give are secure but also allows the team to check if they fulfill the necessary requirements set by the client. Leaving so little to no room for mistakes or intentional manipulation.

But setting a team which collects and manages the information from the stakeholders and checks the working progress accordingly, which resonds to the employer directly has seen other benefits as well like, avoiding misunderstandings and saving an incredible amount of time in the documentation and other calculations in terms of cost.

Using BIM also updates and gives the information that previously was made manually to the government in terms of sales and supplies from different place and the

amount bought and used of the materials which in itself also helps fight the evasion, a topic which our government considers one of its priorities.

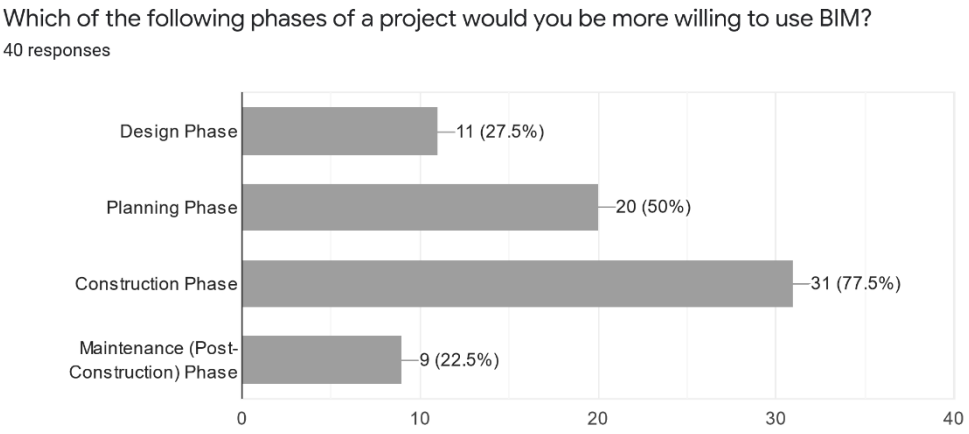


Chart Results 13

BIM separates every project in 4 different main phases: *design, planning, construction* and *maintenance* (lifecycle) phase. While there are specification and protocols for each phase and every possible scenario, I must note that some of them deeply rely on each other forminh like this a chain reaction. However, we must set the basics, and the rest will come naturally.

In my survey for the question of which phase of the project would they like to use more BIM or rather what phase it would see more usage and success the greates part of the interviewed replied with construction phase, and coming directly after it the planning phase. The design and maintenance phase are also as important and I am proposing standards that affects the basics of all four phases, this question was used rather to understand which phase of the project would we see the most benefits.

Now if we go back to table 2, we notice that, despite the ISO-19650 and IFC another standard that applies a lot is CIC but also COBie in the United Kingdom and CoBIM in Finland. These are two protocols that impact a lot the contruction phase in different directions starting from the delivery of the building information models and things like equipments, spare parts, data sheets, warranties, etc. but also saves a lot of

time in organizing the preventives and schedules. Another benefit that is gained from this protocol is the fact the documentation provided via it, makes it easier the arrangement and gives us the option to re-use it in a faster period of time saving a lot of resources.

These protocols are also closely linked with maintenance phase due to the fact that once the asset is finished and is put into service, the documents and bims provided via will be used throught its entire lifecycle. Another factor for adopting them is the fact that from the following two question of my survey the responses I got were related to these very protocols.

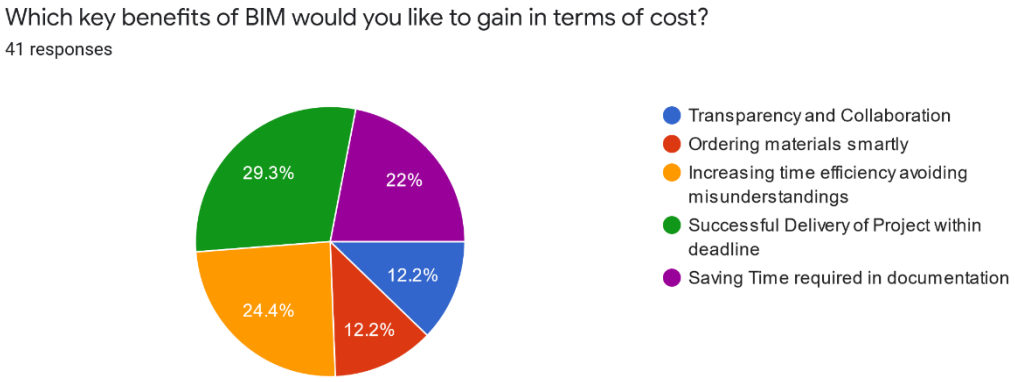


Chart Results 14

As we can see from these charts (upper and lower) time efficiency is one of the main expectations from BIM to bring, since it will be very costly in every aspect if the project does not achieve its deadline as changes might be requested or forced to happen

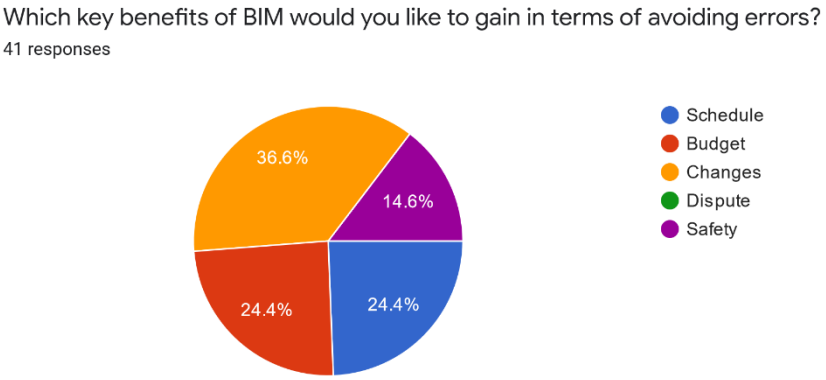


Chart Results 15

The time saved in this form can be used to move on to other projects which as a result will generate more income, making this a 100% efficient value added to the AEC.

5.2.4 The changes that BIM is expected to bring.

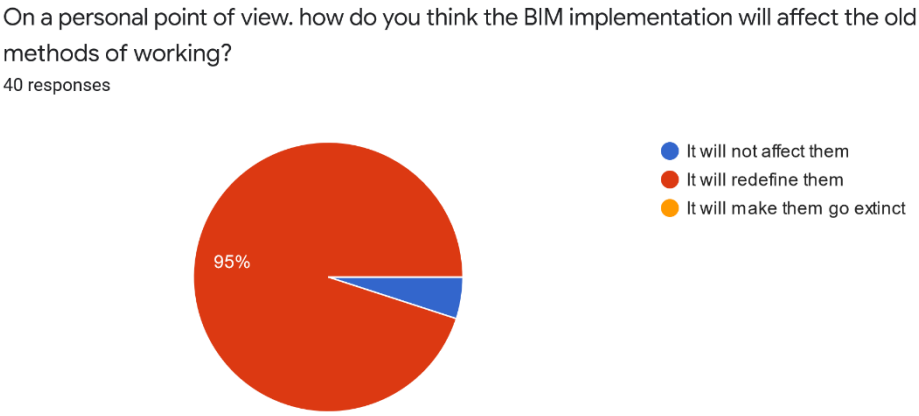


Chart Results 16

By taking a look at the result of this question once again I have to repeat that while it might be a difficult process to move from traditional methods of work towards more modern approaches it is about time that we start adopting the same format of documentation that the international standards required.

The Data Dictionary of the buildingSMART (bSDD) according to a flyer posted by them in their official website: "*On projects with experienced data modellers and BIM managers it is known that 2% of interactions have identifiable data errors that lead to delays and cause additional time to fix."* But a lot of monetary value could be saved as shown in the table below posted in the mentioned flyer.

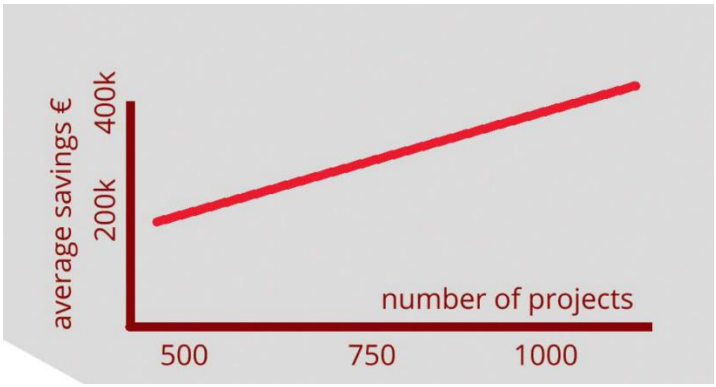
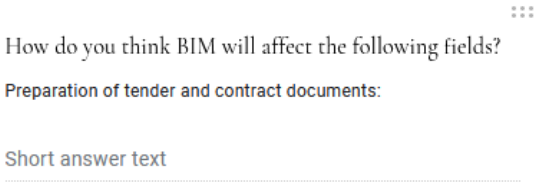


Figure 5.3. 1 *Data modeling cost reduction* ***[20]***

Actual savings might be even higher due to shorter engineering time, less failure cost and better automated analaysis.

Uniclass is another international nomenclature and classification structure used in AEC that contains tables which classify items and activities starting from the likes of *"Ac_05 Project management activities"* or *"Ac_05_00 Strategy stage activities"* up to *"Zz_80_85 Trees and planting"* or even *"Zz_85_05_60 Paths"* [21].



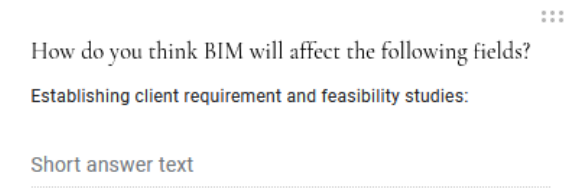
The approach towards the preparation of tender and contract documents was a rather positive one as it expected from the architects in our country as I received responses like the following ones taken directly from the survey, *"Will improve the correctness of the documents."* or *"It will incorporate a more uniform, all-inclusive*

solution in tender documents." or even "It helps contractors to improve cost estimates, improves the visualisation process and saves a lot of time."

Based not only on their feedback but also on the experience of those project that have finished successfully with BIM, I conclude that: it will not only greatly decrase the amount of time needed to prepare these documents, but will make them easier accessible and archiveing them would be a much easier procces that reduce the time of restoring them should the neccessity arise once more.

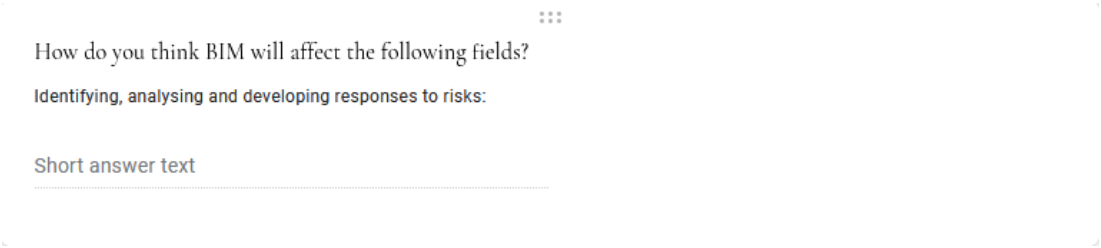
The answers towards this question were unified toward a reduction of the costs, and an efficient management of the budget, below I am listing some of the responses to this particular question: "*It creates the potential for more precise and thorough cost estimations. Furthermore, it will allow for a more rapid examination of the costs analysis and construction variations."* another response was regarding the materials and their usage *"It makes faster and precise calculations of costs, material usage and their benefits."*

However, I can conclude that the cost analysis will be reduced in both aspects time and money, one of the most common mistakes that happen in construction is the fact that clashes happen and BIM prevents it with clash detections, that avoid them on site and gives an option since the planning phase of a project, as well as reduce the lifecycle cost because we will have the BIM of the built asset.



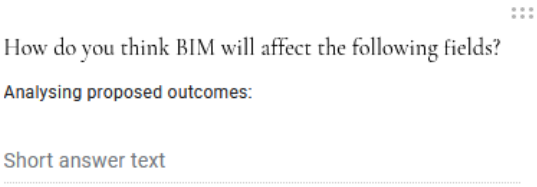
While there were people who think that BIM will not affect the client requirements there was a particular answer which perfectly defines this answer: "*You can design and visualize the whole project using BIM during preconstruction, before the shovel ever hits the ground. So, it can improve communications and coordination with client requirements.*"

And I am in the group of people which think that there would be a significant boost in terms client requirements since BIM revolves around the EIR and also increases the precision of feasibility studies by keeping both sides happy.



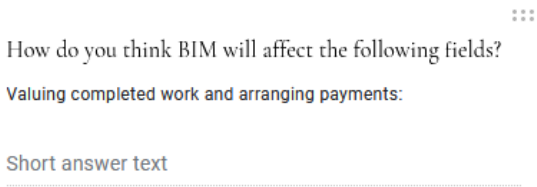
The employers tend to be a bit sceptical when it comes to benefits like this though it might be a thing which is in everybodys best interests. The responses I received from this question were as such: *"Will be very easy to understand the risk assessment and to valuate the market."* or *"Due to imediately testings of the constructed project, and the opportunity to adapt it following the risks or threatens that come across the design and construction project, it will improve this."* or even *"I think tht BIM might be used not only to help the project development process as a systematic risk management tool, but also as a core data generator and platform for other BIM-based technologies to do further risk assessments."*

In my personal opinion now, this is one of the most underrated benefits of BIM since this one appears in almost every single BIM project, and from my experience I think that this one would also benefit the common workers the most during the construction phase, so that a lot of mistakes that are made on site will be avoided and they will work on a more precise rate.



An overall improvement is expected from BIM even in this form and the architects expect to see efficiency from it. The responses like *"It will improve analysing as BIM has all the needed inputs for analysing and adapting with the outcomes."* or *"One of the most significant advantages of building information modeling (BIM) is the ability to assess construction project performance using data analytics."* are what best describe it.

In my opinion despite the fact that it will be easier to understand, since BIM allows you to analyse on 3D virtual model, I think this one would be the field where BIM will find its most wide usage during its early steps of implementation.



The responses to this particular question were from on-field experience of the interviewd or their collegues and they responded in the following way: *"I have heard that BIM has the potential to provide more efficient operation in completed work, as well as arranging payments."* and *"Will improve the payments method and also the performance of work."* these responses were due to the fact that those who currently undergoing BIM training or use BIM in their project already know that everything is evaluated and calculated in units, and will automatically give a final result for making it easier and faster.

However from my point of view and the experienced I have accumulated not only during this period of time but seeing as other sectors of industry are affected as well I could say that this is a topic that is greatly affected by stereotypes of a country to be honest, outside Albania the governments have taken measures to keep the competition fair while I am afraid here we might see a monopolization of the people with the necessary skills and budget to quickly adopt BIM and set the prices according to their personal interest so I think that this is a very wide topic to disccus.

5.4 Conclusions

To briefly sum all this research up, as I went through different projects, and analyzing different protocols of BIM and their outcomes I understood that the key node that makes the BIM successful and the most important component of making BIM function after you apply it is communication. To ensure this communication we need to "speak the same language", and I would like to start from here with my proposals for BIM implementation and Albanian standards will begin. As I mentioned in the beginning of the thesis BIM revolves around a contractual agreement between employer and the project team, which provides information and specifications about the project team, which both sides are obliged to fulfill.

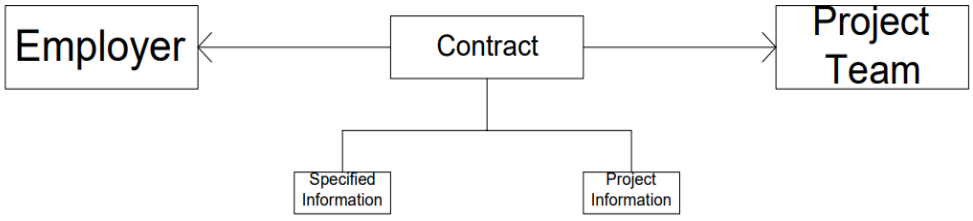


Figure 5. 4. 1

From my research about BIM as a process in its whole, in broad terms, we could separate it into four main phases: design phase, planning phase, construction phase and maintenance phase (life-cycle).

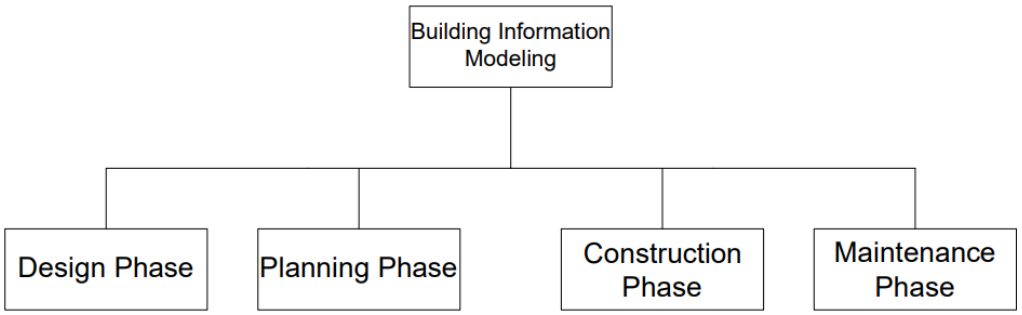


Figure 5. 4. 2

Once again, I want to note that this are briefly conclusions to sum up and clarify my work, (check chapter four and chapter five), after careful analysis of taking into consideration the effects that adoption of BIM has had in different countries, of how the protocols had influenced different aspects of the project, the following standards and protocols I propose to serve as the basements towards a brighter future of BIM implementation in our country.

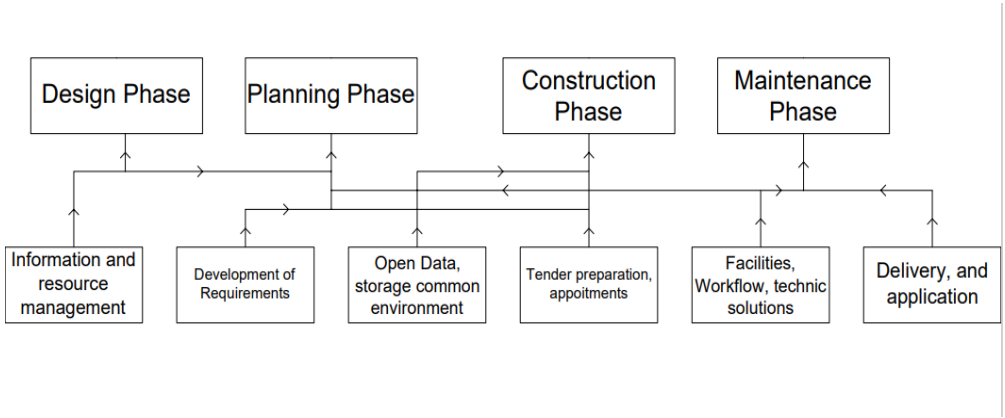


Figure 5. 4. 3

For the designing phase of BIM, ISO-19650 should be mandated for its benefits that it has shown so far, in terms of organization of information and the management of the building information models. Uniclass2015 which was updated during 2020 regarding the classification of the information during this phase and during the

construction phase as well. Alongside Data Dictionary which contains the international nomenclature for BIM elements in every aspect of the project.

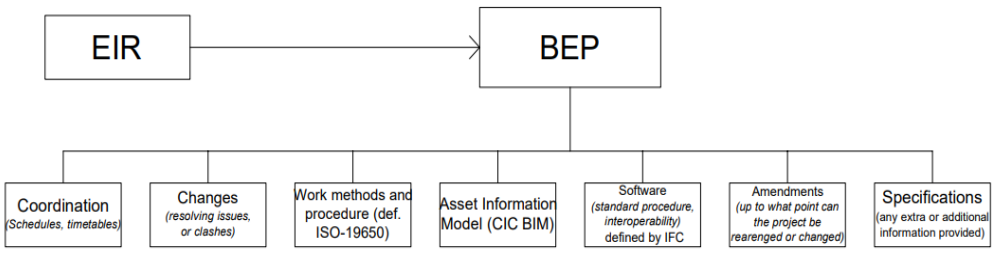


Figure 5. 4. 4

The planning phase is one of the most important phases since a lot of clash detections and decision making happen during this phase, and as I mentioned earlier is one of the phases that BIM will find a wide field of usage opening way to new opportunities especially during the early steps of its implementation in Albania, I propose the following standards and protocols based on the analysis made by me in this research. So basically, after the EIR contract is made the BIM Execution Plan (BEP) starts being composed by the Project Team and seys out the procedure for its development to check if there is any conflict with EIR which needs resolving before the works begins. Things like coordination, inconsistency, methods, procedures, assets of information models, softwares, amendments, specifications, etc. (fig. 5.4.4) are all defined in this phase of the project.

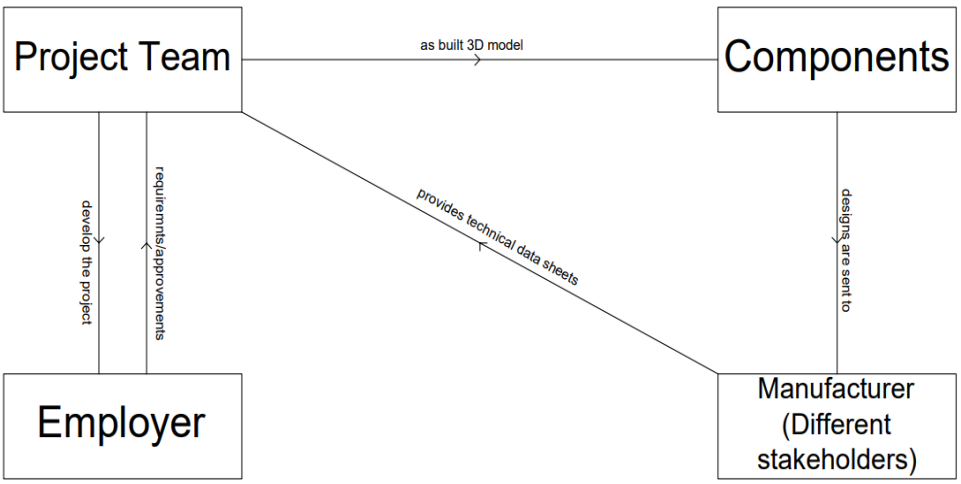


Figure 5. 4. 5

Every participant of the project has to provide the technical datasheets for the required components or the services which they provide, in documented form. So that the entire information is collected and after the information type is specified (Fig 5.4.6) The available info is put into the common data storage environment so that it is accessible to everyone. And also, several clash detection simulations are made to prevent any obstacle or incompatibility that may arise on the go by lowering the risk of error, and boosting efficiency.

Industry Foundation Classes which is the standard for facilitating the information exchange between different softwares since this the phase during which all the components of a built asset will come together. BIM Toolkit will also be an added value as a starter protocol since it finding a wide range of adoption internationally and defines roles and the responsibilities that each stakeholder shares. CIC BIM Protocol will help to keep building information models under control by defining their obligations and liabilities and will be a key node in the negotiations between the client and the service providers should the need to make changes before the construction phase begins.

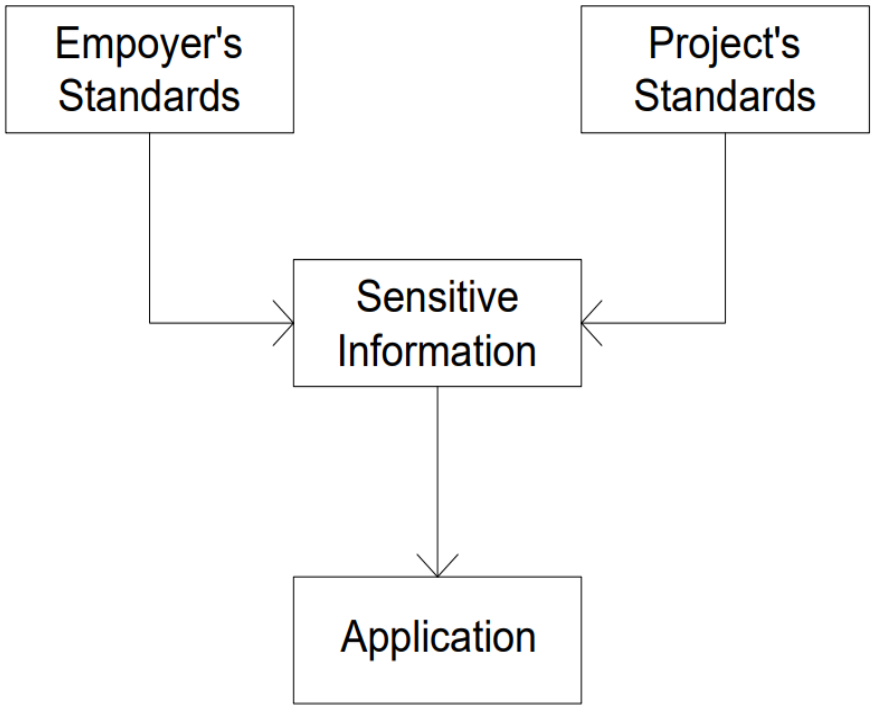


Figure 5. 4. 6

After the employer’s standards and projects specific standards regarding security requirements for their respective provided information are clarified, this information is filtered to identify which parts should be specified as sensitive for the sole purpose of treating it differently to the rest of it. Then the application phase begins if there are not left any unsolved issues regarding both the documentation and any other topic which mighy concern the project or be in any form of obstacle.

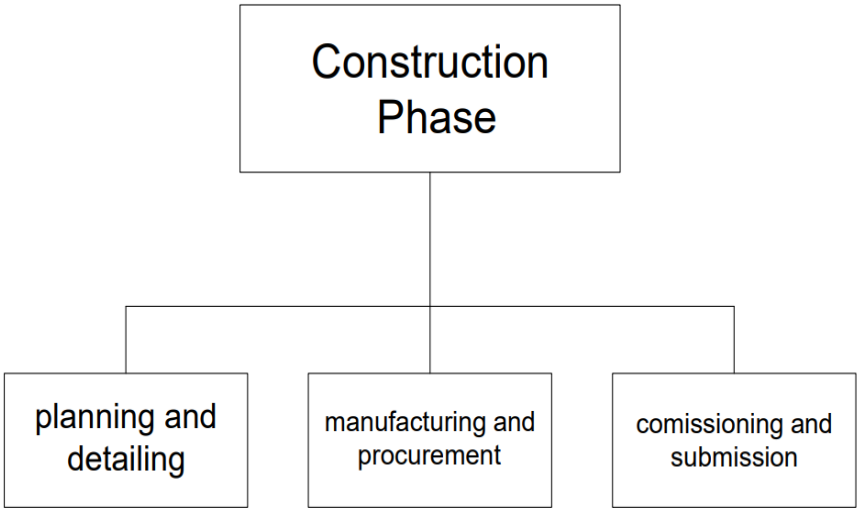


Figure 5. 4. 7

During the construction phase except the protocols that I mentioned beforehand and the planification, details, manufacture and procurement that are already defined in the previous phase, we can find the commissioning and submission as well as another two protocols which have proven themselves to be a very valuable asset in BIM project are COBie which will provide the layouts of working and the delivery of the bims, equipments, documents, spare parts, will help organize the schedule and the information provided, as defined into this protocol can be reused for different purposes, this protocol and CoBIM will be deeply related to the maintenance phase especially after the building will be put to use.

With the end of the construction phase in most of the traditional projects is commonly the final stage and brings an end to the documentations and appointment however this is not the case with a BIM project.

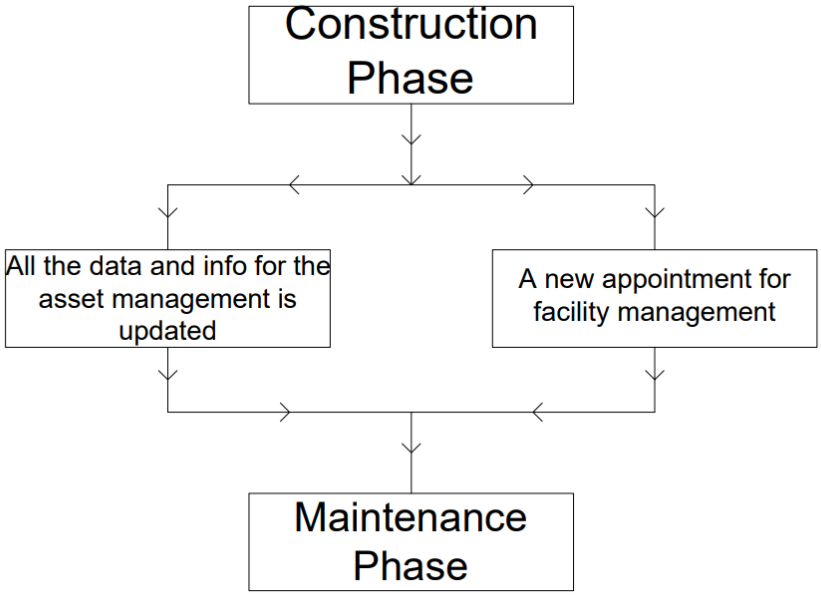


Figure 5. 4. 8

CoBIM will be put to best use during the maintenance phase of the built asset as it supports the management uses of it by defining different aspect that need attention throughout the entire lifespan of the building from the short up to the long-term plans.

As can seen in the figure 5.4.8, once the construction phase ends, all the information is checked up once again, and is compared if it matches the initial execution plan and information models that were provided since the beginning. If there are any changes that were made everything is updated once again, and after all the documents are handed over to the employer a new appointment is also made for the maintenance of the built asset, it usually lasts for 3 years in most of other countries, and building performance measurments and other system analysis is made throughout this 3 year period of time, while there always remain the possibility to make independent surveys after this period of time and the building is put to use.

5.5 Proposals

Taking into consideration that I propose to adopt BIM and make it mandatory for public projects in our country, some of the steps that could be taken to make the whole process of its implementation easier. Besides promoting it by the side of the government and maybe financially supporting and encouraging all firms to take part and adopt it, BIM could also be included as part of architecture schools' curricula.

Not only would this help prepare the young generations of architects for BIM, but this would also remove one of the biggest issues. That of having to spend time and money to train staff since you will have already trained graduets in BIM, and also this would bring us more specialized architects in this aspect since they would have their basic skills earned from the university and maybe developed even further long before starting to apply in real projects.

But BIM should not only be limited to new project since it can be used for existing buildings as well or buildings that need intervention or reconstruction. Wether it is a public asset or a private one, it may be services, government, dwellings or schools etc. BIM can be adopted to optimize the efficiency of these building.

The table below shows a summarized of the protocols as used in the respective countries, and how they stand in comparison to our countrys standards regarding the BIM. Below are my proposals for each standard.

Protocols							
Country	*Project*	BS EN ISO-19650	IFC/BFC	Uniclass/bsDD	CIC/IDM+MVD/BAP	BIM Toolkit	COBie/CoBIM
United Kingdom	Private	+	+	+	+	+	+
	Public	+	+	+	+	+	N/A
Finland	Private	+	+	+	+	+	+
	Public	+	+	+	+	+	N/A
Germany	Private	+	+	?	+	N/A	?
	Public	+	+	N/A	+	N/A	?
Albania		+	+	x	x	x	x

Table 12 Comparison

The protocols that are already published in our country by Drejtoria e Përgjithshme e Standardizimit are the following two as I mentioned in the chapter 5.1:

1. ***ISO-19650****, which defines standards to organize and digitize the information of buildings and civil engineering works, (including BIM), information management of BIM in terms of: concepts and principles, delivery phase of the assets, operational phase of the assets and security-minded approach to information management.*

And:

2. ***Industry Foundation Classes (IFC)****, which are an actual open international standard for BIM data to be interexchanged and shared between different operating softwares used by the stakeholders of the projects. IFC clarifies a format structure with data, information and schemes to come in an exchangeable way. The above-mentioned formats are defined as Extensible Markup Language XML, for clear fonts and exchangeability in ISO 10303.*

Similar to the **IFC** was **BCF (Building Collaboration Format)** but it was for their respective softwares by their developers. The following standard can be adopted as is, since its purpose is to clarify an international codification of nomenclatures.

3. ***Uniclass 2015****- is a classification structure for the different disciplines of construction industry. Its contents differ from small elements like the types of plants or trees and other activities related to the project. Providing codification and nomenclature for the above-mentioned elements.*

   Data Dictionary *serves the same function as Uniclass with the only difference the fact that it was developet by Finlands buildingSMART.*

The following protocols can be adopted as they are or we can develop our own standards by taking into consideration the current condition on which sits the construction industry in Albania.

4. ***CIC BIM Protocol*** *which specifies obligations, liabilities and limitations regarding the usage of bims and can be applied by clients to require certain working methods.*

   Information Delivery Manual (IDM) and Model View Defination (MVD) *both are related to one another regarding the processes and description on the specific uses of the bims. Again, these standards are developed by Finland for their own construction industry.*

5. ***BIM Toolkit*** *offers a digital plan of work to define roles and responsibilities and tool to verify that the necessary information is uploaded in the current working model.*

6. ***COBie (Construction Operations Building Information Exchange)*** *and* ***CoBIM (Common BIM Requirements)*** *are both standards that define lifecycle BIM standards and specializes in delivering bims regarded information of the build asset during the construction and the maintenance phase and all the sub-topics related to these phases.*

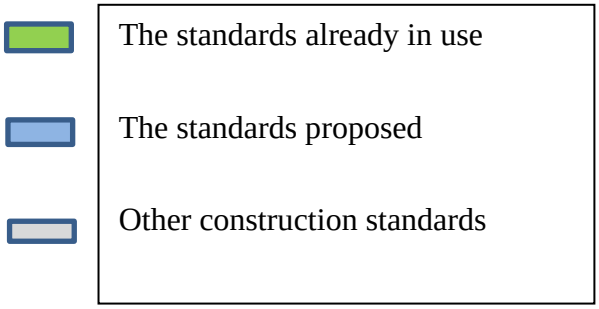


Table 13 Proposals

		Countries							
		United Kingdom		Germany		Finland		Albania	
	Project	Private	Public	Private	Public	Private	Public	Private	Public
Phases	Design	**CIC BIM Protocol:** Obligations and limitations for bims. **ISO-19650:** Organization of information about construction. **BIM Toolkit:** Digital Plan of Work.	**CIC BIM Protocol:** Obligations and limitations for bims. **ISO-19650:** Organization of information about construction. **BIM Toolkit:** Digital Plan of Work.	**BIM-BVB:** Legal conditions and BIM related specifications **AIA:** The principal information requirements, equivalent of EIR	**ISO-19650:** Organization of information about construction. **IFC:** Standard format for software exchanges.	**IDE:** Equivalent of IFC. **IDM:** Provides utilization for BIM based information. **MVD:** Technical guides for IDM impementations. **ISO-19650:** Organization of information about construction.	**ISO-19650:** Organization of information about construction. **IFC:** Standard format for software exchanges. **MVD:** Technical guides for IDM impementations. **DD:** International nomenclature for BIM elements.	**CIC BIM Protocol:** Obligations and limitations for bims. **ISO-19650:** Organization of information about construction. **IFC:** Standard format for software exchanges.	**CIC BIM Protocol:** Obligations and limitations for bims. **ISO-19650:** Organization of information about construction. **IFC:** Standard format for software exchanges. **DD:** International nomenclature for BIM elements.
	Planing	**IFC:** Standard format for software exchanges. **ISO-19650:** Organization of information about construction. **DPD:** A mean for digitizing the delivery of the Project. **Uniclass 2015:** Nomenclature and classification of information.	**CIC BIM Protocol:** Obligations and limitations for bims. **BIM Toolkit:** Digital Plan of Work. **COBie:** A format for publication of information.	**IFC:** Standard format for software exchanges. **GAEB & OKSTRA:** Similar to IFC adapted by Planen Bauen. **ISO-19650:** Organization of information about construction. **IFC:** Standard format for software exchanges.	**ISO-19650:** Organization of information about construction. **IFC:** Standard format for software exchanges.	**DD:** International nomenclature for BIM elements. **IDE:** Equivalent of IFC. **MVD:** Technical guides for IDM impementations. **BCF:** Collaboration format for Tekla and Solibri softwares.	**ISO-19650:** Organization of information about construction. **IFC:** Standard format for software exchanges. **IDM:** Provides utilization for BIM based information. **IDE:** Equivalent of IFC.	**BIM Toolkit:** Digital Plan of Work. **ISO-19650:** Organization of information about construction. **IFC:** Standard format for software exchanges.	**BIM Toolkit:** Digital Plan of Work. **ISO-19650:** Organization of information about construction. **IFC:** Standard format for software exchanges. **Uniclass 2015:** Nomenclature and classification of information.
	Construction	**CIC BIM Protocol:** Obligations and limitations for bims. **ISO-19650:** Organization of information about construction. **DPD:** A mean for digitizing the delivery of the Project. **COBie:** A format for publication of information.	**CIC BIM Protocol:** Obligations and limitations for bims. **ISO-19650:** Organization of information about construction. **BIM Toolkit:** Digital Plan of Work.	**BIM BAP:** The execution plan for BIM projects in Germany.	***NOTE*:** General construction standarts of Gemany	**ISO-19650:** Organization of information about construction. **IDM:** Provides utilization for BIM based information. **BCF:** Collaboration format for Tekla and Solibri softwares. **COBIM:** Lifecycle BIM standards fort he built asset.	**COBIM:** Lifecycle BIM standards fort he built asset. **IFC:** Standard format for software exchanges. **ISO-19650:** Organization of information about construction. **IDM:** Provides utilization for BIM based information.	**BIM Toolkit:** Digital Plan of Work. **CIC BIM Protocol:** Obligations and limitations for bims. **COBie:** A format for publication of information.	**BIM Toolkit:** Digital Plan of Work. **CIC BIM Protocol:** Obligations and limitations for bims. **COBie:** A format for publication of information. **COBIM:** Lifecycle BIM standards fort he built asset.
	Maintenance	**IFC:** Standard format for software exchanges. **COBie:** A format for publication of information.	**IFC:** Standard format for software exchanges. **COBie:** A format for publication of information.	**BIM BAP:** The execution plan for BIM projects in Germany.	***NOTE*:** General maintenance standarts of Gemany	**IFC:** Standard format for software exchanges. **IDM:** Provides utilization for BIM based information. **COBIM:** Lifecycle BIM standards fort he built asset. **ISO-19650:** Organization of information about construction.	**COBIM:** Lifecycle BIM standards fort he built asset. **IDM:** Provides utilization for BIM based information. **IFC:** Standard format for software exchanges. **BCF:** Collaboration format for Tekla and Solibri softwares.	**IFC:** Standard format for software exchanges. **COBie:** A format for publication of information.	**IFC:** Standard format for software exchanges. **COBie:** A format for publication of information. **COBIM:** Lifecycle BIM standards fort he built asset.

By adopting these standards in our construction industry, we can open the way for BIM in Albania and help improve the overall condition of this particular sector of life in our country.

CHAPTER 6

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APPENDIX

The following is a survey with questions that I prepared. It shows very brief BIM information which brings forward a basic insight to BIM benefits to the takers of this survey and what are they expecting from BIM or which properties are they most looking forward to, as well as some critical opinion about the way BIM will change the traditional working method in Albania.

This survey will help us select some other BIM standards in according to the level of BIM in Albania and as well to fulfill but also to boost the expectations and pave its path towards an easier implementation in Albania.

BIM Implementation in Albania

1. In which city do you work/study in?

Mark only one oval.

- ◯ Berat
- ◯ Dibër
- ◯ Durrës
- ◯ Elbasan
- ◯ Fier
- ◯ Gjirkokastër
- ◯ Korçë
- ◯ Kukës
- ◯ Lezhë
- ◯ Shkodër
- ◯ Tiranë
- ◯ Vlorë

2. Please input your age

3. Please select your occupation.

Mark only one oval.

- ◯ Architect
- ◯ Engineer
- ◯ Student
- ◯ Other: _____

4. How many years of experience do you have in your profession?

Mark only one oval.

- ◯ Less than 1 year
- ◯ 1-5 years
- ◯ 5-10 years
- ◯ More than 10 years

5. Do you know the requirements/standards of project submission, in your local municipality?

Mark only one oval.

- ◯ Yes
- ◯ No

6. Have you ever heard about the term of BIM, (Building Information Modelling) ?

Mark only one oval.

- ◯ Yes
- ◯ No

7. Do you know what ISO-19650 is or have you came across it during your experience as student/architect/engineer?

Mark only one oval.

- ◯ Yes
- ◯ No

8. Do you currently use BIM or intend to start using it at your workplace?

Mark only one oval.

- ◯ I do not currently use BIM
- ◯ I do not use BIM, but I intend to use it
- ◯ I am currently undergoing training in BIM related topics
- ◯ Yes, I use BIM

9. Which of the following phases of a project would you be more willing to use BIM?

Check all that apply.

- ☐ Design Phase
- ☐ Planning Phase
- ☐ Construction Phase
- ☐ Maintenance (Post-Construction) Phase

10. Which of the following BIM benefits are you looking most forward to gain?

Check all that apply.

- ☐ Cost and Resource savings (time, money, etc.)
- ☐ Opportunity for personalized design prefabrication of different construction modules
- ☐ Improved communication and coordination
- ☐ Increased efficiency with higher quality result

11. Do you think BIM implementation costs (hard/software, training) to give the return of investment that will be made in these terms?

Mark only one oval.

- ◯ Yes
- ◯ No

12. How has BIM affected the productivity of your project/work?

Mark only one oval.

- ◯ Increased Productivity
- ◯ Decreased Productivity
- ◯ I haven't used BIM yet

13. Which key benefits of BIM would you like to gain in terms of cost?

Mark only one oval.

- ◯ Transparency and Collaboration
- ◯ Ordering materials smartly
- ◯ Increasing time efficiency avoiding misunderstandings
- ◯ Successful Delivery of Project within deadline
- ◯ Saving Time required in documentation

14. Which key benefits of BIM would you like to gain in terms of avoiding errors?

Mark only one oval.

- ◯ Schedule
- ◯ Budget
- ◯ Changes
- ◯ Dispute
- ◯ Safety

15. BIM revolves a lot around sharing information around stakeholders, would this be okay with you or would you like a separate team to work only on information management?

Mark only one oval.

- ◯ It is okay to share all the information in real time with all the stakeholders
- ◯ I would like a dedicated team which would secure the privacy of the information of the service provided by my side

16. Do you think BIM will be adopted quickly by the construction industry of our country as means to increase their level on an international scale?

Mark only one oval.

- ◯ Yes
- ◯ No

17. On a personal point of view. how do you think the BIM implementation will affect the old traditional methods of working?

Mark only one oval.

- ( ) It will not affect them
- ( ) It will redefine them
- ( ) It will make them go extinct

18. How do you think BIM will affect the following fields?
Preparation of tender and contract documents:

_____

19. How do you think BIM will affect the following fields?
Cost analysis and lifecycle costing:

_____

20. How do you think BIM will affect the following fields?
Establishing client requirement and feasibility studies:

_____

21. How do you think BIM will affect the following fields?
Identifying, analysing and developing responses to risks:

_____

22. How do you think BIM will affect the following fields?
Analysing proposed outcomes:

_____

23. How do you think BIM will affect the following fields?
Valuing completed work and arranging payments:

_____

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